



Integrating Natural Capital into Sustainable Development Decision-Making in Uganda

A project funded by the UK Government



Land and Soil Improvement Accounts for Uganda



March 2021

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Citation: NEMA (2021), Land and Soil Improvement Accounts for Uganda,

ISBN: *978-9970-881-23-9*

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“Integrating Natural Capital Accounting into Sustainable Development Decision-making in Uganda” is a project funded by the Darwin Initiative through the UK Government, and implemented by the National Environmental Management Authority (NEMA), Uganda Bureau of Statistics (UBoS) and National Planning Authority (NPA) in Uganda, in collaboration with the UN Environment Programme World Conservation Monitoring Centre (UNEP-WCMC), the International Institute for Environment and Development (IIED) and the Institute for Development of Environmental-Economic Accounting (IDEEA Group).

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FOREWORD

Uganda's Land and Soil Improvement Accounts are one of three Experimental Ecosystem Accounts (EEA) developed under the "*Integrating Natural Capital into Sustainable Development Decision Making in Uganda Project*." The project was implemented with financial support from the United Kingdom (UK) Government's Darwin Initiative, and a national and international partnership involving the National Environment Authority (NEMA), the National Planning Authority (NPA) and the Uganda Bureau of Statistics (UBOS), and the United Nations Environment Programme's World Conservation Monitoring Centre (UNEP-WCMC), the International Institute for Environment and Development (IIED), and the Institute for Development of Environmental Economic Accounting (IDEEA Group).

These Land and Soil Improvement Accounts will support the delivery of Uganda's green growth aspirations of food security, improved livelihoods, wealth creation and biodiversity conservation, and agricultural industrialisation as espoused in the third National Development Plan (NDP III) and the Uganda Green Growth Development Strategy (UGGDS). The Land and Soil Improvement Accounts showed that the land-cover changes that occurred between 2005 and 2015 contributed an additional 5% to the existing land degradation. The soil nutrient outflows from crop harvest, soil erosion and leaching were on average six times higher the soil nutrient inflows from fertilisers and crop residues, among others, and the land productivity was generally 64% lower over a 25-year period between 1990 and 2015. As a result, the observed improvements in crop and livestock output and income were because the area under production and product prices had increased. The estimated gross revenue from agriculture production did not consider the depletion of soil nutrients and the lower yield.

The policy recommendations from the compilation of the accounts include the urgent need to prioritise SLM practices as part of NDP III implementation, the need to streamline the value chains and market structure so that incentives for land and soil management practices in the commodity markets can be transmitted with higher precision, the urgent action needed on land-use planning at individual, community, sub-regional and national level, and the need to implement economic instruments to complement existing efforts on land and soil management. This is vital for maintaining the contribution of agriculture to the economy, long-term food security and safeguarding Uganda's wildlife from habitat loss. There were several data gaps identified in terms of the completeness of the condition accounts, and the supply and use tables for which research recommendations and partnerships were proposed.

On behalf of the Government of Uganda, the National Environment Management Authority, the Uganda Bureau of Statistics and the National Planning Authority, collectively I welcome the Land and Soil Improvement Accounts, and congratulate the technical committee for the "*Integrating Natural Capital into Sustainable Development Decision Making in Uganda Project*" on the work done, and thank the Darwin Initiative for the financial support provided. We strongly believe that these accounts will contribute significantly to improved and sustainable land and soil management in Uganda.



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ACKNOWLEDGEMENTS

Uganda's Land and Soil Improvement Accounts were developed under *Integrating Natural Capital into Sustainable Development Decision Making in Uganda Project* with national leadership of the National Environment Authority (NEMA), the National Planning Authority (NPA) and Uganda Bureau of Statistics (UBOS). There was support during implementation from the National Biodiversity Task force for Uganda. The project was implemented with funding from the Darwin Initiative (UK Government), and with technical partnership from the United Nations Environment Programme World Conservation Monitoring Centre (UNEP-WCMC) and the Institute for Development of Environmental Economic Accountings (IDEEA Group).

The development of the accounts has been steered by an Expert Working Group for this accounting theme. Their participation in expert meetings, contributions and participation are gratefully acknowledged. In addition, the contributions of participants at the inception meeting to initiate the development of the accounts and meetings to road map the institutionalization of the accounts is also acknowledged. Collectively, these inputs have been essential for developing the accounts presented in this report so that they respond to the needs of national stakeholders, are technically robust and make use of the best data available.

The Government of Uganda also extends specific gratitude to the following institutions for their technical contributions to the development of these accounts.

- The Ministry of Agriculture, Animal Industry and Fisheries (MAAIF)
- The Ministry of Water and Environment (MWE)
- The Ministry of Lands, Housing and Urban Development (MoLHUD)
- The National Agricultural Research Organisation (NARO)
- The National Forestry Authority (NFA)
- Busitema University
- Makerere University
- Ministry of Tourism, Wildlife and Antiquities

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ACRONYMS

AAS	Annual Agricultural Survey
AEZ	Agro-Ecological Zone
BNF	Biological Nitrogen Fixation
EAA	Ecosystem Accounting Area
EWG	Expert Working Group
FAO	Food and Agriculture Organisation of the United Nations
GDP	Gross Domestic Product
HAC	High Activity Clay soils
IDEEA	Institute for Development of Environmental Economic Accounting
IIED	International Institute for Environment and Development
IPCC	Intergovernmental Panel on Climate Change
LAC	Local Activity Clay soils
MAAIF	Ministry of Agriculture, Animal Industry and Fisheries
MoFPED	Ministry of Finance, Planning and Economic Development
MWE	Ministry of Water and Environment
NARO	National Agricultural Research Organisation
NBSAP	National Biodiversity Strategy and Action Plan
NCA	Natural Capital Accounting
NDP II	Second National Development Plan
NDP III	Third National Development Plan
NFA	National Forestry Authority
NP-AEEA	National Plan for Advancing Environmental Economic Accounting
NPP	Net Primary Productivity
REDD+	Reducing Emissions from Deforestation and forest Degradation
SDG	Sustainable Development Goals
SEEA – EEA	System of Environmental Economic Accounts – Experimental Ecosystem Accounting
SEEA EA	System of Environmental Economic Accounts Ecosystem Accounting (March 2021)
SLM	Sustainable Land Management
SNA	System of National Accounts
SOC	Soil Organic Carbon
UBOS	Uganda Bureau of Statistics
UK	United Kingdom
UN	United Nations
UGGDS	Uganda Green Growth Development Strategy
UNDP	United Nations Development Programme
UNEP WCMC	United Nations Environment Programme World Conservation Monitoring Centre
UNIDO	United Nations Industrial Development Organisation
UNSD	United Nations Statistical Division
ZARDI	Zonal Agricultural Research Development Institute

EXECUTIVE SUMMARY

Introduction

Nationally, 85% of the population of Uganda is based in rural areas (UBOS 2016) and in rural areas nearly all livelihood engagement in subsistence agriculture (GoU/UNDP 2014); therefore, the state of degradation is critical to the outcome of human and capital investments into land care by among others the many farm households in the country. Therefore, the Land and Soil Improvement Accounts for Uganda were developed to provide information on the extent and conditions of land degradation in the country and inform responses to counter the land degradation and in order to achieve optimal land productivity. This, in turn, will produce pressures on natural ecosystems and biodiversity from conversion of land to permanent or shifting agricultural production. The accounts will support delivery of Uganda's green growth aspirations of food security, improved livelihoods, wealth creation and biodiversity conservation. Sustainable Land Management (SLM) and agricultural industrialization were adopted as some of the projected outcomes and interventions in the national land policy 2013 and third National Development Plan (NDP III) respectively.

The Land and Soil Improvement Accounts were developed as part of the implementation of the *Integrating National Capital into Sustainable Development Decision Making in Uganda* project by the Government of Uganda with support from the Darwin Initiative, funded through the UK Government. The main objective of the accounts is to provide information on land and soil, which are drivers for economic development in Uganda. The accounts will provide an understanding on the trends in soil fertility and support the development of better policies for land and soil management. In turn, using this information to improve land-use efficiency and productivity will reduce pressure to convert natural ecosystems and habitats and improve the well-being of many of Uganda's rural poor.

The Land and Soil Improvement Accounts were developed based on the core accounting modules of the System of Environmental Economic Accounting Ecosystem Accounting (SEEA EA) framework, recently adopted as an international standard in March 2021 (UNSD, 2021). The SEEA EA accounts are complemented by nutrient flow accounts based on structures proposed in the SEEA Central Framework (UN *et al.* 2014a) and SEEA Agriculture, Forestry and Fisheries (FAO & USD, 2018). The integrated set of accounts compiled comprise: ecosystem extent accounts, thematic nutrient flow and thematic carbon accounts, and the ecosystem supply and use tables (extended to make links to the formal economy).

The ecosystem extent accounts provided information on the changing configurations of land and land use in Uganda, and its stability, between 2005 and 2015. The thematic nutrient flow accounts show the net nutrient balance between nutrient inflows into the soil and nutrient outflows from the soil. The thematic carbon accounts provided information on the state of land productivity due to land use configurations based on the net biomass accumulation and soil organic carbon (SOC) between 1990-2000 and 2010-2015. The thematic carbon accounts were developed at national level due to the absence of sub-national default factors, and the use of an international standard under the Intergovernmental Panel on Climate Change (IPCC). The ecosystem supply and use tables showed the economic activity between ecosystem types, croplands and grasslands and the economic units, households, and businesses as well as between producers of crop and livestock products and consumers.

The zones from which the operational area for the Zonal Agricultural Research and Development Institutes (ZARDIs) was defined were adopted as the ecosystem accounting areas (EAAs). The use of zones as EAAs is consistent with Uganda's Annual Agricultural Survey (AAS) and the Uganda National Household Surveys (UNHS) for Uganda's National Statistics Office (NSO), the Uganda Bureau of Statistics (UBOS), and they represent Uganda's agro-ecological zones. Notwithstanding the use of zones as EAAs, there were two exceptions.

Matching the zones used as the Ecosystem Accounting Areas (EAA) with the Agro-ecological zones

Zones	Agro-ecological zones represented
1. Abi	North Western Savannah Grasslands
2. Buginyanya	Eastern Highland Ranges, Kyoga Plains and the Eastern Lake Victoria Crescent
3. Bulindi	Western Savannah Grasslands
4. Kachwekano	Southern Highland Ranges and Southwestern Farmlands
5. Mukono	Western and Central Lake Victoria Crescent, Southern part of the Western Savannah and the Eastern part of the Pastoral Rangelands
6. Ngetta	Central and western parts of North Eastern Savannah Grasslands, the eastern part of the North-Western Savannah Grasslands, and northern parts of the Kioga Plains
7. Nabuin	North Eastern drylands
8. Serere	Southern and eastern parts of North Eastern Savannah Grasslands, and north eastern parts of the Kioga Plains
9. Mbarara	Pastoral Rangelands and the South Western Farmlands
10. Rwebitaba	Western Savannah Grasslands, Western Highland Ranges, and Pastoral Rangelands

Findings

Ecosystem Extent

The ecosystem extent accounts were compiled using the National Biomass Survey Land Cover Map used in Uganda's Land and Physical Assets Accounts for the 10 EAAs. The 10 EAAs are Abi zone, Buginyanya zone, Bulindi zone, Kachwekano zone, Mbarara zone, Nabuin zone, Ngetta zone, Rwebitaba zone, and Serere zone. Country wide, 34%, equivalent to 8.3 million ha, of Uganda's land area transitioned between one ecosystem types (represented by IPCC Land Cover Classes as proxies) between 2005 and 2015.

Given government targets to increase the cover of forest and wetlands, the Ecosystem Extent Accounts were structured to provide an indicator of land cover flows indicative of loss of these ecosystem types due to conversion for human use. These flows were labeled as indicative of 'degradation', as they indicate an increasing distance to the goals set for increasing the extent of these ecosystem types.

The national ecosystem extent accounts showed around 1.16 million ha of the gross additions to cropland and around 7,000 ha for settlement between 2005 and 2015 are considered land cover flows indicative of degradation (i.e., conversion of forest or wetland to cropland or settlement). This was equivalent to 5% of the aggregate national land cover that was degraded due to conversion of forest and wetland to other non-natural ecosystem types (mainly cropland) between 2005 and 2015. At the national level, improvement with respect to increasing forest and wetland extent based on land-cover change was only approximately 240,000ha between 2005 and 2015. At the zone level, the ecosystem extent accounts show the following:

- The highest proportion of land cover flows indicative of degradation between 2005 and 2015 was in the Ngetta zone, at 10% of total land cover. This is equivalent to 20% of all the land cover transition between 2005 and 2015 in this zone. Whereas, land cover flows indicative of improvement were 1%.
- Rwebitaba zone had the second largest land cover flows indicative of degradation, representing 9% for overall land area. This is equivalent to 26% of the land transitions in the zone between 2005 and 2015, transitions indicative of improvement was 5%.
- In the Nabuin zone, the land cover flows indicative of degradation was 2% and improvement only 0.3% of all land cover flows. The land cover flows indicative of degradation in the zone represented 1% of the total zone.
- In Serere zone, land-cover flows indicative of degradation was 9% and improvement 3% between 2005 and 2015. The land cover flows indicative of degradation in the zone represented 2% of the total zone.
- For Mukono zone, land cover flows indicative of degradation was 15% and improvement 5%. The land cover flows indicative of degradation in the zone represented 1% of the total zone.
- For Mbarara zone, transitional land cover change indicative of degradation was 5% and improvement 2%. The land cover indicative of degradation between 2005 and 2015 in this zone represented 2% of the total area.
- For Kachwekano zone, transitional land cover change indicative of degradation was 4%, and improvement 16% of total land cover flows. The land cover flows indicative of degradation between 2005 and 2015 in this ZONE represented 1% of total area.
- For Bulindi zone, transitional land cover change indicative of degradation was 23% and improvement 3%. The land cover flows indicative of degradation between 2005 and 2015 in this zone represented 8% of total area.
- For Buginyanya zone, out of all the land cover changes between 2005 and 2015, 13% were considered indicative of land degradation and 9% improvement. The land cover flows indicative of degradation between 2005 and 2015 in this zone represented 2% of total area
- For the Abi zone, transitional land cover change indicative of degradation was 17% and improvement 4% of all land cover changes. The land cover flows indicative of degradation between 2005 and 2015 in this zone represented 7% of total area.

Soil nutrient flow accounts

At the national scale, the net nutrient outflow increased from 341,964t (N), 112,454t (P), and 419,614t (K) in 2009 to 442,929t (N), 142,590t (P), and 564,780t (K) 2018. The soil nutrient flows indicate increasingly negative nutrient balance in croplands, the nutrient imbalance increases by 30%, 27% and 35% for nitrogen, phosphorous and potassium respectively. The negative nutrient balance associated with these net nutrient outflows were the result of low nutrient inflows from crop residues, BNF and atmospheric deposition, as well as organic and inorganic fertilisers estimated, compared to the outflows from crop harvests, soil erosion and leaching.

The results for soil nutrient balance across the 10 zones were similar to the national results. The soil nutrient inflows were much lower than outflows, leading to net negative soil nutrient balances. The net soil nutrient

balance became increasingly negative in all but three zones (Abi, Buginyanya and Serere zones). The highest relative increases in nutrient net outflows were identified in the Nabuin and Bulindi zones, where net nutrient imbalance more than doubles for all three macro nutrients between 2009 and 2018. With regard to Abi, Buginyanya and Serere zones, the reduction in soil nutrient depletion was driven by the reduction in nitrogen outflow associated with types of crops produced.

The monetary accounts for soil nutrient flow show that monetary value of nutrient outflow increased by 130% between 2009 and 2018. The aggregate monetary value of the net soil nutrient outflow increased from UGX 1.8 trillion in 2009 to UGX 4.8 trillion in 2018.

Thematic carbon accounts

The global framework for measuring progress towards SDG 15.3.1 (Proportion of land that is degraded over total land area) employs three different sub-indicators that communicate on different aspects of land degradation. Two of these concern land productivity and carbon stocks, measured based on the NPP and SOC, respectively. The NPP is a measure of biomass/carbon accumulation during photosynthesis and atmospheric respiration over a period of time, while SOC is a measure of carbon stock trapped in organic and mineral soils.

In order to provide an insight into the trends in the sub-indicators, thematic carbon accounts have been compiled at the national scale. These reveal that Annual biomass accumulation decreased by 64% between 1990-2000 and 2010-2015. This change was driven by reductions in Annual NPP due to changes in land use configuration in Uganda, particularly reduction in forest extent. This has implications for the supply of non-crop biomass provisioning ecosystem services and regulating ecosystem services linked to climate change mitigation (i.e., carbon storage and sequestration).

The net organic soil SOC losses are very high in croplands due to the relatively high carbon emission factors from soil associated with conversion of natural ecosystems to crop production. This reveals how changing patterns of land use for agriculture may, potentially, lead to degradation of organic soils due to SOC losses and reduced soil quality in croplands if not properly managed.

Ecosystem supply and use tables

The physical supply and use tables (PSUT) account national and across the zone were in balance between supply and use. The national PSUT showed increased output of maize, rice, groundnuts, soybeans, bananas, cassava and Irish potatoes between 2009 and 2018, while the outputs for finger millet, sorghum, beans, sim and sweet potatoes increased, and the output for cattle reduced.

The increase in crop output was largely due to the 54% increase in cropped area from 5.3 million ha in 2009 to 8.1 million ha in 2018. The decrease in crops like finger millet, sorghum and sim-sim are linked to the poor performance in the ZONEs where the crops are dominant: Ngetta, Serere and Nabuin. Cattle output decreased because it was measured in terms of live animal sales, however there was increased specialization in dairy, which was not reflected in the accounts.

The monetary supply and use tables (MSUT) show that national supply and use of crops and livestock products increased by 148% from UGX 4.7 trillion to UGX 11.8 trillion between 2009 and 2018. The increase in monetary value was both the result of a 106% increase in average product prices for both crops and

livestock, and the increase in output also outweighed the decrease in output over the two time periods. However, the yields were lower for maize, millet, rice, beans, groundnuts, sweet potatoes and Irish potatoes. The only increase in yield registered was for cassava and bananas. It is noted that further work is required to express these accounts in constant prices.

Whereas the increase in monetary value suggests an improvement in economic welfare linked to the accounts, the net weighted increase linked to crop output was only 42%, over the nine-year period between 2009 and 2018. The average annual increases are likely to be further diminished by other factors such as the high population growth rate 3.03% (UBOS 2016), and compounded by the depletion of soil nutrients, among others

Conclusions

- Based on the ecosystem extent accounts, around 5% of the aggregate national land cover was degraded due to conversion of forest and wetland to other non-natural ecosystem types (mainly cropland) between 2005 and 2015. This is based on national goals to increase forest cover and wetland area. The highest proportional land degradation with respect to total land cover flows was 26%, 23% and 20% in Rwebitaba zone, Bulindi zone and Ngetta zone respectively. This reduced to 17% in the Abi zone, 15% in the Mukono zone, 13% in Buginyanya zone, 9% in the Serere zone, 5% in Mbarara zone, 4% in the Kachwekano zone, and 2% in the Nabuin zone. The land-cover flows considered indicative of degradation concern the conversion of natural ecosystems, such as forests and wetlands, for agricultural production and other anthropogenic uses. As such, this pattern of land-cover transition in ZONEs represents a pressure on biodiversity in terms of natural ecosystem loss and loss of habitat for species.
- The soil nutrient depletion increased by approximately 30% between 2009 and 2018. The high net nutrient outflow was the result of very low nutrient inflows in organic and inorganic fertilisers, crop residues, atmospheric deposition and BNF compared to the outflows in crop harvest, soil erosion, and leaching. Given that crop harvests have to occur for the production cycle to exist, the effort in soil nutrient management lies in the largely manageable nutrient inflows of organic and inorganic fertilizer, and outflows of soil erosion.
- The annual biomass carbon accumulation was lower by 64% in 2010-2015 compared to 1990-2000. Increasing NPP will be managed through increased biomass cover, particularly through forest and tree cover restoration in all land cover, under SLM, REDD+ and smart agriculture practices. Net organic soil SOC loses are very high in croplands due to the relatively high carbon emission factors from soil associated with conversion of natural ecosystems to crop production. This reveals how changing patterns of land use for agriculture may, potentially, lead to degradation of organic soils due to SOC loses and reduced soil quality. SLM activities and additional efforts to increase organic manure and to support soil mineralization, through an increase in crop and plant residues and creation of a micro-climate that enhances the mineralization of soils may be adopted to manage this issue where appropriate.

- The ecosystem supply and use showed the aggregate crop output measured. Overall, the crop yields were lower for all but three of the crops considered for the accounts. The increase in crop output was largely due to the expansion of planted area. It would seem that the output increased due to the expansion of planted area outweighed the decrease in yields; however, such a situation is not sustainable, in part because the soil nutrients were very depleted. In addition, the MSUT only considered the gross revenue from crops and livestock production, if the costs were considered including the economic costs of nutrient depletion, there is a high likelihood that the current production is unprofitable.
- The ecosystem supply and use also showed that 70-80% of the current crop and livestock production is for households' consumptive use; and, only in a few cases, such as Mukono zone, where a high level of urbanization exists, the supply and use for business increased.

Policy recommendations

1. Soil nutrient depletion can be mitigated through actions that lead to an increase in nutrient inflow from organic and inorganic fertilisers, BNF and crop residues. Concurrently, nutrient outflow can be reduced through actions to reduce the volume of crop residues that leave the farm during harvest, minimizing soil erosion and nutrient leaching. A comprehensive soil and land management (SLM) package comprising soil fertilizer application and smart agriculture practices (e.g., agroforestry, minimum tillage, terracing, mulching and cover crops), as prescribed in existing guidance, needs to be fast-tracked and prioritized in government budgets and development support. Increasing land-use efficiency and productivity through such schemes will directly benefit rural population with a high dependence on subsistence agriculture. It is highlighted that the trend in nutrient depletion have increased substantially in the Bulindi and Nabuin zones in recent years. This would also have significant benefits for biodiversity by reducing pressure to convert natural ecosystems (including forests and wetlands) for permanent or shifting agricultural production.
2. Use of economic incentive associated with voluntary and verified carbon credit schemes, both through national and international schemes need to be scaled up leading to an increase in above ground biomass/carbon stock accumulation and SOC. The system for economic incentives under the Environment Act 2019 needs to be detailed, and accompanying regulations developed to support the opportunities that biomass base and soil organic carbon can create. This could also create incentives for restoring forests and wetlands due in order to secure associated climate change mitigation benefits.
3. Individual, community and subnational land-use planning would improve land-use efficiency, reduce soil nutrient depletion and improve carbon stock accumulation, as highlighted in the natural SLM guidance and NDPIII. Land-use planning would enable land users to make optimal choices, whether for subsistence use and/or communal use and soil fertility improvement actions. This is highly relevant for ZONES with high poverty incidence, such as Nabuin, Ngetta and Buginyanya and where poverty is associated with falling crop production (as is the case for Buginyanya) and this would also ease the integration of incentive measures and soil fertility improvement action. This

integrated approach to land-use planning could also deliver better outcomes for biodiversity by reducing future land requirements for agriculture, and conserving natural ecosystems (including forests and wetlands) and their extent. It could also, potentially, create space for forest and wetland restoration to support the sustainable supply of other biomass related provisioning and other ecosystem services. This may be particularly relevant for the Rwebitaba, Bulindi and Ngetta zones, where land cover flows indicative of degradation is relatively high.

4. Given the high nutrient depletion in the country, it is evident that the farmers in the country adopt and use the most efficient technology options on seeds, soil fertility improvement and agronomic practices of optimal planting spaces, timing and crop rotation. This may be particularly relevant in ZONEs where large increases in nutrient imbalances are observed in recent years, such as Bulindi and Nabuin.
5. Land and soil nutrient depletion and other indicators of soil quality degradation (e.g., SOC) needs to be included in the macroeconomic indicators, under a sustainable wealth indicator e.g., green GDP. The use of a sustainable indicator will support the streamlining and correcting the errors of commission and omission when attributing the contribution of land and soil resources to commodity value chains. Actions to realign the institutional arrangements for market structures linked to land and soil production will ensure that the revenue distribution in the value chains will enhance resource rents for the land and soils resources, and spur investment in land and soil replenishment.
6. Increased value addition for crop and livestock value chains will be critical to generating sustainable market led incentives for re-investment in land and soil resources, alongside streamlining the commodity value chains, as envisaged in the NDPIII.

Recommendations for research

1. It would be useful to develop indicators on land use efficiency from the accounts. These could be achieved via integration of information in the ecosystem extant accounts and planted area and production data from the Annual Agricultural Surveys. This would be a, potentially, very useful indicator land use and arable agriculture planning.
2. The indicator on land cover flows related to forest and wetland loss rely on flows between IPCC land cover classes aggregated from the National Biomass Survey and National Physical Land Asset Accounts. Better understanding of what is happening to these ecosystems would be provided with improved ecological detail, particularly for wetlands where on the ground surveying is often required to identify full extent of these ecosystems. The analysis is structured on forests and wetlands, there will be other important ecosystems supplying important services to people and supporting important biodiversity. Other indicators could be developed to communicate the relationship between evolving land use and these wider environmental development issues.

3. The NPP and SOC relied on default factors from the IPCC. There is a need to develop Tier 2 and Tier 3 default factors to increase precision of measures, which will ultimately improve policy recommendations and implementation.
4. The supply and use tables only covered 15 crops, with output gaps for field peas, cow peas and pigeon peas in 2018. As more data is collected within the Annual Agriculture Survey System and others, the size of the PSUT and MSUT will have to be expanded to have higher representation of commercial crops. Particularly coffee in the MSUTS and, more generally, cottons, tea, sugarcane, vegetables and fruits, among others. Nevertheless, these Land and Soil Improvements Accounts provide a strong foundation for the improvement required.
5. There are data gaps on the soil nutrient balance, particularly with organic and inorganic fertilizer by ZONE. There is a need to include data collection on fertilizer and manure in the AAs and UNHS to address the existing gaps.
6. As momentum for development of natural capital accounts grows, there is a need for institutional development at the Uganda Bureau of Statistics to have an improved supply and use table, and an environmentally extended Social Accounting Matrix (SAM), as well as economic applications through simulations of the macroeconomic models to demonstrate the value of the natural capital accounts to the quality of policy and decision making in the country.
7. There is still room for further developing the types of economic instruments that ensure optimal investments to enhance NPP and SOC in the country. The applied research would build on existing examples, under REDD+ and voluntary carbon projects, among others.

1.0 INTRODUCTION

1.1 Background

The National Environment Management Authority (NEMA), Uganda Bureau of Statistics (UBOS) and National Planning Authority (NPA), with support from the United Nations Environment Programme World Conservation Monitoring Centre (UNEP-WCMC), the Institute for International Environment and Development (IIED) and the Institute for the Development of Environmental-Economic Accounting (IDEEA), are implementing the project on “Integrating Natural Capital into Sustainable Development Decision Making in Uganda”. The project is funded through the Darwin Initiative by the UK Government. The project aims at supporting: (i) the delivery of the Ugandan National Development Plan, Green Growth Development Strategy and the National Biodiversity Strategy and Action Plan (NBSAP); (ii) the integration of the value of biodiversity into national reporting, poverty reduction, and planning processes; (iii) the organization of biodiversity-related natural capital data using internationally endorsed accounting frameworks; (iv) decision-makers to implement integrated environmental-economic planning for green growth, poverty alleviation and attaining the SDGs and Aichi Targets; and (v) capacity development for account compilers and users to institutionalize the accounting approach.

This- natural capital accounting (NCA) project aims to develop three sets of natural capital accounts; Land and Soil Improvement Accounts, Fisheries Resource Accounts and Biodiversity and Tourism Accounts. The project was implemented in three phases. Phase 1 flowed over from 2019 into 2020 and it consisted of development of a standard methodology. Capacity building has been provided for data providers and accounts producers covering accounts developers and users, and demonstration of the application of accounts to different decision-making processes in Phase 2, while Phase 3 (2021) worked with specific sectors on a detailed application of the accounts to a sector planning process and/or a significant development issue.

1.2 Motivation for Natural Capital Accounting in Uganda

Uganda uses the Gross Domestic Product (GDP) as an indicator for assessing economic progress and development in the country. In Financial Year (FY) 2017/18, for instance, GDP at constant prices was estimated to have grown by 6.1%. The sectoral performance showed that Agriculture, Forestry and Fishing GDP also increased by 3.8% in FY 2017/18. The traditional system of assessing economic progress or GDP is based on the System of National Accounts (SNA). Uganda’s National Accounts generally do not include the full value of natural capital; the supply and use tables and asset tables generally record economic activity acknowledged within the monetary value chains. The two main challenges with the system are those of omission, whereby natural capital is completely neglected within the accounting system, and misrepresentation (commission), where the economic activity is recorded under a different sector. For example, a consolidated value chain for agro-industry e.g., vegetable oil may be recorded as industrial activity thereby leaving out agricultural land management, production, and marketing, among others from the information recorded in the SNA and subsequently reflected in the GDP calculations.

The sustainable use of the stocks of biodiversity is fundamental to maximizing economic growth and human well-being in Uganda over the medium to long term. However, the value of biodiversity is often neglected in traditional assessments of economic progress and development planning. This encourages inefficient and unsustainable growth, requiring investment in manufactured infrastructure to replace the benefits provided by nature. The loss of benefits disproportionately impacts the rural poor since much of their real income is directly dependent upon ecosystem services. These challenges are recognized in Uganda's National Development Plan (NDP II), Uganda Green Growth Development Strategy (UGGDS) and the National Biodiversity Strategy and Action Plan (NBSAP). Collectively, these plans recognize the need to manage natural capital to deliver economic development and poverty alleviation. The plans also identify natural capital accounting as a strategic intervention towards improved management.

Natural capital accounts are a set of objective data on the stocks of natural resources, including ecosystems and species, and the flows of benefits they provide. They aim to provide detailed integrated statistics on how natural resources contribute to the economy and how the economy affects natural resources. In recent years, natural capital accounting (NCA) has become a prominent tool for providing more evidence-based approaches in support of sustainable development, green economy transition and climate change adaptation.

In this context, biodiversity-related NCA can improve decision-making by providing information on biodiversity and the benefits it provides in a consistent and timely manner. This can assist decision-makers in evaluating land use options, assessing progress towards policy targets and policy formulation. By combining this information with economic and social statistics, biodiversity-related NCA can be a key tool to guide sustainable development planning that can achieve long-term economic growth and thus contribute to poverty alleviation and better outcomes for nature. The System of Environmental-Economic Accounting (SEEA) is a multipurpose framework that integrates economic and environmental data to provide a comprehensive integration of interrelationships between the economy and the environment, the stocks and changes in stocks of environmental assets as they bring benefits to humanity (UN SEEA 2018).

1.3 Purpose and objectives of Land and Soil Improvement Accounts

1.3.1 Purpose

The ultimate objective of the project was to support the delivery of green growth in Uganda that contributes to poverty alleviation, wealth creation and meeting biodiversity goals. As such, the project directly supports the delivery of the Ugandan National Development Plan, Green Growth Development Strategy and NBSAP. The work also supports international commitments to integrate the values of biodiversity-related natural capital in decision-making (e.g., Aichi Target 2, SDG Target 15.9, and as an associate member of the Gaborone Declaration for Sustainability in Africa). In this regard, the project is designed to help deliver on the ambitions set out in Uganda's National Plan for Advancing Environmental-Economic Accounting (NP-AEEA), developed as part of a coordinated effort between UBOS, United Nations Statistics Division (UNSD), NPA, NEMA, and other Ministries, Departments and Agencies. It complements existing initiatives by

ensuring biodiversity elements become a concrete component of Uganda's regular environmental accounting process.

Land and Soil Improvement Accounts have been developed to provide information on land and soils which is the driver for agricultural development and other land uses including biodiversity conservation in the country. These accounts will provide for an understanding of the evolution of land use, condition and soil fertility in order to draw policies for better soil management practices and ensure sustainable agriculture and hence reducing poverty and biodiversity impacts associated with conversion of natural ecosystems to farmland. The Land and Soil Improvement Accounts will support Uganda Bureau of Statistics (UBOS); Ministry of Agriculture, Animal Industries and Fisheries (MAAIF); National Planning Authority (NPA) and Ministry of Finance, Planning and Economic Development (MoFPED) in integrating natural capital accounts into the system of national accounts (SNA), national and sub-national macroeconomic modelling and reporting systems.

1.3.2 Objectives

The objectives of the accounts are to

- (i) provide a description of ecosystem extent, nutrient and carbon flows in ecosystems and supply and use tables of crop and livestock economic activity linked to land and soils in Uganda.
- (ii) develop a meta-database to support the Land and Soil Improvement Accounts development, coordination, and future efforts to establish a platform for data sharing, access and collection arrangements, and accounts compilations and to
- (iii) propose policy and research recommendations to guide the next steps of action for land and soil management in the country.

1.4 Scope

The Land and Soil Improvement Accounts were developed to support the agricultural sector, the environmental regulator, the land management sector, local governments, and the biodiversity conservation sector to undertake actions for land and soil improvement and mitigation of impacts on biodiversity (i.e., conversion of natural ecosystems for agricultural production). The accounts were developed to provide prescriptive options at regional (ZONE) level that can be extended to districts and community level action. The accounts also have a national scope for policy directly linked to implementation of the third National Development Plan (NDP III), Uganda Green Growth Development Strategy (UGGDS), the National Environment Act (2019) and the National Land Policy (2013).

The specific policy areas addressed by the accounts include the state of land degradation, the soil fertility trends, land management options for agriculture and biodiversity conservation. The links between land degradation, soil fertility and land productivity, crop and livestock production, food security, biodiversity and the use of the Land and Soil Improvement Accounts to improve implementation of macro and subnational policies and programmes.

2.0 METHODOLOGY

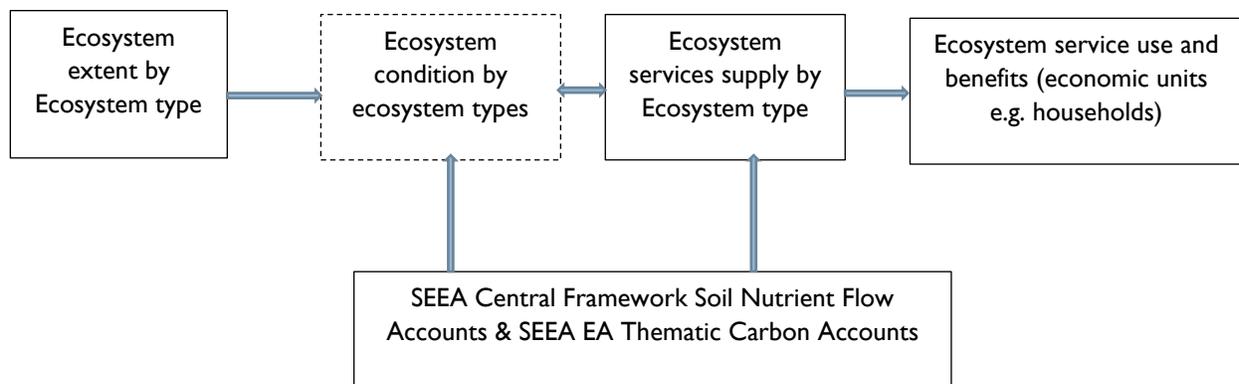
2.1 Study Design

The Land and Soil Improvement Accounts were developed based on the SEEA Ecosystem Accounting (SEEA EA) framework (UNSD, 2021). As the SEEA EA was only adopted as an international standard in March 2021, the accounts presented have been compiled using the SEEA Experimental Ecosystem Accounting (SEEA EEA) framework and associated Technical Recommendations (UN *et al.*, 2014, 2017). However, they are considered to be consistent with the accounting standards set out in the recently adopted SEEA EA (UNSD, 2021).

As set out in Chapter 13 of the SEEA EA, thematic accounting for climate change and carbon is supported by the SEEA. The Land and Soil Improvement Accounts also include accounts for carbon flows, inspired by thematic carbon stock account structure presented in the SEEA EA. In addition, a set of novel accounts were developed for nutrient flows based upon structures presented in the SEEA Central Framework and subsystem for Agriculture Forestry and Fisheries (SEEA CF & SEEA AAF).

Figure 1 shows the accounting modules used to develop the land and soil improvement ecosystem extent, nutrient flow, thematic carbon and ecosystem supply and use tables. Whilst ecosystem condition accounts have not been specifically compiled, as Figure 1 shows, the soil nutrient flow accounts and thematic carbon accounts do provide indicators that are very relevant to ecosystem condition (i.e., for nutrient balance, biomass carbon accumulation, NPP and SOC). Hence the ecosystem condition accounts are identified with a dotted line in Figure 1.

Figure 1: Accounting Module of the SEEA EA and SEEA CF used for the Land and Soil Improvement Accounts



The accounts were designed to be implemented in a participatory manner. A Land and Soil Improvement Accounts consultant was hired as a task team leader working with a technical team, the Expert Working Group (EWG) on the Land and Soil Improvement accounts. The EWG was composed of statisticians from the Uganda Bureau of Statistics (UBOS) and experts from the National Agricultural Research Organisation (NARO), the Ministry of Agriculture, Animal Industry and Fisheries (MAAIF), and Busitema University. The consultant took lead in data collection, analysis and synthesis with support of the UBOS team, while

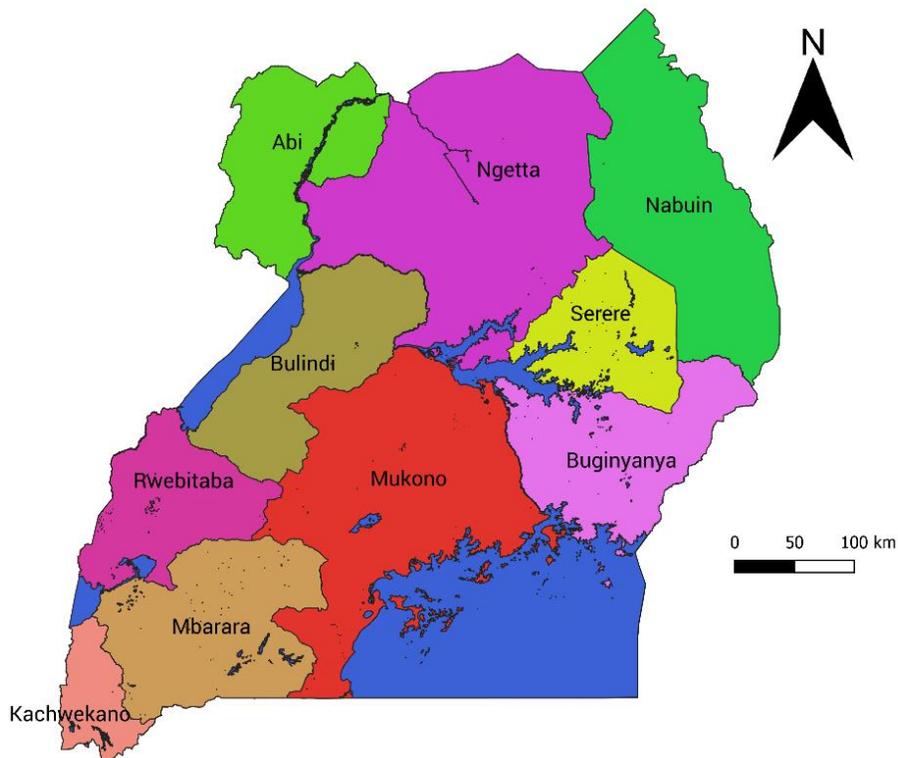
synthesis of findings was done with support from the EWG. Consultative meetings were conducted at four steps to review the methodology, review the draft report of the ecosystem extent and condition accounts, review of the ecosystem supply and use tables, and review of the metadata report. The aggregated report received iteration between the consultant and the EWG as part of validating the findings, conclusions and recommendations.

2.2 Data type and collection

2.2.1 Ecosystem Accounting Areas

Ecosystem accounting relies on three spatial categorizations. The three categories are; the Basic Spatial Unit (BSU), the Ecosystem Asset (EA) comprising a contiguous area of the same Ecosystem Type (previously called 'Land Cover Ecosystem Unit or LCEU); and, the Ecosystem Accounting Area (EAA) (previously called Ecosystem Account Unit) (see UN et al. 2014a and UN et al. 2018). The BSU is the smallest homogenous unit in the map and comprises an analytical unit, rather than an accounting unit per se. The BSU adopted in the land cover account is a 1-hectare grid cell. The use of hectares is aligned with national indicators for land use in the Vision 2040 and NDP III. The Ecosystem Accounting Area (EAA) used in the accounts were the operational areas of Uganda's Zonal Agricultural Research and Development Institutes (ZARDI). The 10 zone EAAs created are: Abi, Buginyanya, Bulindi, Kachwekano, Mbarara, Mukono, Nabuin, Ngetta, Rwebitaba and Serere (Figure 2).

Figure 2: Areas served by the Zonal Agricultural Research Development



Source: NARO (2020)

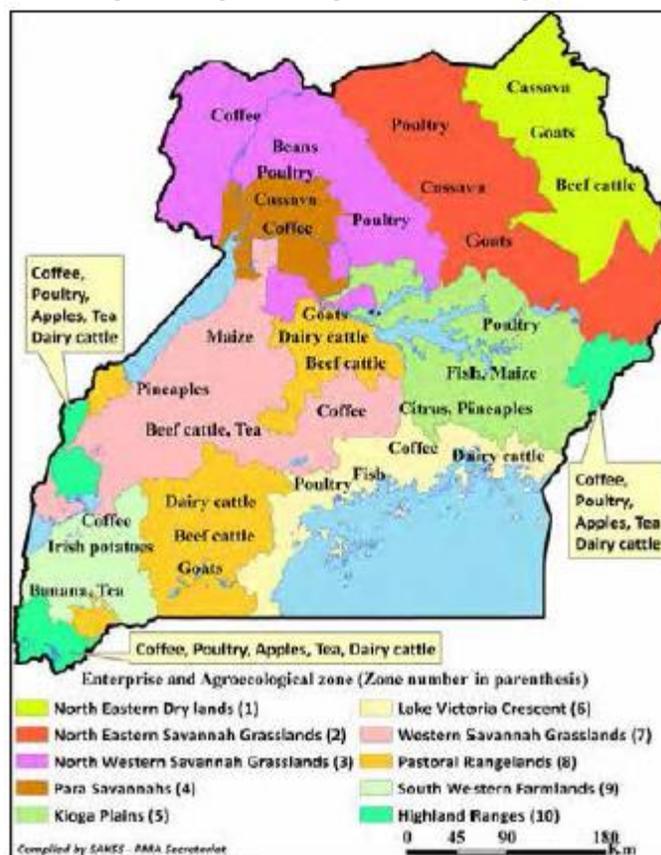
The zones provide an effective overlay of Uganda's nine Agro-ecological Zones (AEZs) and the districts. The match between ZARDIs and AEZs is shown in the Table 1 below, with the AEZ shown in Figure 3. The use of the areas served by the ZARDIs, herein referred to as zones, is consistent with the Annual Agricultural Survey (AAS) statistics developed by the Uganda Bureau of Statistics (UBOS) and the Ministry of Agriculture, Animal Industry and Fisheries (MAAIF). The Nabuin zone was subdivided to create the Serere zone to cater for the Teso sub-region and the Nabuin zone to cater for the Karamoja sub-region (UBOS/UNHS 2017).

Table 1: Match the zones based on the ZARDIs and the AEZs they represent and districts covered

Zones	Agro-ecological zones represented	Districts covered
11. Abi	North Western Savannah Grasslands	<i>Nine Districts</i> – Adjumani, Arua, Koboko, Maracha, Moyo, Nebbi, Packwach, Yumbe, Zombo
12. Buginyanya	Eastern Highland Ranges, Kyoga Plains and the Eastern Lake Victoria Crescent	<i>Covers 24 Districts</i> <i>Sebei sub-zone</i> – Kapchorwa, Kween, Bukwo <i>Bukedi sub-zone</i> – Busia, Budaka, Butaleja, Pallisa, Tororo <i>Bugisu sub-zone</i> – Bududa, Bulambuli, Manafwa, Mbale, Sironko <i>Busoga sub-zone</i> – Jinja, Kamuli, Iganga, Luuka, Bugiri, Namayingo, Namutumba, Buyende, Kaliro, Kibuku, Mayuge
13. Bulindi	Western Savannah Grasslands	<i>Covers five Districts</i> - Hoima, Masindi, Buliisa, Kibaale Kiryandongo
14. Kachwekano	Southern Highland Ranges and Southwestern Farmlands	<i>Covers five districts</i> - Kabale, Kanungu, Kisoro, Rubanda, Rukungiri
15. Mukono	Western and Central Lake Victoria Crescent, Southern part of the Western Savannah and the Eastern part of the Pastoral Rangelands	<i>Covers 21 districts</i> - Mubende, Mityana, Luwero, Kyankwanzi, Mukono, Kayunga, Nakasongola, Nakaseke, Masaka, Kalangala, Buikwe, Kalungu, Lwengo, Mpigi, Kampala, Bukomansimbi, Gomba, Butambala, Buvuma, Wakiso and Kiboga.
16. Ngetta	Central and western parts of North Eastern Savannah Grasslands, the eastern part of the North-Western Savannah Grasslands, and northern parts of the Kioga Plains	<i>Acholi sub-zone</i> – Agago, Amuru, Gulu, Kitgum, Lamwo, Nwoya, Omoro, and Pader <i>Lango sub-zone</i> – Alebtong, Amolatar, Apac, Dokolo, Kole, Lira, Otuke and Oyam
17. Nabuin	North Eastern drylands	<i>Covers seven Districts</i> – Napak, Moroto, Nakapiripirit, Kotido, Abim, Kaabong, and Amudat
18. Serere	Southern and eastern parts of North Eastern Savannah Grasslands, and north eastern parts of the Kioga Plains	<i>Covers eight Districts</i> – Serere, Soroti, Kaberamaido, Ngora, Kumi, Bukedea, Amuria, and Katakwi
19. Mbarara	Pastoral Rangelands and the South Western Farmlands	<i>Covers 13 Districts</i> – Buhweju, Bushenyi, Ibanda, Isingiro, Kiruhura, Lyantonde, Mbarara, Mitooma, Ntungamo, Rakai, Rubirizi, Sembabule, and Sheema.
20. Rwebitaba	Western Savannah Grasslands, Western Highland Ranges, and Pastoral Rangelands	<i>Covers seven Districts</i> – Bundibugyo, Kabarole, Kamwenge, Kasese, Kyegegwa, Kyenjojo, and Ntoroko.

Source: UBOS 2018

Figure 3: Agro-Ecological Zones of Uganda



Source: MAAIF (2018)

2.2.2 Ecosystem extent/land covers

Ecosystem assets are spatial areas containing a combination of biotic and abiotic components and other characteristics that function together. In the context of Uganda, there are 13 land-cover/ land-use classes that aggregate the main groups of ecosystems in the country on the basis of their land cover characteristics. Following the SEEA EEA Technical Recommendations, these land cover classes have been adopted as a proxy for different ecosystem types in Uganda (UN 2014). The national 13 land-cover classes were further aggregated to the six land-cover classes of the Intergovernmental Panel on Climate Change (IPCC). The six broad ecosystem types adopted for the accounts were: forestlands, croplands, grasslands, wetlands, settlements, and ordinary lands (IPCC 2006) (Table 2). Whilst these classes provide limited ecological detail, they effectively communicate the broad trends associated with agriculture related land use and associated expansion, particularly for cropland. However, it is recognized that these classes may not accurately capture the extent of all ecosystems. For instance, areas of wetland are often underestimated when using these land cover classes (see UNEP-WCMC & IDEEA Group, 2017).

Table 2: Conversion of classification from Land Use Land Cover system into IPCC land cover system

National LULC classification system	IPCC Class
Broad leaved plantations	Forest
Coniferous plantation	Forest
Tropical high forest well stocked	Forest
Tropical high forest low stock	Forest
Woodland	Forest
Bush	Ordinary lands
Grassland	Grassland
Wetland	Wetland
Small scale farmland	Cropland
Commercial Farmland	Cropland
Built up area	Settlements
Open Water	Open Water
Impediments	Ordinary lands

The forest lands account for all the five land-cover classes in Uganda, the croplands merged small scale farmlands and commercial farmlands, grasslands and wetlands were as used in the land classification for Uganda, and settlements referred to built-up areas, while ordinary lands combined bushlands and impediments. For completeness, the open water cover under the 13 land-cover classes of Uganda was added as an ecosystem type.

The ecosystem extent accounts were presented by zone (alternatively referred to as zones). The use of the IPCC land cover classes as ecosystem types was agreed as one of the outcomes of the expert working group (EWG) on the land and soil improvement accounts. The ecosystem extent accounts described the opening stock of the area of the ecosystem type, additions, reductions, net changes and closing stocks between 2005 and 2015.

The Uganda Green Growth Development Strategy (UGGDS) identifies sustainable forestry and wetlands as two of the four strategic investment areas for natural capital management and development in pursuit of green growth. Uganda's strategic biodiversity-related targets are also to increase forest cover from the current area to 24% of land cover, and wetlands to 13% of land cover (GOU 2013). As such, the Ecosystem Extent accounts have been structured to provide an indicator of land cover flows indicative of loss of these ecosystem types due to conversion for human use. These flows were labeled as indicative of 'degradation', as they indicate an increasing distance to the goals set for increasing the extent of these ecosystem types. Therefore, land degradation, in this particularly sense, occurs when forest and wetland ecosystems, which have a high biodiversity density are converted into croplands and settlements, which have a low biodiversity density. Table 3 presents the ecosystem change matrix used to classify IPCC land cover flows indicative of degradation (or improvement). It is acknowledged that there are other land cover flows that have significant impacts on people, the ecosystem services they use and biodiversity.

Table 3: Illustrative ecosystem change matrix for identifying land cover flows indicative of degradation

IPCC Classes	Forest lands	Crop lands	Grasslands	Wetlands	Settlements	Ordinary lands
Forest Lands	N/A					
Crop Lands		N/A				
Grasslands			N/A			
Wetlands				N/A		
Settlements					N/A	
Ordinary lands						N/A

Red = Degradation; Green = Improvement; Blue = Stable flows

2.2.3 Soil nutrient flow accounts

In order to better understand the nutrient flows from the environment to the economy, the SEEA CF proposes the use of material flow accounts (UN et al., 2014a). These are also expanded upon in the SEEA Agriculture Forestry and Fisheries (SEEA AFF) (FAO & UNSD, 2018). In broad terms, nutrient flow accounts provide a recording of the nutrient inputs into agricultural ecosystems and the nutrient outflows from them. As this represents an ecological input into the agricultural production function, it can be considered as an ecosystem service (as shown in Figure 1). Because of the difficulties in measuring all ecosystem inputs into agricultural production, the approach adopted within the soil and land improvement ecosystem service accounts follows the ‘harvest approach’ for cultivated crops and livestock (as described in the SEEA EEA (2014), para 3.30). The flow of nutrients from the soil is considered a particularly important intermediate ecosystem service flows for measurement in the context of agricultural land management in Uganda.

From the nutrient flow accounts, an overall nutrient balance can be calculated. Negative nutrient balances (i.e., where removals exceed inputs for given nutrients) can be an indicator of a lack of sustainability in production since, ultimately, the production of crops cannot continue without an appropriate balance of nutrients in the soil. As shown in Figure 1, a negative nutrient balance will have an impact on ecosystem condition over time.

There is no formalized structure for nutrient flow accounts within the SEEA. However, accounting for nutrient balances (or nutrient auditing) has been undertaken for some decades now in order to better understand the sustainability of agricultural production systems. The EuroStat & OECD (2013)¹ have also produced a handbook for calculating Nutrient Budgets. As such, there is a body of literature that can be drawn on to best structure the accounts and obtain the multiple coefficients necessary for estimating the flows of nutrients in and out of agricultural ecosystems. This has allowed for a suitable structure for the soil nutrient flow accounts to be determined, presented in the Annexes to this report.

The nutrient flow accounts and associated balances are based on assessment of soil nutrient inflows and outflows based on the crop and livestock production in 2009 and 2018 (UBOS 2009; MAAIF/UBOS 2020). The nutrient flow accounts included only the three macro-elements in soil nutrients; nitrogen (N), phosphorus (P) and potassium (K). The soil nutrient flow was estimated for each zone. There were significant data gaps for organic and inorganic nutrient inflows, however, the nutrient flows and outflows

¹https://ec.europa.eu/eurostat/documents/2393397/2518760/Nutrient_Budgets_Handbook_%28CPSA_AE_109%29_corrected3.pdf/4a3647de-da73-4d23-b94b-e2b23844dc31

were estimated based on relationship between nutrient consumption and crop production and crop output (World Bank 2005, FAO 2007, UBOS 2008 and MAAIF/UBOS 2020).

The nutrient flow and balance accounts were first compiled in physical terms. They are also presented in monetary terms. The monetary accounts were determined by multiplying the physical soil fertility by the average price of fertilisers. The average price of fertilisers was determined by using the Uganda consumer price index (UBOS 2009, 2018). The reference prices were obtained from MAAIF/UBOS (2015; Adong 2015).

2.2.4 Thematic carbon accounts

The SEEA EA proposes various thematic domains for accounting to inform decision-making in different policy areas. One of these is carbon and climate change related decision-making. Carbon stock accounts are introduced in the SEEA EA as a way of organizing information on biomass carbon within ecosystems. These also provide a structure in which to organize information on the biomass accumulation, land productivity (or Net Primary Productivity, NPP) and soil organic carbon (SOC). Together with land cover change, these sub-indicators are relevant to the calculation of SDG Indicator 15.3.1, Proportion of land that is degraded over the total land area. The Ecosystem Accounting Area for the thematic carbon accounts was the national level. The calculations using Tier 1 default factors of the IPCC's Guidelines for conducting greenhouse gas inventories at the national level (IPCC 2006). Table 4 is an illustrative structure of national ecosystem condition accounts.

Table 4: Illustrative structure of national thematic carbon accounts

Indicators of ecosystem condition	Flow of accounts
Biomass carbon flows (including NPP)	Increase in biomass stock (including NPP)
	Decrease in stock (including use of biomass provisioning ecosystem services)
	Annual net accumulation of biomass carbon
Net change in SOC	Flow of SOC from Organic Soils
	Flow of SOC from Mineral Soils
	Total Flow of SOC from Soils

2.2.5 Ecosystem supply and use account

The ecosystem services supply and use account records the flows of ecosystem services supplied by ecosystem types to economic units during an accounting period. Within the SEEA EA, the concept of the supply of ecosystem services is equal to the use (or receipt) of ecosystem services. The Land and Soil Improvement Accounts will focus on the 'enabling food provisioning' ecosystem service. Subsequently, the supply and use can be equated by using proxy data on biomass (metric tonnes) of crops and livestock harvested from ecosystems.

1. The structure of the ecosystem service supply and use accounts will be presented based on the SEEA EEA Technical Recommendations (UN et al., 2018).
2. The Physical Supply Ecosystem Service presents statistics on the different crop and livestock output which are the *enabling food provisioning*' service by ecosystem types.

- The monetary value of 'enabling food provisioning' service is captured in the farm gate price. The monetary accounts take the simple format to the physical supply and use tables; hence it is the values of the ecosystem services that are included, the physical unit multiplied by prices.

2.3 Data analysis

Table 4 described the data sources, the accounts developed and the analytical approaches used to support compilation of the accounts. Six specific accounts were developed: the physical ecosystem extent accounts for land and soil improvement, the physical and monetary accounts for NPP, SOC and soil fertility, the physical supply and use accounts (PSUT), and the monetary supply and use accounts (MSUT). Whereas all accounts were developed for all 10 EAAs, only four (Abi, Buginyanya, Mbarara and Mukono zones) are described in the following Section 3 of the report. The zones were selected for their representation of the four regions of Uganda, northern, eastern, western and central region. The Abi zone represents the north western savannah grasslands agro-ecological zones (AEZ), Buginyanya zone represents the highland ranges AEZ, the Mbarara zone represents the pastoral rangelands AEZ, and the Mukono zone represents the Lake Victoria crescent AEZ.

The set of accounts described in Section 3 illustrate the potential analytical uses and policy insights the accounts provide at zone level. A full set of accounts for all zones is provided in the annexes to support further analyses. The integrated Analyses in Section 4 of this report draws on the results from all 10 zone to inform the conclusions and recommendations presented in this report.

Table 5: Types of accounts and indicators, data sources and analytical approaches

Indicator/ accounts developed	Data sources	Analytical approaches
Ecosystem Extent		
Ecosystem extent	Land cover/ land use classes from the National Biomass Survey 2017. Additional secondary elaboration of the IPCC land cover classes (IPCC 2006)	Pivot table creation by Districts, aggregated to zones as proxies for Agro-Ecological Zones (AEZ) based on Agricultural sector operations. Pivots based on 13 land cover classes. The 13 land cover classes further merged into 6 land cover classes based on Intergovernmental Panel on Climate Change (IPCC) classification. Land cover flows indicative of degradation comprised: conversion from forestlands and wetlands into croplands and settlements. Land cover flows indicative of improvement comprised: expansion of forestlands and wetlands as land is converted from croplands and settlements
Soil nutrient flow accounts		
Soil fertility trends), physical and monetary	Soil nutrient inflows and outflows were based on derived data. The data types used were the National Crop and Livestock Censuses (UBOS 2008, 2009), and the Annual Agricultural Survey 2018 (UBOS 2020). Additional secondary data from World Bank 2005 and derived data with	The accounts were compiled based on simulation analysis of crop output as the basis for the required soil nutrients as out flow. Similarly, nutrient inflow was derived for BNF and atmospheric deposition using the technical relationship between planted areas and the BNF and level of atmospheric deposition occurring based on default factors from the UN FAO. The

Indicator/ accounts developed	Data sources	Analytical approaches
	FAO 2007 on crop response and soil nutrient outflows	accounts were then compiled out of the nutrient inflows and nutrient outflows and they also showed the results of the net balance of nutrient outflows/inflows.
Thematic carbon accounts (physical)		
Biomass carbon flows	Derived data through analysis of land-cover change across the six IPCC classes and use of the IPCC Guidelines for National Inventories	The NPP was compiled using the IPCC 2006 Guidelines for National Inventories on GHGs under the categories of the six land covers classes, and presented for 1990, 2000, 2005, 2010 and 2015. The IPCC default factors were imposed on the land cover and land-cover change.
SOC Flows	Derived data through analysis of land-cover change across the six IPCC classes and use of the IPCC Guidelines for National Inventories	Produced from calculations using IPCC 2006 Guidelines for Conducting National Inventories of Greenhouse Gases (GHGs)
Ecosystem Supply and Use Tables		
Physical supply and use tables/ accounts	The crop and livestock outputs data obtained from the National Crop and Livestock Censuses (UBOS 2008, 2009), and the Annual Agricultural Survey 2018 (UBOS 2020).	The PSUT was compiled based on the guidance from the Methodological note development from the Land and Soil Improvement Accounts (NEMA et al. 2019a) with additional guidance from Data compiles from UNSEEA-EA Manual (UN 2014, 2017).
Monetary Supply and use tables/accounts	The prices for crops were based on work done by Kraybill and Kidoido (2009). The livestock prices were drawn from work done by Behnke and Nakirya (2012) while fertiliser prices were based on work by Adong (2015), and UBOS and MAAIF (2015). UBOS Consumer Price Index 2018, 2009 and World Bank 2020 price indices. The physical commodity supply and use was based on the data compiled in the PSUT	The MSUT was developed as a byproduct of the PSUT. The PSUT was multiplied by the appropriate price information.

3. ECOSYSTEM EXTENT ACCOUNTS

3.1 Land and soil ecosystem extent accounts

3.1.1 National land and soil extent based on IPCC classes

Uganda’s national extent is 24.16 million ha. Between 2005 and 2015, croplands, already the largest land cover in the country, increased by 17.6% from 8.95 million ha to 10.53 million ha. Forestlands and ordinary lands suffered overall reduction of 54% from 3.60 million ha to 1.95 million ha and 34% from 2.98 million ha to 1.97 million ha, respectively. Wetlands had a net reduction of just 5% from approximately 0.75 million ha to 0.72 million ha, while grasslands had a net addition of 25% from 4.06 million ha to 5.10 million ha, over the same period.

The national land ecosystem extent account (Figure 4 and Table 6) points to decreasing forest, ordinary lands and wetlands as croplands, and grasslands expanded. The main gross reductions were the 2.47 million ha of forest lands, followed 2.40 million ha of ordinary land (bushlands), 1.63 million ha of grassland and 1.44 million ha of croplands. Forestlands comprised nearly one-third of the gross reductions in land cover between 2005 and 2015. Conversely, the main gross additions were 3.01 million ha of cropland followed by 2.66 million ha of grassland and 1.40 million ha of ordinary land, all occurring between 2005 and 2015.

As Figure 4 and Table 6 reveal, 1.16 million ha of the gross additions to cropland between 2005 and 2015 are considered land cover flows indicative of degradation (i.e., conversion of forest or wetland to cropland). Similarly, just over 7,000 ha of the gross additions to settlement extent are considered indicative of degradation. Table 6 reveals that national land cover flows indicative of improvement with respect to increasing forest and wetland extent was only around 240,000 ha between 2005 and 2015.

Figure 4: Change in Land National Extent based on IPCC land cover classification

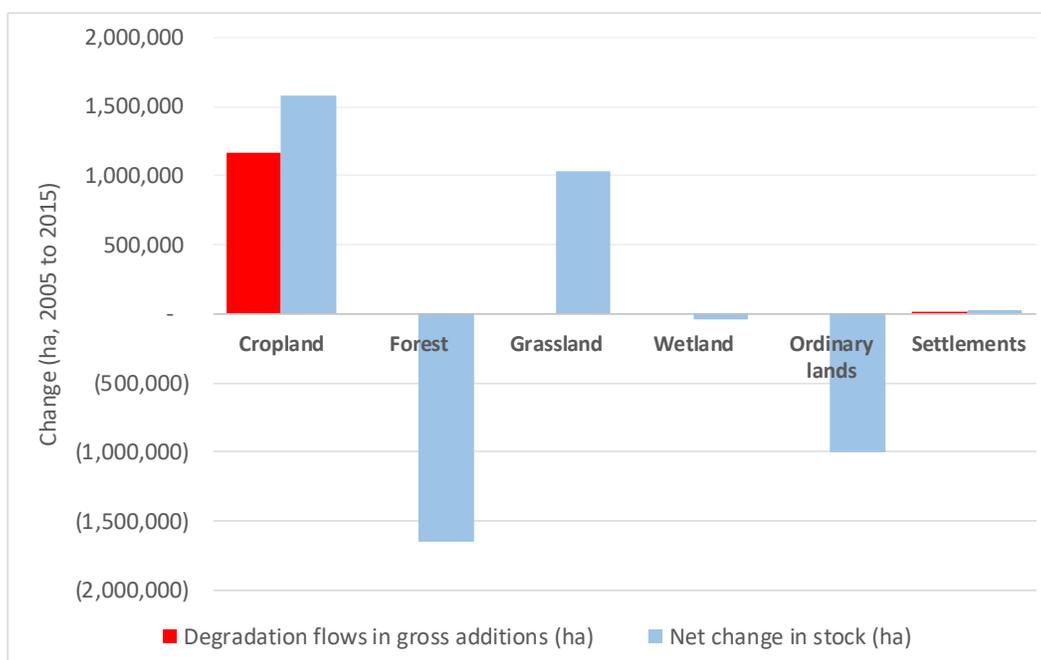


Table 6: National land and soil ecosystem extent account by IPCC land cover class, 2005 to 2015

Classifications >>	Cropland	Forest	Grassland	Wetland	Ordinary lands	Settlements	Open Water	Total
Opening stock (ha)	8,954,325	3,604,241	4,063,619	753,042	2,976,508	97,271	3,706,490	24,155,496
Total additions to stock (ha)	3,012,364	816,822	2,664,521	224,464	1,402,343	82,897	52,406	8,255,817
Total reductions in stock (ha)	1,435,870	2,469,402	1,630,768	262,025	2,403,837	44,601	9,314	8,255,818
Net change in stock (ha)	1,576,494	(1,652,579)	1,033,753	(37,562)	(1,001,494)	38,296	43,092	-
Improvement flows	-	178,698	-	61,203	-	-	-	239,901
Degradation flows	1,160,887	-	-	-	-	7,260	-	1,168,146
Stable or stable flows	9,369,932	1,772,964	4,449,327	654,277	1,551,290	128,307	3,712,553	21,638,652
Closing Stock (ha)	10,530,819	1,951,662	5,097,372	715,481	1,975,014	135,567	3,749,581	24,155,496

3.1.2 Abi zone

Abi zone is located in the West Nile sub-region of Uganda. The zone is equivalent to 6.5% of Uganda's national land cover with an area of 1.58 million ha (Table 7). Ninety-one percent net reduction in land cover was for forests and the remaining 9% net reduction occurred in wetlands. The largest net increase in land cover was for grasslands at 62% followed by the 34% net increase in croplands, while settlements had a net increase of 2%.

Land cover flows indicative of degradation (forests and wetlands conversion to cropland and settlement) in the Abi ZONE was 110,842 ha. Whereas, land cover flows indicative of improvement was only 23,628 ha. The decline in forest cover was largely due to forest clearing with the land converting into grasslands followed by croplands (Figure 5). The main drivers for forest land-cover decrease were mostly from deforestation, and cropland conversion was only the secondary driver for land-cover change. Table 7 reveals that the land cover flows indicative of degradation with respect to cropland expansion (approx. 111,000 ha) are larger than the net change in cropland extent (approx. 94,000 ha). This suggests some shifting agricultural practices, supported by the relatively large gross additions (approx. 206,000 ha) and reductions (approx. 112,000 ha).

Total reductions were 638,642 ha of which 46%, 20%, 18% and 11% was due to reduction in forests, bushlands, croplands and grasslands respectively. In contrast, out of the 638,642 ha, total additions, 38% occurred in grasslands, 32% in cropland, 20% in bushlands and only 7% in forestlands. While some forestlands were being converted unto croplands, the larger proportion was converted into grassland. The land converted for bushlands was negligible, therefore the major transitions were forests into grasslands and croplands.

Figure 5: Change in Extent for Abi ZONE area, 2005 to 2015 in ha

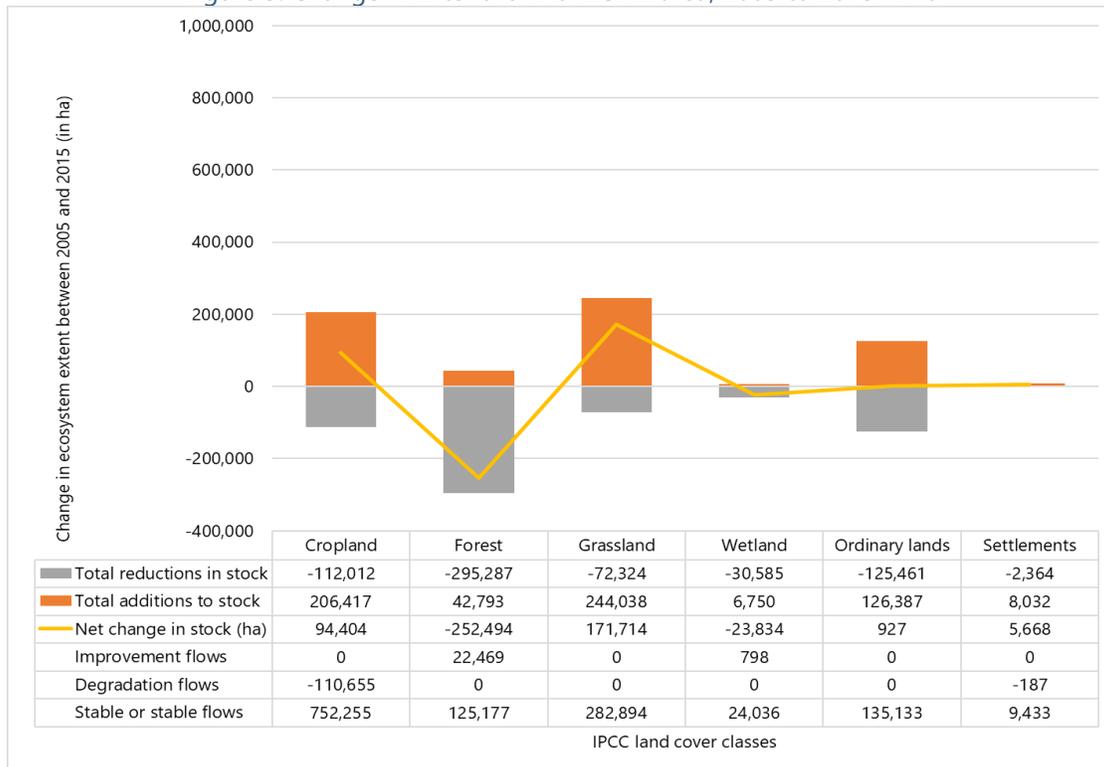


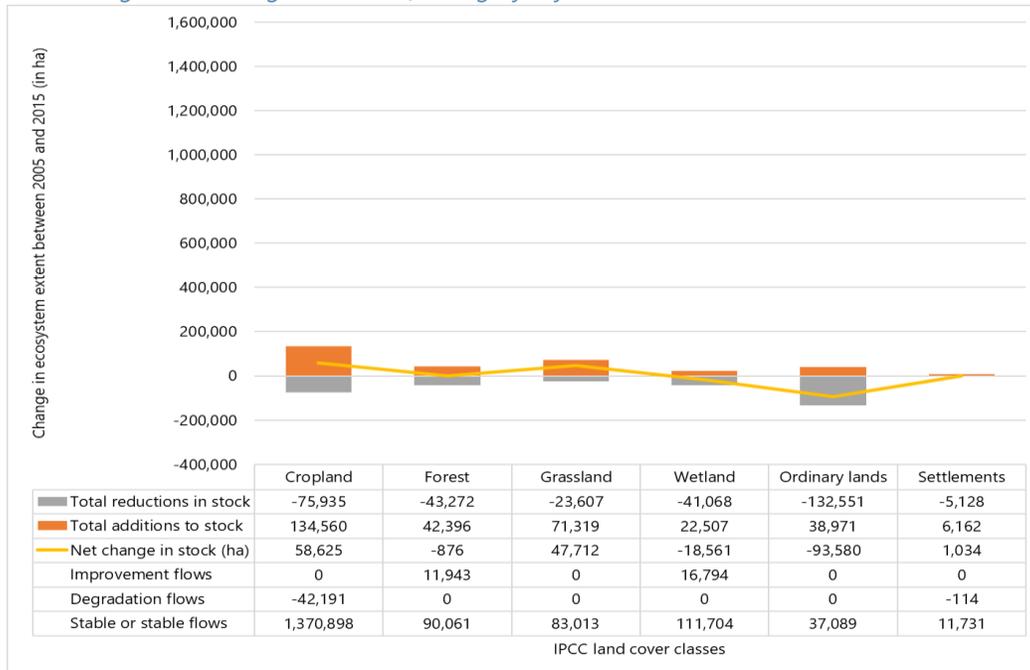
Table 7: Abi zone land and soil ecosystem extent account by IPCC land cover classes, 2005 to 2015

Classifications >>	Cropland	Forest	Grassland	Wetland	Ordinary lands	Settlements	Open Water	Total
Opening stock (ha)	768,506	400,141	166,332	48,669	159,494	3,952	30,180	1,577,272
Total additions to stock (ha)	206,417	42,793	244,038	6,750	126,387	8,032	4,224	638,642
Total reductions in stock (ha)	112,012	295,287	72,324	30,585	125,461	2,364	610	638,642
Net change in stock (ha)	94,404	(252,494)	171,714	(23,834)	927	5,668	3,615	(0)
Improvement flows	-	22,469	-	798	-	-	-	23,268
Degradation flows	110,655	-	-	-	-	187	-	110,842
Stable or stable flows	752,255	125,177	282,894	24,036	135,133	9,433	30,320	1,359,248
Closing Stock (ha)	862,910	147,647	338,046	24,834	160,420	9,620	33,795	1,577,272

3.1.3 Buginyanya zone

The Buginyanya zone is a fusion of the Lake Victoria Crescent AEZ, the Highland Ranges AEZ and the Kyoga Plains. The zone covers an area of 2.66 million ha equivalent to 11.0% of the national land cover. The major transitions in land cover were between ordinary lands (bushlands and impediments), croplands and grasslands (Table 8). The net reduction in ordinary lands was 93,580 ha, equivalent to 82% of the reduction in this land cover class. The largest net increase in land cover stock was for croplands. Fifty-two percent of the net increase was for croplands, and 42% of the net increase was in grasslands.

Figure 6: Change in Extent for Buginyanya ZONE area, 2005 to 2015 in ha



The land cover transitions in the Buginyanya zone were largely conversion from bushlands to croplands and grasslands. The bushlands decreased by 60% (93,580 ha) despite occupying only 6% of the total land cover for the zone in 2005 (Figure 6). The conversion of bushlands indicated that all the other land was under full use with limited land available for conversion. Land cover flows indicative of degradation in the Buginyanya zone was 42,305 ha. Over the same period, these were offset (to a degree) by land cover flows indicative of improvement of 28,737 ha

Table 8: Buginyanya Zone land and soil ecosystem extent by IPCC land cover classes, 2005 to 2015

Classifications >>	Cropland	Forest	Grassland	Wetland	Ordinary lands	Settlements	Open Water	Total
Opening Stock (ha)	1,354,464	102,880	40,831	147,059	154,010	10,811	851,451	2,661,505
Total additions to stock (ha)	134,560	42,396	71,319	22,507	38,971	6,162	6,552	322,467
Improvement flows	-	11,943	-	16,794	-	-	-	28,737
Degradation flows	42,191	-	-	-	-	114	-	42,305
Stable or stable flows	1,370,898	90,061	83,013	111,704	37,089	11,731	852,194	2,556,690
Total reductions in stock (ha)	75,935	43,272	23,607	41,068	132,551	5,128	906	322,467
Net change in stock (ha)	58,625	(876)	47,712	(18,561)	(93,580)	1,034	5,646	(0)
Closing Stock (ha)	1,413,090	102,004	88,543	128,498	60,430	11,844	857,097	2,661,505

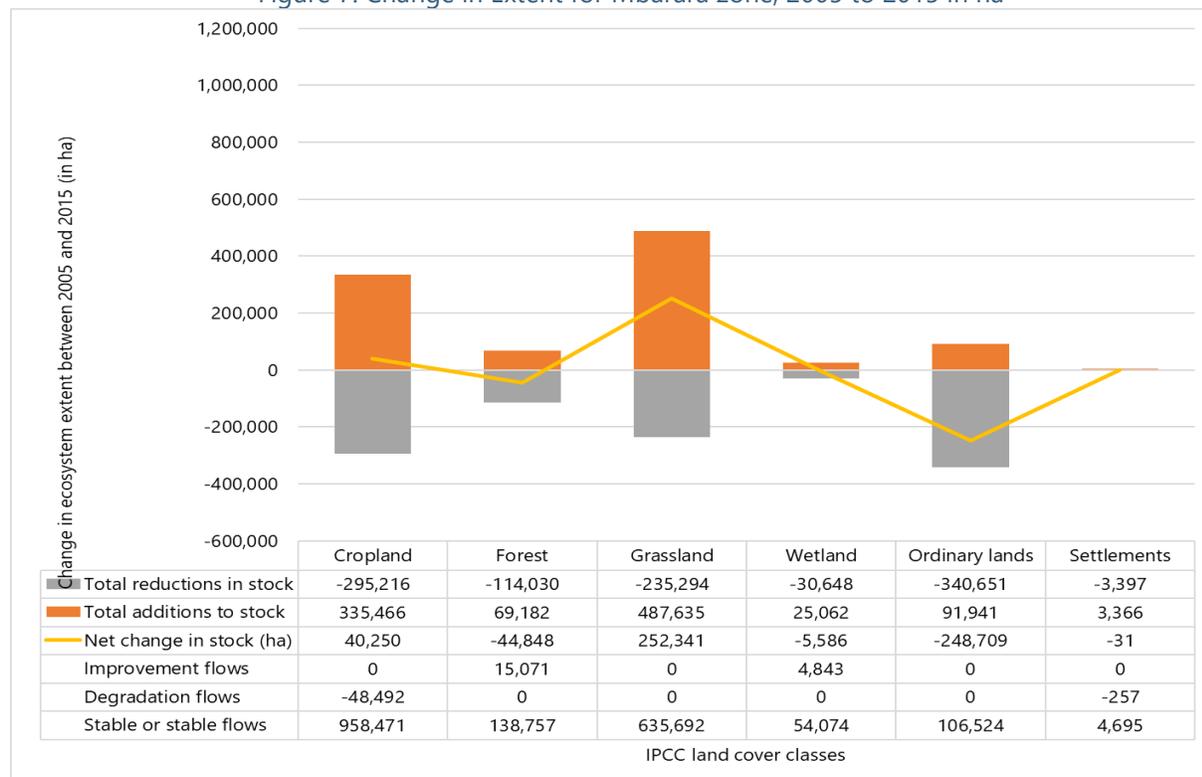
In the Buginyanya zone, the bush lands 41% and croplands 24% had the largest reduction while grassland had only 7% of the total reductions. Conversely croplands 42% and grasslands 22% had the largest addition, while bushlands had only 12% addition, and the additions to forests were cancelled out by the reductions, the major transactions. Therefore, it was the bushlands that converted into croplands. The changes in the land management systems were likely to be due to reclamation of marginal land so households in active fallowing of land under use as grasslands. The grasslands are also used for livestock production and foraging for wildlife. In the Buginyanya zone though, they are likely to represent fallows.

3.1.4 Mbarara zone

Mbarara zone is located in the Pastoral Rangelands and crosses into the South Western Farmlands. The zone has an area of 2.36 million ha equivalent to 9.7% of the country's land cover. The zone is dominated by croplands (41%) and grasslands (26%) whose dominance was strengthened through a net increase of 40,250 ha and 252,341 ha, respectively (Table 9). The croplands and grasslands represent the major land uses of crop farming, livestock production, and wildlife conservation. The increase in grassland area was more than five times larger than the increase in cropland area, an indication of the increased importance of the livestock production, and the wildlife conservation under the Lake Mburo National Park (Figure 7). Land cover flows indicative of degradation (forests and wetlands loss) was 48,749 ha between 2005 and 2015. Whereas, land cover flows indicative of improvement was only 19,914 ha

The Mbarara zone is characterized by stable perennial banana and tea crops alongside subsistence production of food crops and mixed farming with improved livestock and pastoral livestock production in the cattle corridor areas.

Figure 7: Change in Extent for Mbarara zone, 2005 to 2015 in ha



For the Mbarara zone, gross reductions were highest for bushlands (33%), croplands (29%), and grasslands (23%) while reductions for forestlands were 11%. Concurrently, the higher additions to land cover for grasslands (48%) and croplands (33%) outweighed the reductions leading to a net increase of 252,341 ha and 40,250 for grasslands and croplands respectively. There was an expansion in grazing lands for livestock and foraging areas for wildlife, as well as cropping areas at the expense of bushlands and forest. The

marginal lands (ordinary lands) were being reclaimed as well as forest lands, as crop and livestock production increased.

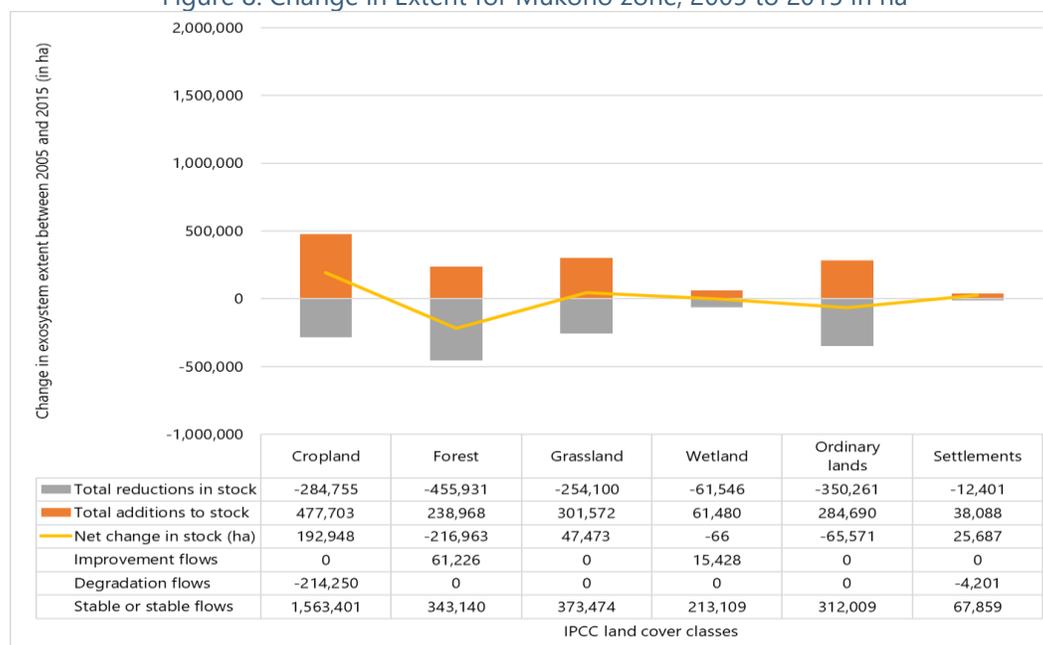
Table 9: Mbarara Zone land and soil ecosystem extent by IPCC land cover classes, 2005 to 2015

Classifications >>	Cropland	Forest	Grassland	Wetland	Ordinary lands	Settlements	Open Water	Total
Opening Stock (ha)	966,714	198,676	609,862	64,503	398,295	4,983	116,491	2,359,524
Total additions to stock (ha)	335,466	69,182	487,635	25,062	91,941	3,366	7,210	1,019,861
Total reductions in stock (ha)	295,216	114,030	235,294	30,648	340,651	3,397	627	1,019,862
Net change in stock (ha)	40,250	(44,848)	252,341	(5,586)	(248,709)	(31)	6,583	(0)
Improvement flows	-	15,071	-	4,843	-	-	-	19,914
Degradation flows	48,492	-	-	-	-	257	-	48,749
Stable or stable flows	958,471	138,757	635,692	54,074	106,524	4,695	118,125	2,016,339
Closing Stock (ha)	1,006,964	153,828	862,203	58,918	149,585	4,952	123,074	2,359,524

3.1.5 Mukono zone

Mukono zone is located in the central part of the country and generally lies within the Lake Victoria Crescent AEZ. At 4.7 million ha, the zone constitutes 19.6% of Uganda's land cover. Thirty-eight percent of the zone lies under the open water system of the Lake Victoria basin. The croplands occupied 29% (1.58 million ha) of the land cover in 2005 but that increased by 12% to 1.78 million ha by 2015. Sixty-eight percent of the land cover conversion was towards croplands. The settlements increased by 54% from 46,373 ha to 72,061 ha, and grasslands also increased by nearly 12% (Figure 8 and Table 11). The increased for croplands, grasslands and settlements were at the expense of forests, bushlands and wetlands. The Land cover flows indicative of degradation (forests and wetlands loss) were 218,451ha between 2005 and 2015, much higher the flows indicative of improvement (only 76,654 ha).

Figure 8: Change in Extent for Mukono zone, 2005 to 2015 in ha



The zone is occupied by Uganda's most populous and urbanized areas of Kampala city, Wakiso and Mukono districts, Entebbe city, and Masaka city among others, which accounts for the expansion in settlements. Croplands, which are the dominant land cover, are still expanding and replacing forests and bushlands.

In the Mukono zone, the highest reductions were for forests (32%) followed by bushlands (25%), croplands (20%) and grasslands (18%). Conversely the largest additions were for croplands (34%), grasslands (21%), bushlands (20%) and forests (17%). The extent changes show large gains for croplands and only marginal gains for grassland largely at the expense of forests and bushlands by just 5%. The croplands and grasslands expanded at the expense of forests and bushlands.

Table 10: Mukono zone land and soil ecosystem extent by IPCC land cover classes, 2005 to 2015

Classifications >>	Cropland	Forest	Grassland	Wetland	Ordinary lands	Settlements	Open Water	Total
Opening Stock (ha)	1,584,703	621,330	406,288	228,603	458,397	46,373	2,071,920	5,417,614
Total additions to stock (ha)	477,703	238,968	301,572	61,480	284,690	38,088	18,069	1,420,570
Total reductions in stock (ha)	284,755	455,931	254,100	61,546	350,261	12,401	1,576	1,420,570
Net change in stock (ha)	192,948	(216,963)	47,473	(66)	(65,571)	25,687	16,493	(0)
Improvement flows	-	61,226	-	15,428	-	-	-	76,654
Degradation flows	214,250	-	-	-	-	4,201	-	218,451
Stable or stable flows	1,563,401	343,140	373,474	213,109	312,009	67,859	2,074,316	4,947,308
Closing Stock (ha)	1,777,651	404,366	453,761	228,537	392,825	72,061	2,088,413	5,417,614

4. SOIL NUTRIENT FLOW ACCOUNTS

4.1 Introduction to soil nutrient accounts

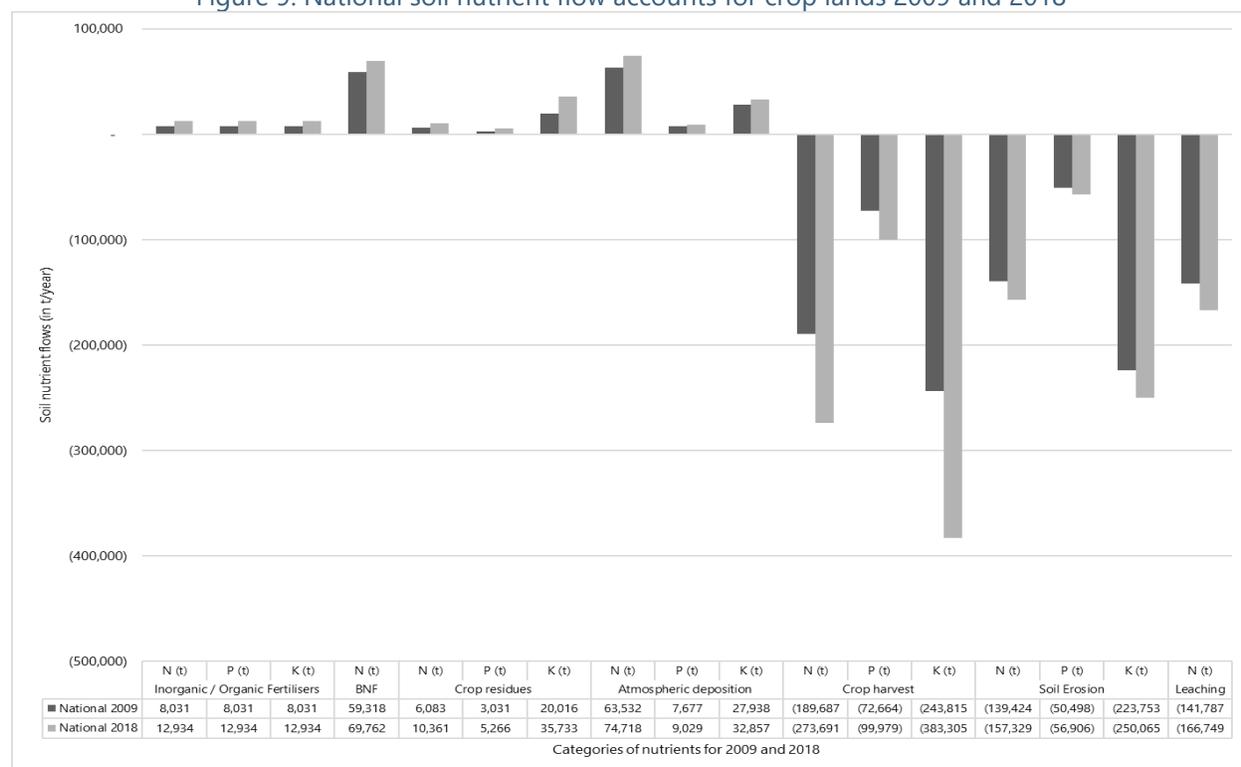
The soil nutrient flow accounts show both the nutrient inflow were from inorganic and organic fertilisers, biological nitrogen fixation, crop residues and atmospheric deposition. The outflows were due to crop harvest, soil erosion and leaching. They cover the period 2009 and 2018. The soil nutrient flows were derived based on calculations of crop production from the Annual Agricultural Surveys of Uganda (for 2009 and 2018) and information on crop nutrient uptake from the FAO (2006) to estimate nutrient loss from crop uptake. This was supplemented with secondary data collected on other nutrient inflows and outflows from studies in Uganda by the World Bank (2005) and Karamage et al. (2016).

4.2 Physical soil nutrient flow

4.2.1 National nutrient flow balance accounts for cropland

Uganda's soil nutrient balance indicates a 30% increase in nitrogen depletion, a 27% increase in depletion of phosphorous and a 35% increase in potassium depletion between 2009 and 2018 (Figure 9). This increased negative net balance was the result of an increase in nutrient outflows. In 2009, the total inflows of nitrogen, phosphorous and potassium were 128,934t, 10,708t and 47,954t, respectively.

Figure 9: National soil nutrient flow accounts for crop lands 2009 and 2018



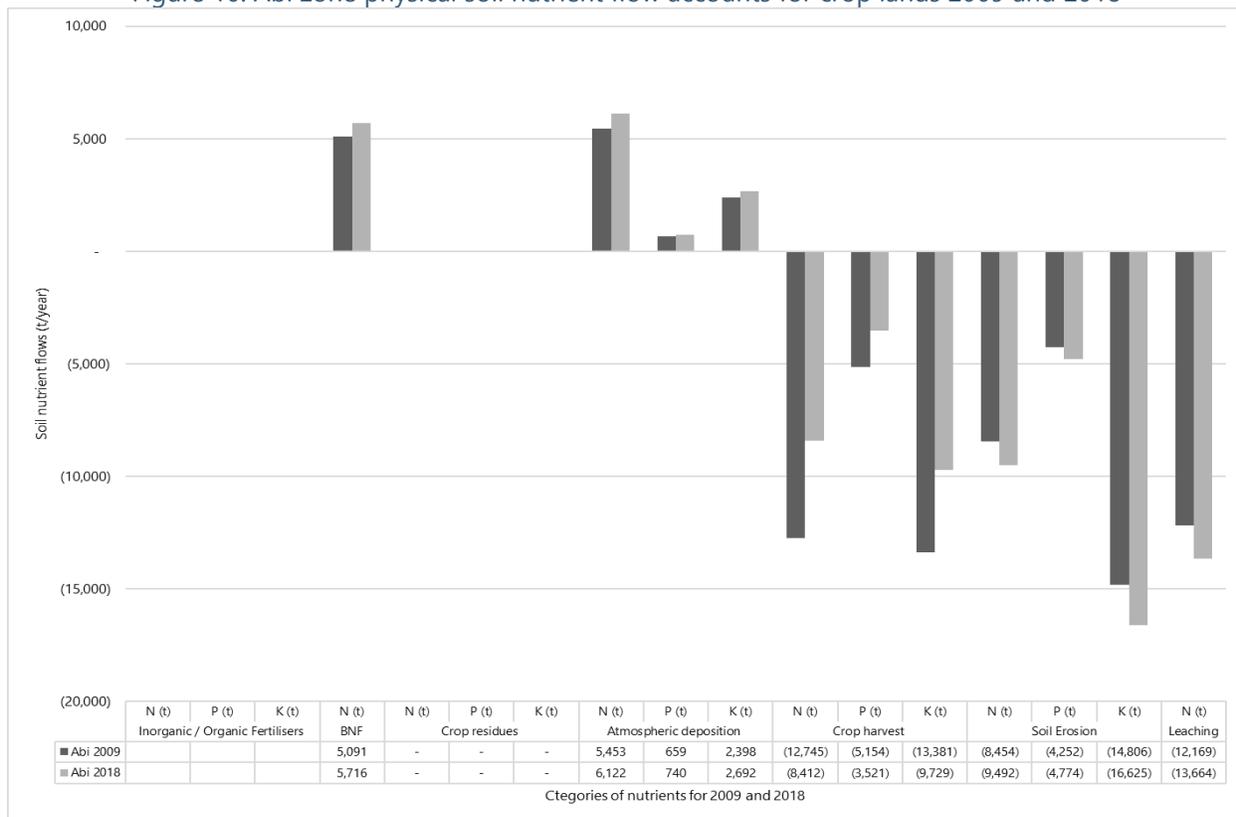
The total soil nutrient inflows were higher: 20%, 33% and 43% at 154,840t, 14,295t, 68,590t, respectively for nitrogen, phosphorous and potassium. On the other hand, the nutrient outflows in 2009 were 470,898t of

N, 156,885t of P and 487,568t of K. By 2018, the nutrient outflows had increased by 27%, 27% and 35% respectively to 597,769t of N, 156,885t of P and 613,370t, of K. the result was that the nutrient flow balance for nitrogen, phosphorous and potassium was worse by 30%, 27% and 35% respectively. The adverse nutrient balance is due to the low soil nutrient inflows compared to the nutrient outflows. The total nutrient inflows for N, P and K were only 27%, 9% and 10% outflows for both 2009 and 2018. The estimated sources of nutrient inflow were atmospheric deposition, BFN and crop residues, while outflow was from crop harvest, soil erosion and leaching. Even if, the data for organic and inorganic fertilizer application is not available, a 2013 estimate showed a total inorganic fertilizer import of 53,447t/year 60% of which was NPK fertilizer, i.e., about 32,068t/year of NPK. (UBOS/MAAIF 2015) with a combined nutrient in-balance of -1.15 million t of NPK in 2018 fertiliser use of 32,068t/year is only able to address 3% of the nutrient deficit experienced in 2018.

4.2.2 Abi Zone nutrient flow balance accounts for cropland

The nutrient flow for soils in the Abi zone showed a negative nutrient balance for nitrogen, phosphorus and potassium. Even though, the nutrient inflows from BNF and atmospheric deposition increased in 2018 as compared to 2009 (essentially due to cropland expansion), the nutrient outflow was still very high as compared to the nutrient inflows. The nutrient outflows were 3 times, 14-times and 12-times higher in 2009 and 3-times, 11-times and 10-times higher in 2018 (Figure 10).

Figure 10: Abi zone physical soil nutrient flow accounts for croplands 2009 and 2018

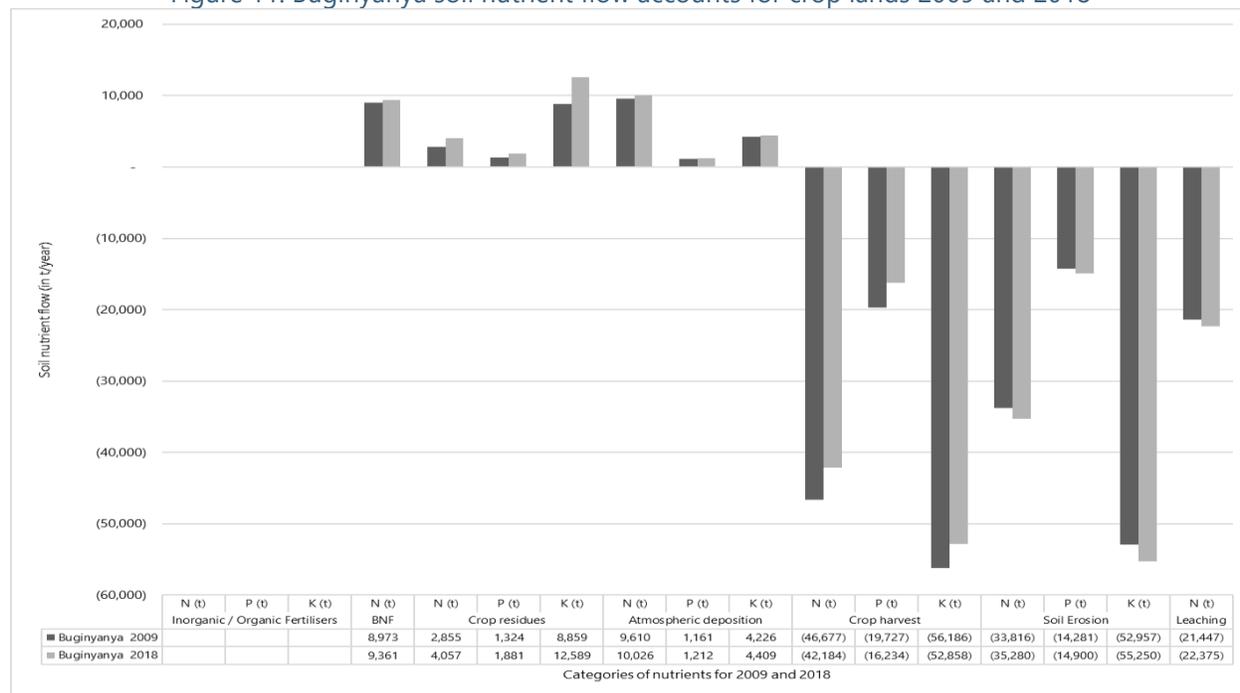


Closing the gap on the nutrient imbalance can only be achieved by increasing inflows from organic and inorganic fertilisers, whose information is not only missing, but based on national estimates are considerably low.

4.2.3 Buginyanya zone nutrient flow balance accounts for cropland

The nutrient inflows for Buginyanya increased by 9%, 25% and 30% respectively for nitrogen, phosphorous and potassium from 2009 to 2018. The outflows declined by 2%, 9% and 1%, but the outflows were already 4 times, 13 times and 8 times higher than the inflows in 2009, and they remained 4 times, 10 times and 6 times higher in 2018 for nitrogen, phosphorous and potassium, respectively. As a result, the nutrient balance showed large net nutrient outflows for nitrogen, phosphorous and potassium (Figure 11). The net outflows of nutrients in the Buginyanya zone were the highest, by zone in the country. The outflow for nitrogen, phosphorous and potassium was 80,503t, 31,523t and 96,058t in 2009 and 76,394t, 28,041t and 91,110t in 2018. The Buginyanya zone is a major produce of Arabica coffee in the Mt. Elgon ranges. The zone also has a large population engaged in small scale subsistence farms for annual crops of maize, beans, sweet potato, cassava, rice and potatoes among others.

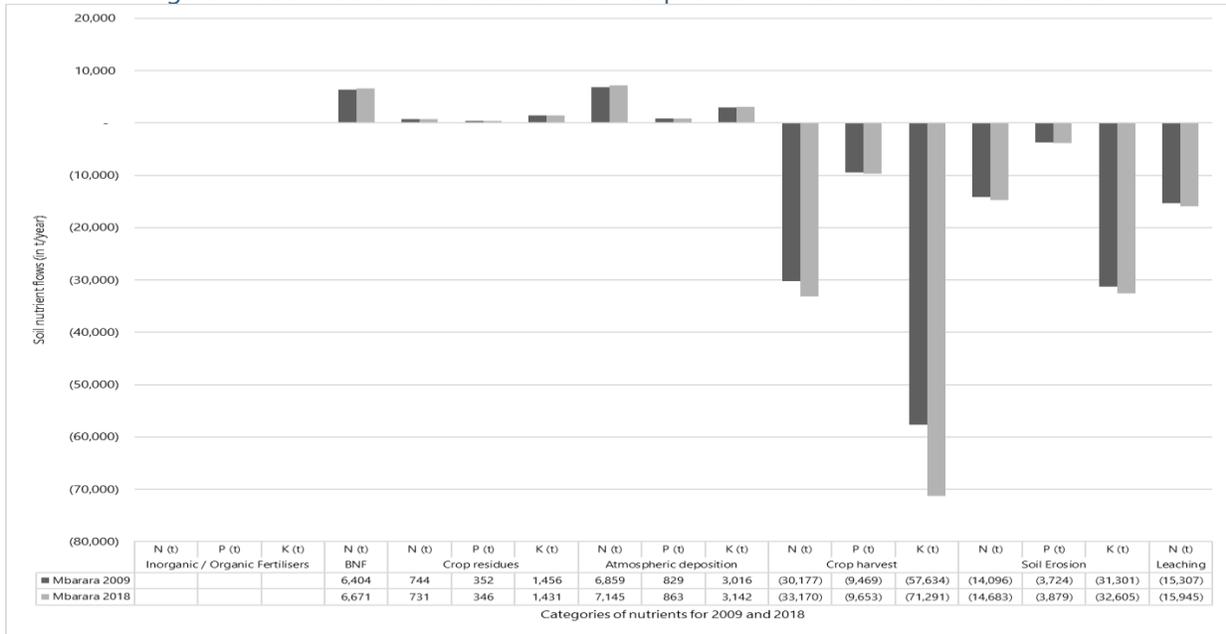
Figure 11: Buginyanya soil nutrient flow accounts for crop lands 2009 and 2018



4.2.4 Mbarara zone nutrient flow balance accounts for cropland

The soil nutrient balance for the Mbarara zone showed that soil nutrient outflows were 4 to 22 times higher than additions. The nitrogen outflows were 4 times higher than additions; Phosphorous outflows were 11 times higher than additions and potassium outflows were 20 to 22 times higher than the addition for 2009 and 2018 (Figure 12). In addition, the net nutrient outflows increased by 8%, 3% and 18% for Nitrogen, Phosphorous and Potassium.

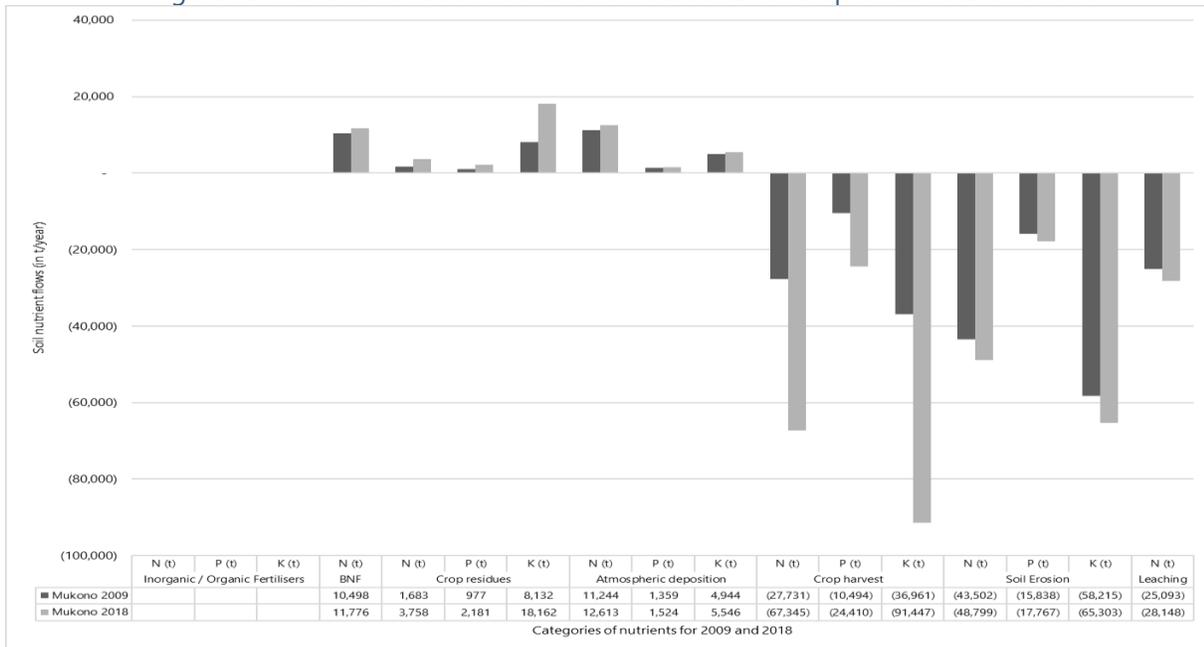
Figure 12: Soil nutrient flow accounts for crop lands in Mbarara zone 2009 & 2018



4.2.5 Mukono zone nutrient flow balance accounts for cropland

The Mukono zone had the third largest planted area in 2009 after Buginyanya and Ngetta. But by 2018, it had the outright largest planted area across the whole country. Therefore, expectedly, the soil nutrient outflows were quite high, the second highest in 2009 after Buginyanya zone, and the highest in 2018. The net nutrient out flows in 2018 were 59%, 60% and 62% higher than in 2009 for nitrogen, phosphorus and potassium due to the two-fold increase in the planted area (Figure 13).

Figure 13: Mukono zone soil nutrient flow accounts for crop lands 2009 and 2018



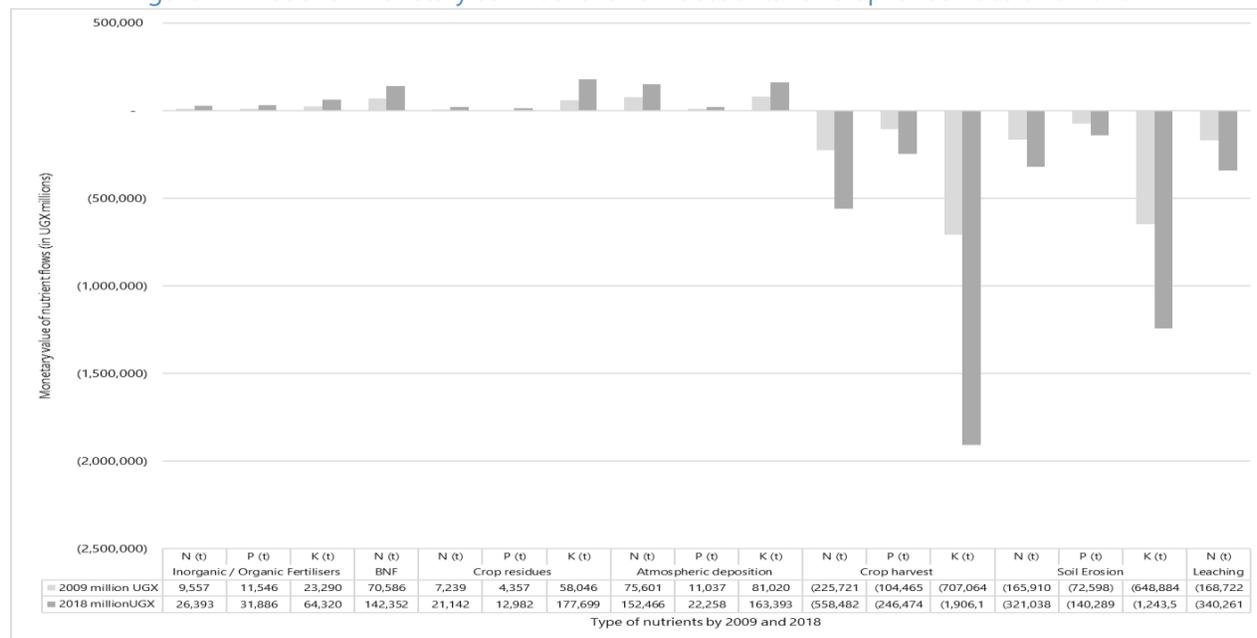
The Mukono zone was the most planted zone in 2018, and therefore had the highest external nutrient requirement to reduce the gap of nutrient outflows in the country.

4.3 Monetary soil nutrient flow accounts

4.3.1 National nutrient flow balance accounts for cropland

The monetary value of the net nutrient outflows also provides the monetary value of soil nutrient depletion in the croplands in the country. The aggregate monetary value of soil nutrient inflows was only UGX 352.3 billion in 2009 and UGX 814.9 billion in 2018, while the aggregate monetary values of outflows were UGX 2.1 trillion in 2009 and UGX 4.8 trillion in 2018. As a result, the monetary value of the net nutrient outflow increased by 2.3-times from UGX 1.7 trillion in 2009 to 3.9 trillion in 2018 (Figure 14). The monetary value of nutrient outflow was 126% higher in 2018 than it has been in 2009. The monetary value of soil nutrients was more than four-times higher than the 30% increase in the average physical quantity of the soil nutrient outflow (section 4.2.1).

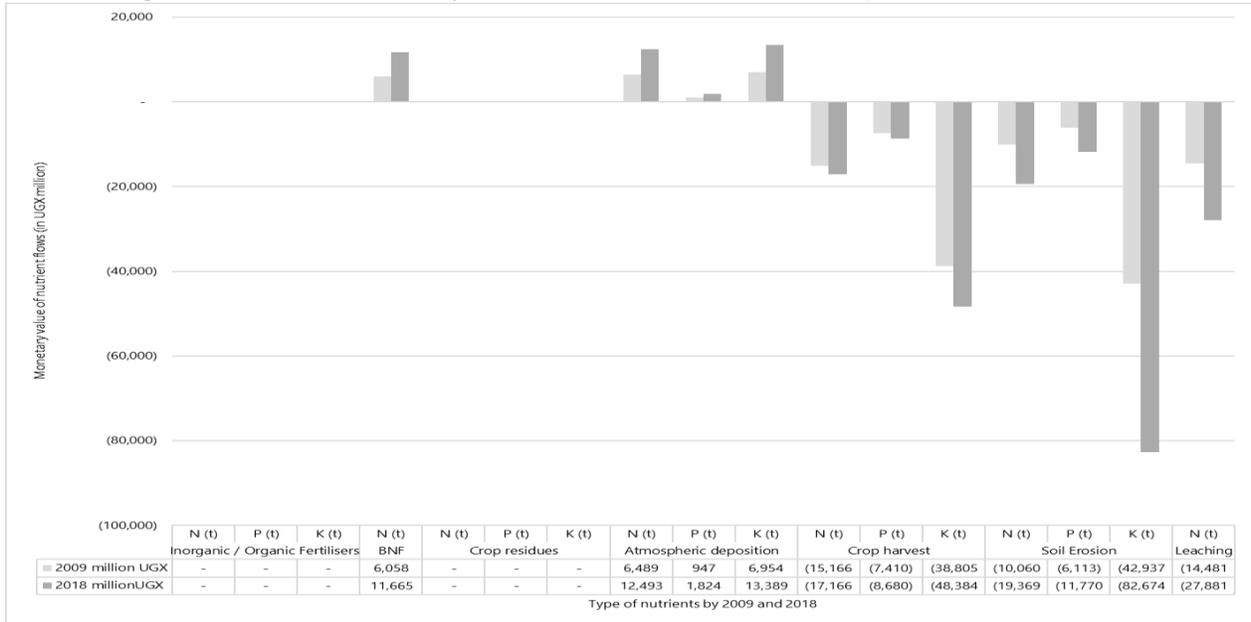
Figure 14: National monetary soil nutrient flow accounts for crop lands 2009 and 2018



4.3.2 Abi zone nutrient flow balance accounts for cropland

In the Abi zone the monetary value of soil nutrient depletion increased by 51% between 2009 and 2018 from UGX 114.5 billion to UGX 176.6 billion, respectively. The monetary value of soil nutrient inflows of UGX 20.4 billion in 2009 and UGX 39.4 billion in 2018 were outweighed by the outflows of UGX 135.0 billion in 2009 and UGX 215 billion in 2018 (Figure 15). Whereas the physical quantity of nutrient outflow was on average 12% less in 2018 than in 2009, the monetary value of soil nutrients 51% higher in 2018 than in 2009 (section 4.2.2).

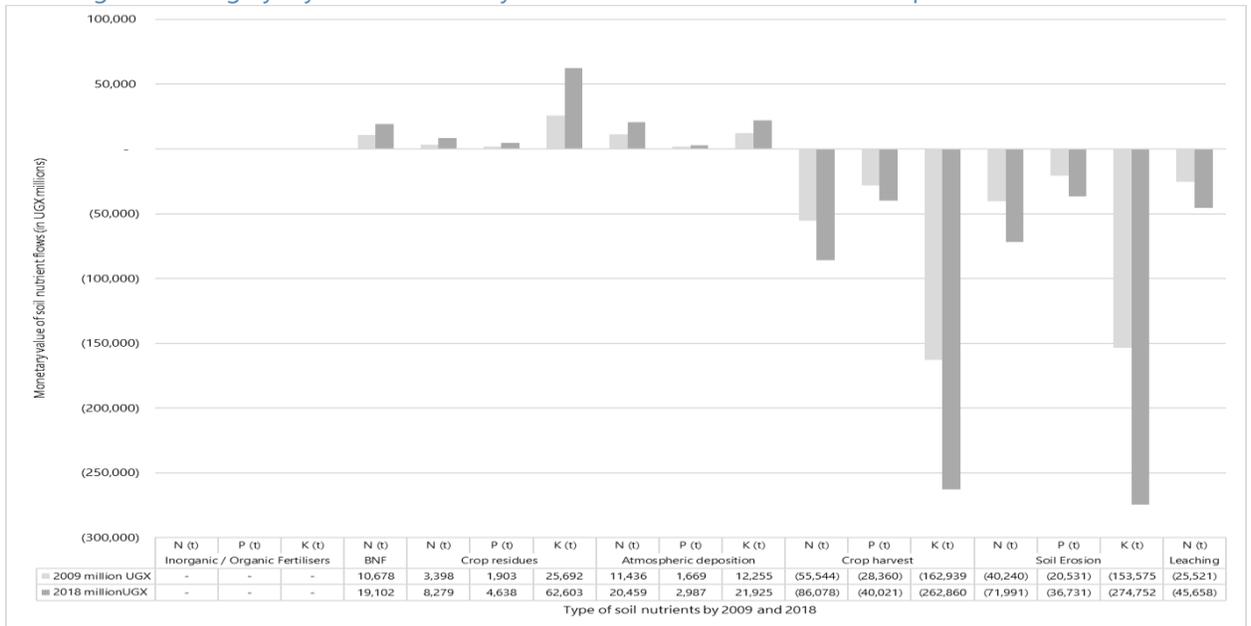
Figure 15: Abi zone monetary soil nutrient flow accounts for crop lands 2009 and 2018



4.3.3 Buginyanya zone nutrient flow balance accounts for cropland

The monetary value of soil nutrient depletion i.e., the net nutrient outflow (net balance) in the Buginyanya zone increased by 59% between 2009 and 2018 from UGX 419.7 billion to UGX 678.1 billion, respectively. The monetary value of soil nutrient inflows of UGX 67.0 billion in 2009 and UGX 140.0 billion in 2018 were outweighed by the outflows of UGX 486.7 billion in 2009 and UGX 818.1 billion in 2018 (Figure 16). Whereas the physical quantity of nutrient outflow was on average 7% less in 2018 than in 2009, the monetary value of soil nutrients 59% higher in 2018 than in 2009 (*section 4.2.3*).

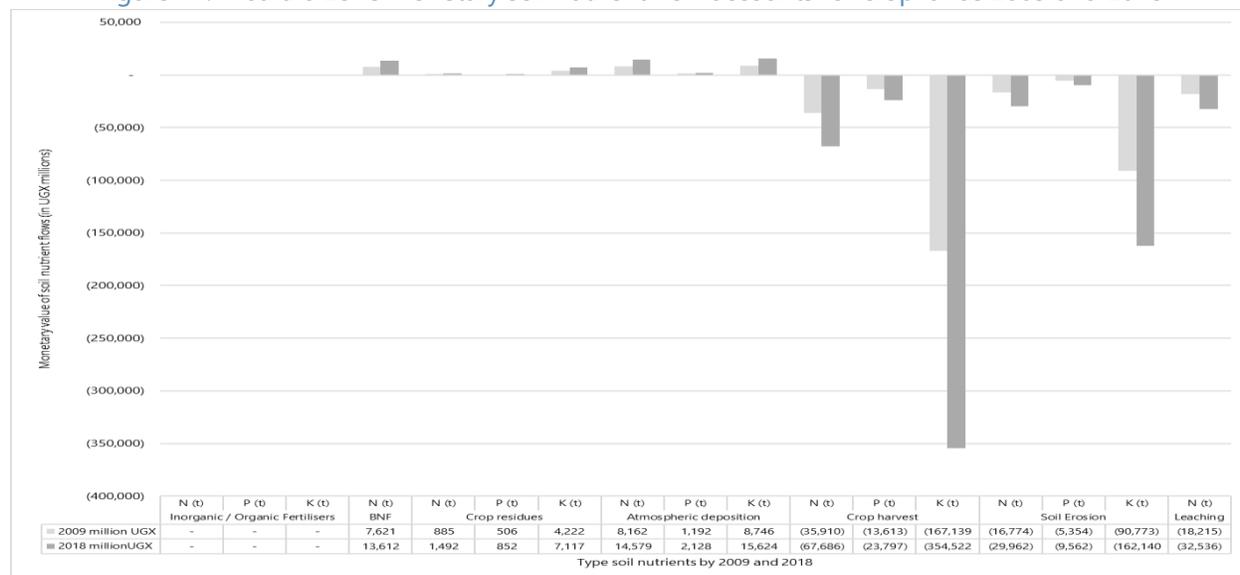
Figure 16: Buginyanya zone monetary soil nutrient flow accounts for crop lands 2009 and 2018



4.3.4 Mbarara zone nutrient flow balance accounts for cropland

Whereas the physical quantity of nutrient outflow increased by 9% between 2009 and 2018 (*section 4.2.43*), the monetary value of soil nutrient depletion i.e., the net nutrient outflow in the Mbarara zone increased by 88% between 2009 and 2018 from UGX 316.4 billion to UGX 624.8 billion, respectively. The monetary value of soil nutrient inflows of UGX 31.3 billion in 2009 and UGX 55.4 billion in 2018 were outweighed by the outflows of UGX 347.8 billion in 2009 and UGX 680.2 billion in 2018 (Figure 17).

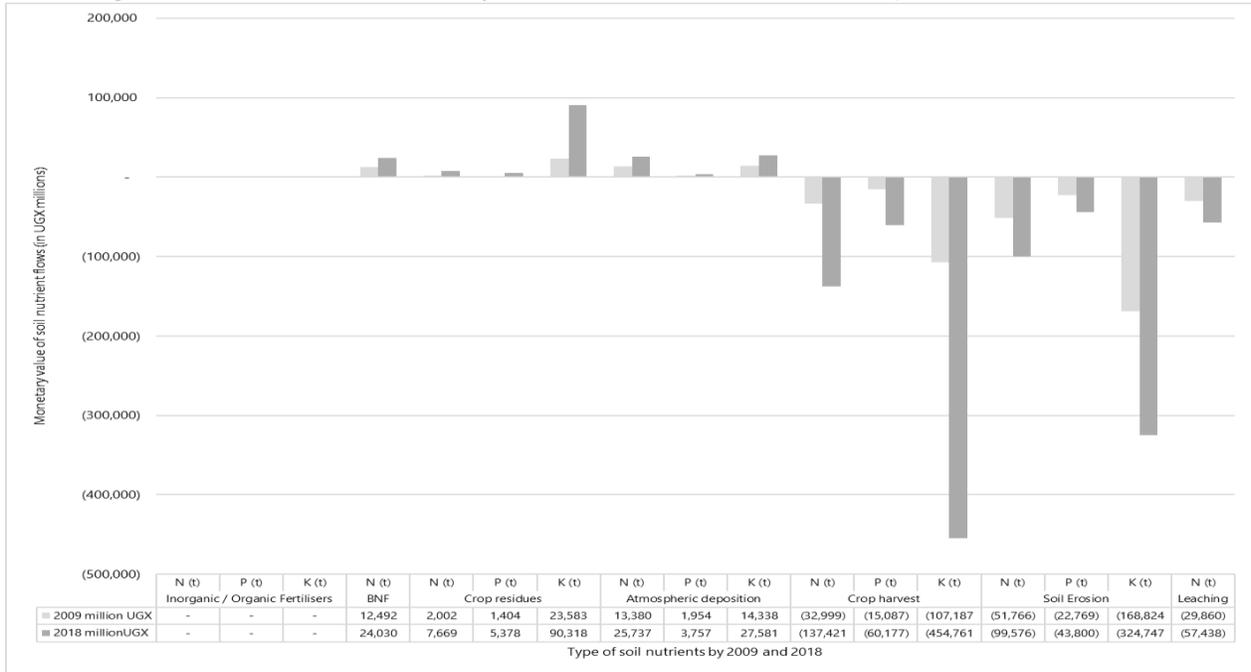
Figure 17: Mbarara zone monetary soil nutrient flow accounts for crop lands 2009 and 2018



4.3.5 Mukono zone nutrient flow balance accounts for cropland

Whereas the physical quantity of nutrient outflow increased by 61% between 2009 and 2018 (*section 4.2.43*), the monetary value of soil nutrient depletion, i.e., the net nutrient outflow, in the Mukono zone increased by 175% between 2009 and 2018 from UGX 359.3 billion to UGX 993.4 billion, respectively. The monetary value of soil nutrient inflows of UGX 69.2 billion in 2009 and UGX 184.5 billion in 2018 were outweighed by the outflows of UGX 428.5 billion in 2009 and UGX 1.2 trillion in 2018 (Figure 18).

Figure 18: Mukono zone monetary soil nutrient flow accounts for crop lands 2009 and 2018



5. THEMATIC CARBON ACCOUNTS

5.1 Introduction to thematic carbon accounts

Ecosystem accounting provides an important tool to understand the key role that ecosystems play in greenhouse gas (GHG) cycling on global, national and regional scales. This functional role of ecosystems is also well-aligned to concepts of land degradation, where land degradation is defined as a long-term decline in ecosystem function. Trends in Biomass Accumulation and Net Primary Productivity (NPP), often with trends in Soil Organic Carbon (SOC) stocks, are used as indicators for Land degradation (Richmond et al. 2007; FAO 2017), including in the context of SDG 15.3.1. Proportion of Land that is Degraded. They are also key indicators related to the carbon cycle.

NPP is the net amount of carbon assimilated after photosynthesis and autotrophic respiration over a given period of time (Clarke et al. 2001). NPP measures land productivity, which is defined as the energy fixed by plants minus their respiration which translates into the rate of biomass accumulation that delivers a suite of ecosystem services. NPP points to changes in the health and productive capacity of the land and reflects the net effects of changes in ecosystem functioning on plant and biomass growth, where declining trends are often a defining characteristic of land degradation (Sims et al. 2017 and Ivanov et al. 2011). Net biomass accumulation in ecosystems is the difference in NPP and the human appropriation of biomass related provisioning ecosystem services (including crop, timber and fuel wood harvesting).

On the other hand, SOC is an indicator of overall soil quality associated with nutrient cycling and its aggregate stability and structure with direct implications for water infiltration, soil biodiversity, vulnerability to erosion, and ultimately the productivity of vegetation, and in agricultural contexts, yields. SOC stocks reflect the balance between organic matter gains, dependent on plant productivity and management practices, and losses due to decomposition through the action of soil organisms and physical export through leaching and erosion (Sims et al. 2017). Together, the NPP and SOC are the indicators for the land degradation condition.

The thematic carbon accounts proposed to support thematic ecosystem accounting in the SEEA EA provide a useful structure to organize information relevant to these two land degradation indicators and integrate with other information from the wider set of ecosystem accounts developed for Uganda. This section presents two sets of thematic accounts, those pertaining to biomass carbon and those related to SOC. Both accounts are compiled at the national scale. The accounts do not attempt to provide a full articulation of carbon stocks and flows. Rather, they describe flows in to, and out of, the biomass carbon and soil organic carbon pools.

5.2 Net Biomass Accumulation and Soil Organic Carbon Flows

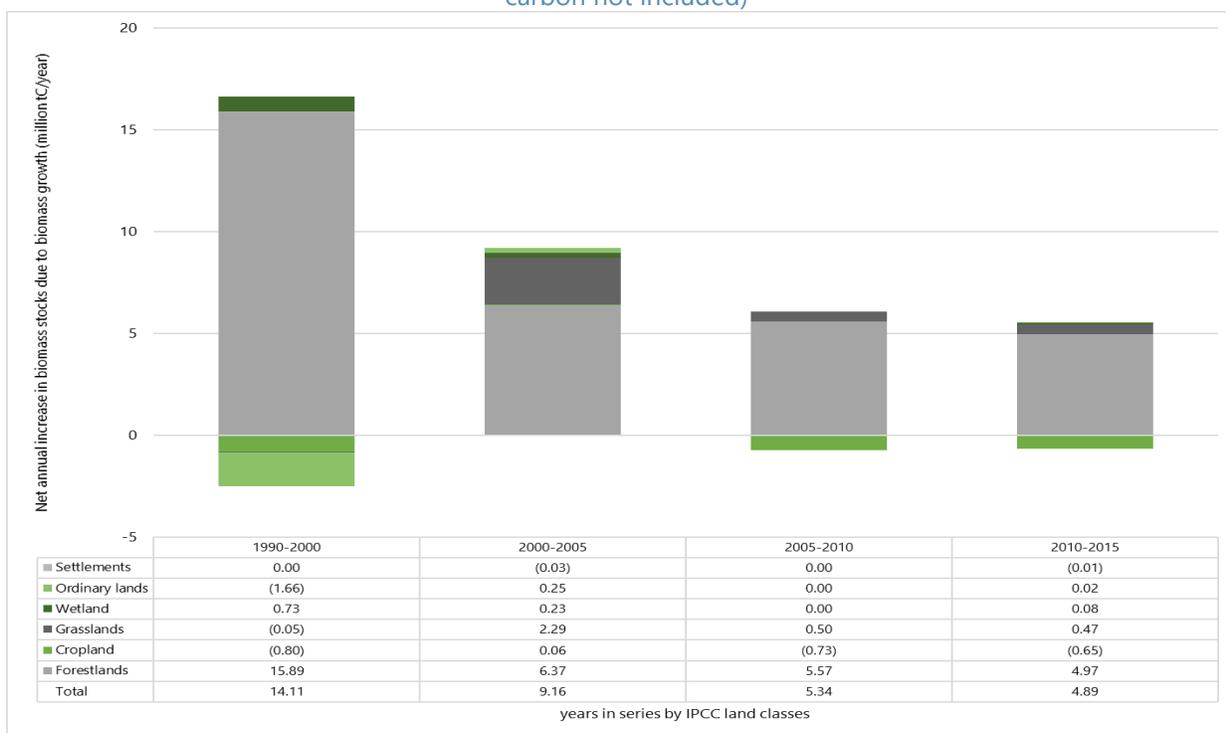
5.2.1 Physical net biomass accumulation

The physical NPP was derived from the biomass carbon flows. The NPP is the net amount of carbon assimilated after photosynthesis and autotrophic respiration over a period of time (Clark et al. 2001). It is often calculated on the basis of the net carbon storage increment over a year (i.e., annual NPP). It can be conceived of as the annual increase in carbon due to biomass growth, minus the loss of and the net change to biomass carbon held in the dead wood / litter. From the balance, important biomass related ecosystem

services can be obtained (e.g., crop harvesting, firewood collection, etc.). This is sometimes referred to as Human Appropriated NPP. The thematic biomass carbon accounts presenting these flows is provided in Table 10. It is noted that flows due to changes in soil organic carbon stocks are excluded from Table 10, these are discussed in the next subsection. The flows accounted for are all based on established IPCC guidelines (2006) and emissions factors associated with different land cover types and land cover flows over accounting periods. The areas of different land cover and associated flows are recovered from the ecosystem extent accounts presented in Section 3.

The results presented in Table 11 are summarized in Figure 19. They show the net accumulation of carbon assimilated in forests, croplands, grasslands, wetlands, ordinary lands, which generally comprises bushlands but also includes impediments, and settlements. The above ground biomass flows were associated with inflows from growth of biomass counteracted by outflows due to biomass removals and fuelwood removal, among others. The growth in biomass whereas positive for forest lands, grasslands and wetlands was negative for croplands and ordinary lands (dominated by bushlands). Negative net growth of biomass was associated with the replacement of vegetation with a higher biomass density such as trees and/or permanent crops and grasses by vegetation with a lower biomass density such as annual crops.

Figure 19: Trends of annual net biomass accumulation between 2000 and 2015 (mtC yr⁻¹) (soil organic carbon not included)



The aggregate national annual accumulation of biomass carbon decreased by 64% from 14 million tons of carbon per year (mtC yr⁻¹) between 1990-2000 to 5 mtC yr⁻¹ between 2010-2015. The highest accumulation was recorded in forest lands; however, the net biomass accumulation in forestlands decreased by 69% between 1990-2000 from 16 mtC yr⁻¹ between 2000 to 5 mtC yr⁻¹ between 2010 to 2015. Wetlands were the only other land cover system that showed a net carbon accumulation of 730,000 tC yr⁻¹ between 1990-2000, which reduced by 89% to 80,000 tC yr⁻¹ between 2010-2015. Ordinary lands had the highest net reduction in biomass carbon stock of 1.7 mtC yr⁻¹ between 1990-2000 but between 2010 and 2015, a net

accumulation of 20,000 tC yr⁻¹ was realized. For croplands the net reduction in carbon stock of 800,000 tC yr⁻¹ reduced by 19% to 65,000 tC yr⁻¹ while grasslands, which has a net carbon stock reduction of 50,000 tC yr⁻¹ between 1990 and 2000 were able to accumulate a peak of 2.3 mtC yr⁻¹ between 2000 and 2005, and 470,000 tC yr⁻¹ between 2010 and 2015. The settlements showed a net reduction in carbon stock ranging between 10,000 and 30,000 tC yr⁻¹ between 2000-2005 and 2010-2015.

Between 1990-2000, the NPP was high because of the large forest area, which was able to reduce the impact of the loss in net biomass that occurred in bushlands, croplands and grasslands. As the forestland declined, so did the NPP as the biomass accumulation in the other land cover systems was quite low relative to forests. Between 2010-2015, the net accumulation in biomass carbon was just over one-third of the accumulation between 1990-2010.

Table 11: Annual biomass carbon flows, ANPP by land cover class, 1990-2000 and 2010-2015 (mtC yr⁻¹)

Biomass flow accounts (Soil Organic Carbon Excluded)	Forest-lands	Crop-land	Grass-lands	Wets-land	Settle-ments	Ordinary lands	Total
1990-2000							
Annual increase in carbon stocks due to biomass growth (mtC yr ⁻¹)	20.74	(0.32)	0.04	0.73	0.00	(1.66)	19.54
Annual carbon loss due to biomass removals (mtC yr ⁻¹)	(1.62)	(0.25)	-	-	-	-	(1.87)
Annual carbon loss due to fuelwood removal (mtC yr ⁻¹)	(3.24)	-	-	-	-	-	(3.24)
Annual change in carbon stocks in dead wood/litter (mtC yr ⁻¹)	(0.00)	(0.24)	(0.09)	-	0.00	-	(0.33)
Annual net biomass accumulation (mtC yr ⁻¹)	15.89	(0.80)	(0.05)	0.73	0.00	(1.66)	14.11
2000-2005							
Annual increase in carbon stocks due to biomass growth (mtC yr ⁻¹)	8.32	0.20	2.92	0.23	(0.03)	0.25	11.89
Annual carbon loss due to biomass removals (mtC yr ⁻¹)	(0.65)	(0.08)	-	-	-	-	(0.73)
Annual carbon loss due to fuelwood removal (mtC yr ⁻¹)	(1.30)	-	-	-	-	-	(1.30)
Annual change in carbon stocks in dead wood/litter (mtC yr ⁻¹)	(0.00)	(0.06)	(0.64)	-	0.00	-	(0.70)
Annual net biomass accumulation (mtC yr ⁻¹)	6.37	0.06	2.29	0.23	(0.03)	0.25	9.16
2005-2010							
Annual increase in carbon stocks due to biomass growth (mtC yr ⁻¹)	7.27	(0.32)	2.12				9.06
Annual carbon loss due to biomass removals (mtC yr ⁻¹)	(0.57)	(0.11)	-				(0.68)
Annual carbon loss due to fuelwood removal (mtC yr ⁻¹)	(1.14)	-	-				(1.14)
Annual change in carbon stocks in dead wood/litter (mtC yr ⁻¹)	(0.00)	(0.30)	(1.61)				(1.91)
Annual net biomass accumulation (mtC yr ⁻¹)	5.57	(0.73)	0.50				5.34
2010-2015							
Annual increase in biomass carbon stocks growth (mtC yr ⁻¹)	6.48	(0.25)	0.76	0.08	(0.01)	0.02	7.09
Annual carbon loss due to biomass removals (mtC yr ⁻¹)	(0.51)	(0.20)	-	-	-	-	(0.71)
Annual carbon loss due to fuelwood removal (mtC yr ⁻¹)	(1.02)	-	-	-	-	-	(1.02)
Annual change in carbon stocks in dead wood/litter (mtC yr ⁻¹)	(0.00)	(0.20)	(0.28)	-	(0.00)	-	(0.48)
Annual net biomass accumulation (mtC yr ⁻¹)	4.97	(0.65)	0.47	0.08	(0.01)	0.02	4.89

From the Table 10, and based on the IPCC land cover classes, and estimation of biomass carbon flows based on the IPCC Guidelines for National Inventories for Greenhouse gases, the land area of Uganda between 2010 and 2015 realised 64% less net biomass carbon accumulation than between 1990 and 2000 due to the land-cover changes in the country. This has implication with respect to the capacity of Uganda's landscape to supply climate regulating services linked to climate change mitigation (i.e., carbon sequestration and storage). Further, as Table 10 shows, aggregate biomass and fuelwood removals decreased from 5.11 mtC

yr⁻¹ to 1.73 mtC yr⁻¹ over this period. This suggests a similar decrease in the supply of biomass provisioning ecosystem services (in terms of total mass of biomass supplied) due to the changing land use configuration (i.e., with respect to timber, fuelwood, non-timber forest products, etc.).

5.2.2 Physical Soil Organic Carbon Flows

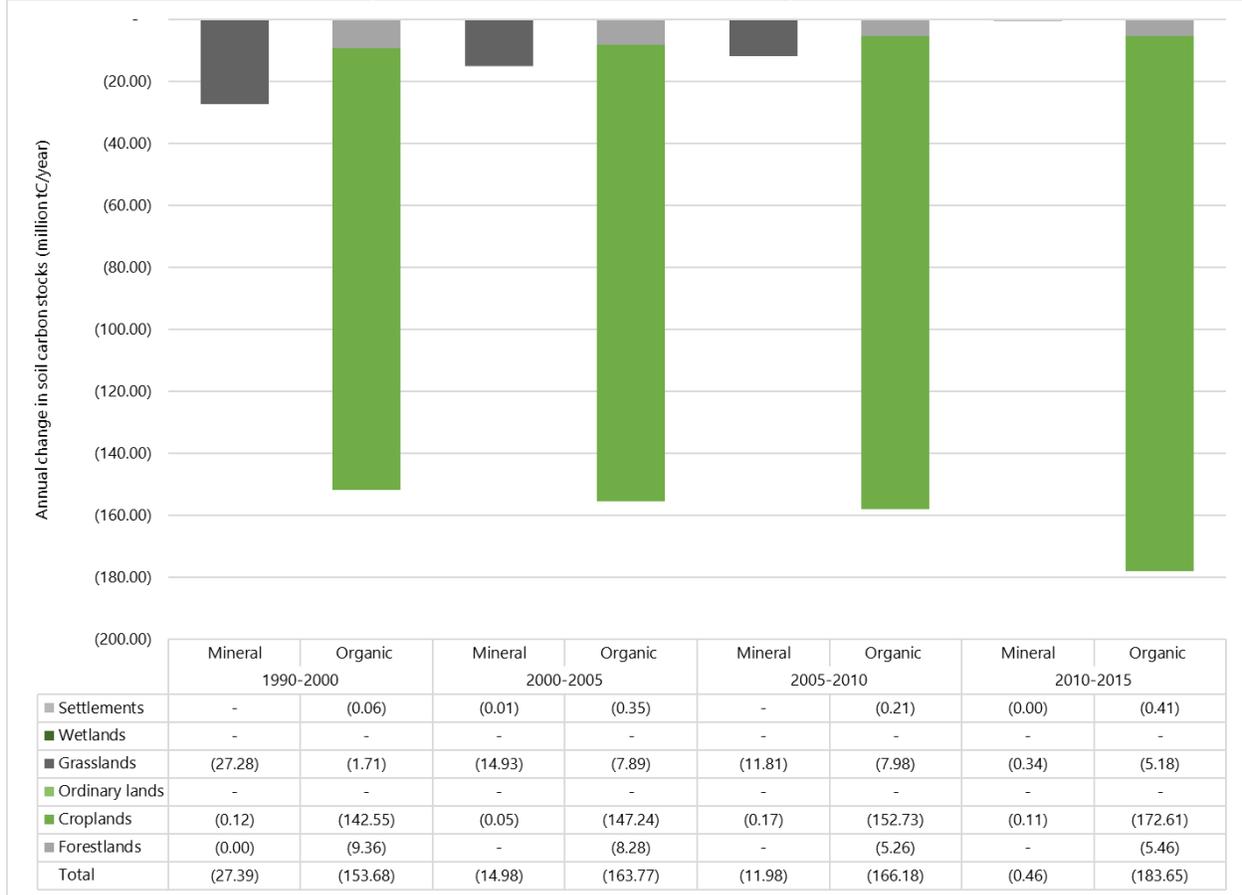
Soil organic carbon (SOC) refers only to the carbon component of organic compounds in soils. The amount of SOC stored in a given soil is dependent on the equilibrium between the amount of carbon (C) entering the soil and the amount of C leaving the soil, determined by microbial mineralization and leaching from the soil as Dissolved Organic Carbon (DOC) (FAO 2017). Locally, C can also be lost or gained through soil erosion or deposition, leading to the redistribution of soil C at local, landscape and regional scales. Levels of SOC storage are therefore mainly controlled by managing the amount and type of organic residues that enter the soil (i.e., the input of organic C to the soil system) and minimizing the soil C losses (FAO and ITPS, 2015).

Table 11 provides an aggregate account of soil organic carbon flows, i.e., net loss of SOC, summarized in Figure 20. These flows have been calculated based on default IPCC emission factors for organic and mineral soils for each IPCC land cover class and associated land cover flows. As such, they give an insight into different land use decisions potentially impact on SOC stocks, a key indicator of soil quality. Understanding the level of SOC loss is important for revealing the magnitude of potential soil degradation issues and the importance of proper soil management. This especially the case for sustainable food production systems.

As Figure 20 shows, Soil organic carbon flow estimates from 1990-2000 to 2010-2015 reveal an increase in net loss of SOC per year in Uganda. Net loss in organic soil SOC increased by 20% from 154 mtC yr⁻¹ between 1990-2000 to 184 mtC yr⁻¹ between 2010-2015 (Figure 20 and Table 12). The highest annual net loss in organic SOC was in croplands, and it increased by 10% from 143 mtC yr⁻¹ between 1990-2000 to 173 mtC yr⁻¹ between 2010-2015. The proportion of the overall net losses in organic SOC from croplands was 93% in 1990-2000, while that for forest lands was 6%, and there were small net losses from grasslands and settlements. Between 2010-2015, croplands contributed 92% of the increase in the net organic SOC loss, while grasslands contributed 5%, and forest lands 3%.

In contrast to organic SOC, mineral SOC loss decreased by 98% from 27 mtC yr⁻¹ to 460,000 tC yr⁻¹ between 1990-2000 and 2010-2015. The loss in mineral SOC was largest in grasslands, with very little contributions from croplands and forest lands. The mineral SOC reduction was almost entirely attributable to changes in the grassland cover. There were large transitions from grasslands to bushlands that occurred between 1990-2010, these were likely to drive the reductions in annual mineral soil SOC losses observed in Figure 20. Between 2000-2005 and 2010-2015, the grassland cover was gradually restored to its 1990 cover, this may explain the annual SOC loss in mineral soils tending to zero in Figure 20 over time.

Figure 20: Trends of annual SOC loss between 1990-2000 and 2010-2015 based on land cover configuration (mtC yr-1) (Brackets are negative values)



The IPCC National Inventory for GHGs used in estimating the carbon pools attributes most the organic SOC accumulation to crop residues in croplands. As expected, because of the increase 24% in cropland cover between 1990 and 2015 (UBOS 2019), the net organic soil SOC losses are very high in croplands due to the relatively high carbon emission factors from soil associated with conversion of natural ecosystems to crop production. This reveals how changing patterns of land use for agriculture may, potentially, lead to degradation of organic soils due to SOC losses and reduced soil quality in croplands if not properly managed. The conversion of grasslands into bushlands resulted into mineral soil SOC loss activity, but only small mineral soil SOC flows were observed elsewhere.

Table 12: Annual soil organic carbon flows by land cover classes between 1990 to 2000 and 2010 to 2015 (mtC yr⁻¹) (Brackets are negative values)

Flow of SOC	Forestlands	Croplands	Grasslands	Wetlands	Settlements	Ordinary lands	Total
1990-2000							
Mineral SOC mtC yr ⁻¹)	(0.00)	(0.12)	(27.28)	-	-	-	(27.39)
Organic SOC mtC yr ⁻¹)	(9.36)	(142.55)	(1.71)	-	(0.06)	-	(153.68)
Total SOC mtC yr ⁻¹)	(9.36)	(142.67)	(28.99)	-	(0.06)	-	(181.08)
2000-2005							
Mineral SOC mtC yr ⁻¹)	-	(0.05)	(14.93)	-	(0.01)	-	(14.98)
Organic SOC mtC yr ⁻¹)	(8.28)	(147.24)	(7.89)	-	(0.35)	-	(163.77)
Total SOC mtC yr ⁻¹)	(8.28)	(147.29)	(22.82)	-	(0.36)	-	(178.75)
2005-2010							
Mineral SOC mtC yr ⁻¹)	-	(0.17)	(11.81)	-	-	-	(11.98)
Organic SOC mtC yr ⁻¹)	(5.26)	(152.73)	(7.98)	-	(0.21)	-	(166.18)
Total SOC mtC yr ⁻¹)	(5.26)	(152.90)	(19.79)	-	(0.22)	-	(178.17)
2010-2015							
Mineral SOC mtC yr ⁻¹)	-	(0.11)	(0.34)	-	(0.00)	-	(0.46)
Organic SOC mtC yr ⁻¹)	(5.46)	(172.61)	(5.18)	-	(0.41)	-	(183.65)
Total SOC mtC yr ⁻¹)	(5.45)	(172.72)	(5.52)	-	(0.41)	-	(184.11)

6. SUPPLY AND USE ACCOUNTS

6.1 Physical supply and use tables

The Physical Supply and Use Tables (PSUT) for the Food Provisioning Ecosystem Service (e.g., Table 13) shows the physical supply of crop and livestock outputs into the economy. These data are obtained from the Annual Agricultural Surveys for 2009 and 2018. The economic units are subdivided into government, business and households. However, at this stage it has not been possible to disaggregate the 'use' of this ecosystem service by these different economic units. Basically, it is not possible to identify which economic units using the ecosystem service are final or intermediate consumers. Out of the six ecosystems used in the account (forestlands, croplands, grasslands, wetlands, ordinary lands and settlements), only two, croplands and grasslands, were considered.

The Physical Supply and Use Tables (PSUT) for SNA Goods and Services (e.g., Table 14) identify the consumers of the crops and livestock that are produced. These are either households (for own consumption or from sales) or businesses using crop or livestock as an input into food processing activities. For the purposes of compiling the PSUTs for SNA Goods and Services, it is assumed all coffee is used by businesses for processing and onward sale / export.

6.1.1 National PSUTs

The national PSUTs (Tables 13a to 14b) show that a general increase in output was realized for seven out of 12 crops which were compared between 2009 and 2018, and increased output for goats and sheep. Output for maize, rice, groundnuts, soybean, bananas, cassava and Irish potato increased by 46%, 5%, 4%, 399%, 51%, 52% and 112%, respectively between 2009 and 2018. On the other hand, the output for finger millet, sorghum, beans, sim-sim, and sweet potatoes decreased by 49%, 27%, 22% 53% and 18% respectively, over the same period. The output for cattle reduced by 6% while that for goats and sheep increased by 7% and 394% respectively.

Table 13a: National PSUT Economic Units and Ecosystem types, 2009

	Economic Unit				Ecosystem types		
	Gov.	Business	Households	Total	Cropland	Grassland	Total
Physical Supply Food Provisioning Ecosystem Services (Tonnes, 2009)							
Maize					2,361,954	-	2,361,954
Finger millet					276,935	-	276,935
Sorghum					367,030	-	367,030
Rice					190,738	-	190,738
Beans					929,274	-	929,274
Field peas					16,454	-	16,454
Cowpeas					11,056	-	11,056
Pigeon peas					11,331	-	11,331
G.nuts					243,489	-	243,489
Sim					95,567	-	95,567
Soybean					21,565	-	21,565
All bananas					4,297,349	-	4,297,349
Cassava					2,894,309	-	2,894,309
Sweet potatoes					1,818,773	-	1,818,773
Irish potato					154,437	-	154,437
Cattle					-	1,848,219	1,848,219
Goats					-	2,440,133	2,440,133
Sheep					-	57,685	57,685
Physical Use Food Provisioning Ecosystem Services (Tonnes, 2009)							
Maize	-	-	-	2,361,954			
Finger millet	-	-	-	276,935			
Sorghum	-	-	-	367,030			
Rice	-	-	-	190,738			
Beans	-	-	-	929,274			
Field peas	-	-	-	16,454			
Cowpeas	-	-	-	11,056			
Pigeon peas	-	-	-	11,331			
G. Nuts	-	-	-	243,489			
Sim	-	-	-	95,567			
Soybean	-	-	-	21,565			
All bananas	-	-	-	4,297,349			
Cassava	-	-	-	2,894,309			
Sweet potatoes	-	-	-	1,818,773			
Irish potato	-	-	-	154,437			
Cattle	-	-	-	1,848,219			
Goats	-	-	-	2,440,133			
Sheep	-	-	-	57,685			

Table 13b: National PSUT Economic Units and Ecosystem types, 2018

	Economic Unit				Ecosystem types		
	Gov.	Business	Households	Total	Cropland	Grassland	Total
Physical Supply Food Provisioning Ecosystem Services (Tonnes, 2018)							
Maize					3,442,432	-	3,442,432
finger millet					141,981	-	141,981
sorghum					268,495	-	268,495
Rice					199,266	-	199,266
Beans					727,652	-	727,652
Field peas					-	-	-
cowpeas					-	-	-
pigeon peas					-	-	-
G.nuts					253,277	-	253,277
Sim					44,530	-	44,530
Soybean					107,623	-	107,623
All bananas					6,494,056	-	6,494,056
Cassava					4,390,234	-	4,390,234
Sweet potatoes					1,484,161	-	1,484,161
Irish potato					327,333	-	327,333
Coffee					307,539	-	307,539
Cattle					-	1,962,232	1,962,232
Goats					-	3,051,801	3,051,801
Sheep					-	743,107	743,107
Physical Use Food Provisioning Ecosystem Services (Tonnes, 2018)							
Maize	-	-	-	3,442,432			
Finger millet	-	-	-	141,981			
Sorghum	-	-	-	268,495			
Rice	-	-	-	199,266			
Beans	-	-	-	727,652			
Field peas	-	-	-	-			
Cowpeas	-	-	-	-			
Pigeon peas	-	-	-	-			
G.nuts	-	-	-	253,277			
Sim	-	-	-	44,530			
Soybean	-	-	-	107,623			
All bananas	-	-	-	6,494,056			
Cassava	-	-	-	4,390,234			
Sweet potatoes	-	-	-	1,484,161			
Irish potato	-	-	-	327,333			
Coffee	-	-	-	307,539			
Cattle	-	-	-	1,962,232			
Goats	-	-	-	3,051,801			
Sheep	-	-	-	743,107			

Table 14a: National PSUT producers and consumers 2009

	Producer				Consumer					
	Gov.	Business	H.holds	Total	Govt.	H.hold	Business	Change in Inventory	Export	Total
Physical Supply SNA Goods and Services (Tonnes, 2009)										
Maize	-	-	-	2,361,954						
Finger millet	-	-	-	276,935						
Sorghum	-	-	-	367,030						
Rice	-	-	-	190,738						
Beans	-	-	-	929,274						
Field peas	-	-	-	16,454						
Cowpeas	-	-	-	11,056						
Pigeon peas	-	-	-	11,331						
G.nuts	-	-	-	243,489						
Sim sim	-	-	-	95,567						
Soybean	-	-	-	21,565						
All bananas	-	-	-	4,297,349						
Cassava	-	-	-	2,894,309						
Sweet potatoes	-	-	-	1,818,773						
Irish potato	-	-	-	154,437						
Cattle	-	-	-	1,848,219						
Goats	-	-	-	2,440,133						
Sheep	-	-	-	57,685						
Physical Use SNA Goods and Services (Tonnes, 2009)										
Maize					-	699,287	1,662,667	-	-	2,361,954
Finger millet					-	210,276	66,659	-	-	276,935
Sorghum					-	353,445	13,585	-	-	367,030
Rice					-	10,290	180,448	-	-	190,738
Beans					-	738,696	190,578	-	-	929,274
Field peas					-	16,454	-	-	-	16,454
Cowpeas					-	11,056	-	-	-	11,056
Pigeon peas					-	11,331	-	-	-	11,331
G.nuts					-	149,112	94,377	-	-	243,489
Sim sim					-	94,100	1,467	-	-	95,567
Soybean					-	21,565	-	-	-	21,565
All bananas					-	4,002,036	295,313	-	-	4,297,349
Cassava					-	2,659,586	234,723	-	-	2,894,309
Sweet potatoes					-	1,624,750	194,023	-	-	1,818,773
Irish potato					-	100,631	53,806	-	-	154,437
Cattle					-	1,681,879	166,340	-	-	1,848,219
Goats					-	2,415,732	24,401	-	-	2,440,133
Sheep					-	57,108	577	-	-	57,685

Table 14b: National PSUT producers and consumers 2018

	Producer				Consumer					
	Gov.	Business	H.holds	Total	Govt.	H.hold	Business	Change in Inventory	Export	Total
Physical Supply SNA Goods and Services (Tonnes, 2018)										
Maize	-	-	-	3,442,432						
Finger millet	-	-	-	141,981						
Sorghum	-	-	-	268,495						
Rice	-	-	-	199,266						
Beans	-	-	-	727,652						
Field peas	-	-	-	-						
Cowpeas	-	-	-	-						
Pigeon peas	-	-	-	-						
G.nuts	-	-	-	253,277						
Sim sim	-	-	-	44,530						
Soybean	-	-	-	107,623						
All bananas	-	-	-	6,494,056						
Cassava	-	-	-	4,390,234						
Sweet potatoes	-	-	-	1,484,161						
Irish potato	-	-	-	327,333						
Coffee	-	-	-	307,539						
Cattle	-	-	-	1,962,232						
Goats	-	-	-	3,051,801						
Sheep	-	-	-	743,107						
Physical Use SNA Goods and Services (Tonnes, 2018)										
Maize					-	1,019,177	2,423,255	-	-	3,442,432
Finger millet					-	107,806	34,175	-	-	141,981
Sorghum					-	258,557	9,938	-	-	268,495
Rice					-	10,750	188,516	-	-	199,266
Beans					-	578,423	149,229	-	-	727,652
Field peas					-	-	-	-	-	-
Cowpeas					-	-	-	-	-	-
Pigeon peas					-	-	-	-	-	-
G.nuts					-	155,106	98,171	-	-	253,277
Sim sim					-	43,846	684	-	-	44,530
Soybean					-	107,623	-	-	-	107,623
All bananas					-	6,047,786	446,270	-	-	6,494,056
Cassava					-	4,034,195	356,039	-	-	4,390,234
Sweet potatoes					-	1,325,834	158,327	-	-	1,484,161
Irish potato					-	213,290	114,043	-	-	327,333
Coffee					-	-	307,539	-	-	307,539
Cattle					-	1,785,631	176,601	-	-	1,962,232
Goats					-	3,021,283	30,518	-	-	3,051,801
Sheep					-	735,676	7,431	-	-	743,107

6.1.2 Physical Supply and Use Tables for Abi Zone

The PSUT Table 16 flows from Table 15, and it shows production and consumption flows for the crops and livestock outputs produced within the Abi zone economy. With the exception of soybean, cassava and Irish potatoes, crop output in the Abi zone declined between 2009 and 2018. The largest decline was for beans where output reduced by 78% from 40,698t to 9,002t. The output of sorghum reduced by 72% while that for maize and finger millet reduced by 41%. The increase in crop output was 33% for soybean from 500t to 665t, 10% for cassava from 514,556t to 567,981t, and 379% for Irish potatoes from 1,258t to 6,029t from 2009 to 2018. Livestock production showed a 5% reduction in cattle from 134,411 heads to 126,377. Goats increased by 7% from 332,325 to 354,156 while sheep increased by 394% from 6,894 to 34,032.

Table 15a: Abi zone PSUT Economic Units and Ecosystem types 2009

	Economic Units				Ecosystem types		
	Gov.	Businesses	Households	Total	Cropland	Grassland	Total
Physical Supply Food Provisioning Ecosystem Services (Tonnes, 2009)							
Maize					136,419	-	136,419
Finger millet					14,283	-	14,283
Sorghum					52,834	-	52,834
Rice					4,697	-	4,697
Beans					40,698	-	40,698
Field peas					2,832	-	2,832
Cowpeas					1,812	-	1,812
Pigeon peas					1,436	-	1,436
G.nuts					32,627	-	32,627
Sim sim					16,538	-	16,538
Soybean					500	-	500
All bananas					29,489	-	29,489
Cassava					514,556	-	514,556
Sweet potatoes					151,376	-	151,376
Irish potato					1,258	-	1,258
Cattle					-	134,411	134,411
Goats					-	332,325	332,325
Sheep					-	6,894	6,894
Physical Use Food Provisioning Ecosystem Services (Tonnes, 2009)							
Maize	-	-	-	136,419			
Finger millet	-	-	-	14,283			
Sorghum	-	-	-	52,834			
Rice	-	-	-	4,697			
Beans	-	-	-	40,698			
Field peas	-	-	-	2,832			
Cowpeas	-	-	-	1,812			
Pigeon peas	-	-	-	1,436			
G.nuts	-	-	-	32,627			
Sim sim	-	-	-	16,538			
Soybean	-	-	-	500			
All bananas	-	-	-	29,489			
Cassava	-	-	-	514,556			
Sweet potatoes	-	-	-	151,376			
Irish potato	-	-	-	1,258			
Cattle	-	-	-	134,411			
Goats	-	-	-	332,325			
Sheep	-	-	-	6,894			

The cassava as the main staple crop showed considerable stability and resilience to increase as the other common annual food crops reduced. One of the advantages with cassava is that traditionally it has tended to remain productive even when crop fertility is relatively low. (Fermont 2009). The increase in Irish potatoes is due to a larger ploughed area, as was the case with soybean. Soybean and Irish potatoes increased in outputs farmer invest and ploughed area expanded.

Table 15b: Abi zone PSUT Economic Units and Ecosystem types 2018

	Economic Units				Ecosystem types		
Physical Supply Food Provisioning Ecosystem Services (Tonnes, 2018)							
	Gov.	Businesses	Households	Total	Cropland	Grassland	Total
Maize					80,812	-	80,812
finger millet					8,364	-	8,364
sorghum					14,970	-	14,970
Rice					4,374	-	4,374
Beans					9,002	-	9,002
Field peas					-	-	-
cowpeas					-	-	-
pigeon peas					-	-	-
G.nuts					22,278	-	22,278
Sim sim					7,028	-	7,028
Soybean					665	-	665
All bananas					19,836	-	19,836
Cassava					567,981	-	567,981
Sweet potatoes					97,901	-	97,901
Irish potato					6,029	-	6,029
Coffee					671	-	671
Cattle					-	126,377	126,377
Goats					-	354,156	354,156
Sheep					-	34,032	34,032
Physical Use Food Provisioning Ecosystem Services (Tonnes, 2018)							
Maize	-	-	-	80,812			
finger millet	-	-	-	8,364			
sorghum	-	-	-	14,970			
Rice	-	-	-	4,374			
Beans	-	-	-	9,002			
Field peas	-	-	-	-			
cowpeas	-	-	-	-			
Pigeon peas	-	-	-	-			
G.nuts	-	-	-	22,278			
Sim sim	-	-	-	7,028			
Soybean	-	-	-	665			
All bananas	-	-	-	19,836			
Cassava	-	-	-	567,981			
Sweet potatoes	-	-	-	97,901			
Irish potato	-	-	-	6,029			
Coffee	-	-	-	671			
Cattle	-	-	-	126,377			
Goats	-	-	-	354,156			
Sheep	-	-	-	34,032			

Table 16a: Abi zone PSUT producers and consumers 2009

	Producer				Consumer					
	Gov.	Business	H.holds	Total	Govt.	Household	Business	Change in Inventory	Export	Total
Physical Supply SNA Goods and Services (Tonnes, 2009)										
Maize	-	-	-	136,419						
Finger millet	-	-	-	14,283						
Sorghum	-	-	-	52,834						
Rice	-	-	-	4,697						
Beans	-	-	-	40,698						
Field peas	-	-	-	2,832						
Cowpeas	-	-	-	1,812						
Pigeon peas	-	-	-	1,436						
G.nuts	-	-	-	32,627						
Sim sim	-	-	-	16,538						
Soybean	-	-	-	500						
All bananas	-	-	-	29,489						
Cassava	-	-	-	514,556						
Sweet potatoes	-	-	-	151,376						
Irish potato	-	-	-	1,258						
Cattle	-	-	-	134,411						
Goats	-	-	-	332,325						
Sheep	-	-	-	6,894						
Physical Use SNA Goods and Services (Tonnes, 2009)										
Maize					-	40,389	96,030	-	-	136,419
Finger millet					-	10,845	3,438	-	-	14,283
Sorghum					-	50,878	1,956	-	-	52,834
Rice					-	253	4,444	-	-	4,697
Beans					-	32,352	8,346	-	-	40,698
Field peas					-	2,832	-	-	-	2,832
Cowpeas					-	1,812	-	-	-	1,812
Pigeon peas					-	1,436	-	-	-	1,436
G.nuts					-	19,981	12,646	-	-	32,627
Sim sim					-	16,284	254	-	-	16,538
Soybean					-	500	-	-	-	500
All bananas					-	27,463	2,026	-	-	29,489
Cassava					-	472,827	41,729	-	-	514,556
Sweet potatoes					-	135,228	16,148	-	-	151,376
Irish potato					-	820	438	-	-	1,258
Cattle					-	122,314	12,097	-	-	134,411
Goats					-	329,002	3,323	-	-	332,325
Sheep					-	6,825	69	-	-	6,894

Table 16b: Abi zone PSUT producers and consumers 2018

	Producer				Consumer					
	Gov.	Business	Households	Total	Govt.	Household	Business	Change in Inventory	Export	Total
Physical Supply SNA Goods and Services (Tonnes, 2018)										
Maize	-	-	-	80,812						
finger millet	-	-	-	8,364						
Sorghum	-	-	-	14,970						
Rice	-	-	-	4,374						
Beans	-	-	-	9,002						
Field peas	-	-	-	-						
Cowpeas	-	-	-	-						
Pigeon peas	-	-	-	-						
G.nuts	-	-	-	22,278						
Sim sim	-	-	-	7,028						
Soybean	-	-	-	665						
All bananas	-	-	-	19,836						
Cassava	-	-	-	567,981						
Sweet potatoes	-	-	-	97,901						
Irish potato	-	-	-	6,029						
Coffee	-	-	-	671						
Cattle	-	-	-	126,377						
Goats	-	-	-	354,156						
Sheep	-	-	-	34,032						
Physical Use SNA Goods and Services (Tonnes, 2018)										
Maize					-	23,925	56,887	-	-	80,812
finger millet					-	6,351	2,013	-	-	8,364
Sorghum					-	14,416	554	-	-	14,970
Rice					-	236	4,138	-	-	4,374
Beans					-	7,156	1,846	-	-	9,002
Field peas					-	-	-	-	-	-
cowpeas					-	-	-	-	-	-
pigeon peas					-	-	-	-	-	-
G.nuts					-	13,643	8,635	-	-	22,278
Sim sim					-	6,920	108	-	-	7,028
Soybean					-	665	-	-	-	665
All bananas					-	18,473	1,363	-	-	19,836
Cassava					-	521,919	46,062	-	-	567,981
Sweet potatoes					-	87,457	10,444	-	-	97,901
Irish potato					-	3,928	2,101	-	-	6,029
Coffee					-	-	671	-	-	671
Cattle					-	115,003	11,374	-	-	126,377
Goats					-	350,614	3,542	-	-	354,156
Sheep					-	33,692	340	-	-	34,032

6.1.3 Physical Supply and Use Tables for Buginyanya zone

Table 17a&b reveals that in the Buginyanya zone, beans, rice, groundnuts, soybeans, and Irish potatoes improved in crop output by 14.5%, 0.5%, 18.4%, 254.6% and 816.3% respectively, while the output for maize, finger millet, sorghum, sim sim, cassava and sweet potatoes declined by 33%, 61%, 67%, 57%, 25%, and 49% respectively (Table 17a&b, 18a&b). The Buginyanya zone covers a large area of the Sebei and Bugisu

zones on the slopes of Mt. Elgon, where the increase Irish potatoes output is likely to have occurred. The Mt Elgon landscapes have cooler temperatures, high rainfall occurrence and relatively high soil fertility, despite soil erosion levels (Mugagga et al. 2011).

The Busoga and Bukedi zones, i.e., in the lower levels of the Lake Victoria Crescent, are likely to be where reduction in output for maize, sorghum, sim sim, cassava and sweet potatoes occurred. The increase in beans, groundnuts, rice and soybean output is likely to have occurred in the lower land, the increased production was likely due to expansion of land/and or increased utilization of land. The Lake Victoria Crescent has a high soil nutrient depletion rate, and the soils have been filled for a long-time, which could account for reduction in output. (World Bank 2005).

Table 17a: Buginyanya zone PSUT Economic Units and Ecosystem types 2009

	Economic Unit				Ecosystem types		
	Gov.	Businesses	Households	Total	Cropland	Grassland	Total
Physical Supply Food Provisioning Ecosystem Services (Tonnes, 2009)							
Maize					935,079	-	935,079
finger millet					65,815	-	65,815
sorghum					49,859	-	49,859
Rice					101,852	-	101,852
Beans					80,377	-	80,377
Field peas					2,192	-	2,192
cowpeas					1,585	-	1,585
pigeon peas					125	-	125
G.nuts					38,107	-	38,107
Sim sim					1,424	-	1,424
Soybean					5,523	-	5,523
All bananas					341,684	-	341,684
Cassava					791,772	-	791,772
Sweet potatoes					641,818	-	641,818
Irish potato					4,625	-	4,625
Cattle					-	247,244	247,244
Goats					-	357,481	357,481
Sheep					-	2,203	2,203
Physical Use Food Provisioning Ecosystem Services (Tonnes, 2009)							
Maize	-	-	-	935,079			
finger millet	-	-	-	65,815			
sorghum	-	-	-	49,859			
Rice	-	-	-	101,852			
Beans	-	-	-	80,377			
Field peas	-	-	-	2,192			
cowpeas	-	-	-	1,585			
pigeon peas	-	-	-	125			
G.nuts	-	-	-	38,107			
Sim sim	-	-	-	1,424			
Soybean	-	-	-	5,523			
All bananas	-	-	-	341,684			
Cassava	-	-	-	791,772			
Sweet potatoes	-	-	-	641,818			
Irish potato	-	-	-	4,625			
Cattle	-	-	-	247,244			
Goats	-	-	-	357,481			
Sheep	-	-	-	2,203			

Table 17b: Buginyanya zone PSUT Economic Units and Ecosystem types 2018

	Economic Unit				Ecosystem types		
	Gov.	Businesses	Households	Total	Cropland	Grassland	Total
Physical Supply Food Provisioning Ecosystem Services (Tonnes, 2018)							
Maize					621,380	-	621,380
finger millet					25,598	-	25,598
sorghum					16,358	-	16,358
Rice					102,317	-	102,317
Beans					92,019	-	92,019
Field peas					-	-	-
cowpeas					-	-	-
pigeon peas					-	-	-
G.nuts					45,131	-	45,131
Sim sim					615	-	615
Soybean					19,584	-	19,584
All bananas					507,379	-	507,379
Cassava					596,879	-	596,879
Sweet potatoes					324,509	-	324,509
Irish potato					42,379	-	42,379
Coffee					44,637	-	44,637
Cattle					-	225,235	225,235
Goats					-	307,311	307,311
Sheep					-	8,970	8,970
Physical Use Food Provisioning Ecosystem Services (Tonnes, 2018)							
Maize	-	-	-	621,380			
finger millet	-	-	-	25,598			
sorghum	-	-	-	16,358			
Rice	-	-	-	102,317			
Beans	-	-	-	92,019			
Field peas	-	-	-	-			
cowpeas	-	-	-	-			
pigeon peas	-	-	-	-			
G.nuts	-	-	-	45,131			
Sim sim	-	-	-	615			
Soybean	-	-	-	19,584			
All bananas	-	-	-	507,379			
Cassava	-	-	-	596,879			
Sweet potatoes	-	-	-	324,509			
Irish potato	-	-	-	42,379			
Coffee	-	-	-	44,637			
Cattle	-	-	-	225,235			
Goats	-	-	-	307,311			
Sheep	-	-	-	8,970			

Table 18a: Buginyanya zone PSUT producers and consumers 2009

	Producer				Consumer					
	Gov.	Business	Households	Total	Govt.	Household	Business	Change in Inventory	Export	Total
Physical Supply SNA Goods and Services (Tonnes, 2009)										
Maize	-	-	-	935,079						
finger millet	-	-	-	65,815						
sorghum	-	-	-	49,859						
Rice	-	-	-	101,852						
Beans	-	-	-	80,377						
Field peas	-	-	-	2,192						
cowpeas	-	-	-	1,585						
pigeon peas	-	-	-	125						
G.nuts	-	-	-	38,107						
Sim sim	-	-	-	1,424						
Soybean	-	-	-	5,523						
All bananas	-	-	-	341,684						
Cassava	-	-	-	791,772						
Sweet potatoes	-	-	-	641,818						
Irish potato	-	-	-	4,625						
Cattle	-	-	-	247,244						
Goats	-	-	-	357,481						
Sheep	-	-	-	2,203						
Physical Use SNA Goods and Services (Tonnes, 2009)										
Maize					-	276,842	658,237	-	-	935,079
finger millet					-	49,973	15,842	-	-	65,815
sorghum					-	48,014	1,845	-	-	49,859
Rice					-	5,495	96,357	-	-	101,852
Beans					-	63,893	16,484	-	-	80,377
Field peas					-	2,192	-	-	-	2,192
cowpeas					-	1,585	-	-	-	1,585
pigeon peas					-	125	-	-	-	125
G.nuts					-	23,337	14,770	-	-	38,107
Sim sim					-	1,402	22	-	-	1,424
Soybean					-	5,523	-	-	-	5,523
All bananas					-	318,204	23,480	-	-	341,684
Cassava					-	727,561	64,211	-	-	791,772
Sweet potatoes					-	573,350	68,468	-	-	641,818
Irish potato					-	3,014	1,611	-	-	4,625
Cattle					-	224,992	22,252	-	-	247,244
Goats					-	353,906	3,575	-	-	357,481
Sheep					-	2,181	22	-	-	2,203

Table 18b: Buginyanya zone PSUT producers and consumers 2018

	Producer				Consumer					
	Gov.	Business	Households	Total	Govt.	Household	Business	Change in Inventory	Export	Total
Physical Supply SNA Goods and Services (Tonnes, 2018)										
Maize	-	-	-	621,380						
finger millet	-	-	-	25,598						
sorghum	-	-	-	16,358						
Rice	-	-	-	102,317						
Beans	-	-	-	92,019						
Field peas	-	-	-	-						
cowpeas	-	-	-	-						
pigeon peas	-	-	-	-						
G.nuts	-	-	-	45,131						
Sim sim	-	-	-	615						
Soybean	-	-	-	19,584						
All bananas	-	-	-	507,379						
Cassava	-	-	-	596,879						
Sweet potatoes	-	-	-	324,509						
Irish potato	-	-	-	42,379						
Coffee	-	-	-	44,637						
Cattle	-	-	-	225,235						
Goats	-	-	-	307,311						
Sheep	-	-	-	8,970						
Physical Use SNA Goods and Services (Tonnes, 2018)										
Maize					-	183,968	437,412	-	-	621,380
finger millet					-	19,436	6,162	-	-	25,598
sorghum					-	15,753	605	-	-	16,358
Rice					-	5,520	96,797	-	-	102,317
Beans					-	73,147	18,872	-	-	92,019
Field peas					-	-	-	-	-	-
cowpeas					-	-	-	-	-	-
pigeon peas					-	-	-	-	-	-
G.nuts					-	27,638	17,493	-	-	45,131
Sim sim					-	606	9	-	-	615
Soybean					-	19,584	-	-	-	19,584
All bananas					-	472,512	34,867	-	-	507,379
Cassava					-	548,473	48,406	-	-	596,879
Sweet potatoes					-	289,891	34,618	-	-	324,509
Irish potato					-	27,614	14,765	-	-	42,379
Coffee					-	-	44,637	-	-	44,637
Cattle					-	204,964	20,271	-	-	225,235
Goats					-	304,238	3,073	-	-	307,311
Sheep					-	8,880	90	-	-	8,970

6.1.4 Physical Supply and Use Tables for Mbarara zone

The crop supply and use trends for Mbarara zone was mixed. As Tables 19a&b show, there were decreases in supply of finger millet, sorghum, beans, and sweet potatoes. In contrast, the supply of maize, groundnuts, soybean, bananas and cassava increased. The Mbarara zone is the source for 60% of the cooked banana production in the country. A lot of the increased in banana output is linked to the expansion in banana farm

size. Overall banana production increased by 17% between 2009 and 2018. Beans, finger millet, groundnuts, cassava and sweet potatoes are important for the local staple diets in the Mbarara zone, the increase in their importance and integration within the mixed farming system (Table 19a&b, 20a&b). Beans and finger millet which are equally important in the staple diet should also have increased. However, the Mbarara zone had the largest loss in nitrogen fertilisers in the early 2000's (World Bank 2005), and there have been no deliberate programs to increase soil fertility in smallholder farms.

The Mbarara zone mixed arms also benefit from a large livestock population of cattle and goats within the subsistence, which could have contributed to minimizing the impact of the high losses of nitrogen and boosted banana, groundnut, soybean and cassava outputs, among others.

Table 19a: Mbarara zone PSUT Economic Units and Ecosystem types 2009

	Economic Unit				Ecosystem types		
	Gov.	Businesses	Households	Total	Cropland	Grassland	Total
Physical Supply Food Provisioning Ecosystem Services (Tonnes, 2009)							
Maize					141,138	-	141,138
finger millet					45,436	-	45,436
sorghum					33,940	-	33,940
Rice					104	-	104
Beans					235,526	-	235,526
Field peas					436	-	436
cowpeas					79	-	79
pigeon peas					-	-	-
G.nuts					16,228	-	16,228
Sim sim					-	-	-
Soybean					209	-	209
All bananas					2,237,870	-	2,237,870
Cassava					97,591	-	97,591
Sweet potatoes					109,025	-	109,025
Irish potato					24,308	-	24,308
Cattle					-	228,422	228,422
Goats					-	293,615	293,615
Sheep					-	3,991	3,991
Physical Use Food Provisioning Ecosystem Services (Tonnes, 2009)							
Maize	-	-	-	141,138			
finger millet	-	-	-	45,436			
sorghum	-	-	-	33,940			
Rice	-	-	-	104			
Beans	-	-	-	235,526			
Field peas	-	-	-	436			
cowpeas	-	-	-	79			
pigeon peas	-	-	-	-			
G.nuts	-	-	-	16,228			
Sim sim	-	-	-	-			
Soybean	-	-	-	209			
All bananas	-	-	-	2,237,870			
Cassava	-	-	-	97,591			
Sweet potatoes	-	-	-	109,025			
Irish potato	-	-	-	24,308			
Cattle	-	-	-	228,422			
Goats	-	-	-	293,615			
Sheep	-	-	-	3,991			

Table 19b: Mbarara zone PSUT Economic Units and Ecosystem types 2018

	Economic Unit				Ecosystem types		
	Gov.	Businesses	Households	Total	Cropland	Grassland	Total
Physical Supply Food Provisioning Ecosystem Services (Tonnes, 2018)							
Maize					166,524	-	166,524
finger millet					27,029	-	27,029
sorghum					6,694	-	6,694
Rice					-	-	-
Beans					111,707	-	111,707
Field peas					-	-	-
cowpeas					-	-	-
pigeon peas					-	-	-
G.nuts					23,776	-	23,776
Sim sim					223	-	223
Soybean					605	-	605
All bananas					2,626,564	-	2,626,564
Cassava					178,049	-	178,049
Sweet potatoes					93,506	-	93,506
Irish potato					48,571	-	48,571
Coffee					40,818	-	40,818
Cattle					-	133,995	133,995
Goats					-	100,992	100,992
Sheep					-	58,570	58,570
Physical Use Food Provisioning Ecosystem Services (Tonnes, 2018)							
Maize	-	-	-	166,524			
finger millet	-	-	-	27,029			
sorghum	-	-	-	6,694			
Rice	-	-	-	-			
Beans	-	-	-	111,707			
Field peas	-	-	-	-			
cowpeas	-	-	-	-			
pigeon peas	-	-	-	-			
G.nuts	-	-	-	23,776			
Sim sim	-	-	-	223			
Soybean	-	-	-	605			
All bananas	-	-	-	2,626,564			
Cassava	-	-	-	178,049			
Sweet potatoes	-	-	-	93,506			
Irish potato	-	-	-	48,571			
Coffee	-	-	-	40,818			
Cattle	-	-	-	133,995			
Goats	-	-	-	100,992			
Sheep	-	-	-	58,570			

Table 20a: Mbarara zone PSUT producers and consumers 2009

	Producer				Consumer					
	Gov.	Business	Households	Total	Govt.	Household	Business	Change in Inventory	Export	Total
Physical Supply SNA Goods and Services (Tonnes, 2009)										
Maize	-	-	-	141,138						
finger millet	-	-	-	45,436						
sorghum	-	-	-	33,940						
Rice	-	-	-	104						
Beans	-	-	-	235,526						
Field peas	-	-	-	436						
cowpeas	-	-	-	79						
pigeon peas	-	-	-	-						
G.nuts	-	-	-	16,228						
Sim sim	-	-	-	-						
Soybean	-	-	-	209						
All bananas	-	-	-	2,237,870						
Cassava	-	-	-	97,591						
Sweet potatoes	-	-	-	109,025						
Irish potato	-	-	-	24,308						
Cattle	-	-	-	228,422						
Goats	-	-	-	293,615						
Sheep	-	-	-	3,991						
Physical Use SNA Goods and Services (Tonnes, 2009)										
Maize					-	41,786	99,352	-	-	141,138
finger millet					-	34,499	10,937	-	-	45,436
sorghum					-	32,684	1,256	-	-	33,940
Rice					-	6	98	-	-	104
Beans					-	187,224	48,302	-	-	235,526
Field peas					-	436	-	-	-	436
cowpeas					-	79	-	-	-	79
pigeon peas					-	-	-	-	-	-
G.nuts					-	9,938	6,290	-	-	16,228
Sim sim					-	-	-	-	-	-
Soybean					-	209	-	-	-	209
All bananas					-	2,084,084	153,786	-	-	2,237,870
Cassava					-	89,677	7,914	-	-	97,591
Sweet potatoes					-	97,394	11,631	-	-	109,025
Irish potato					-	15,839	8,469	-	-	24,308
Cattle					-	207,864	20,558	-	-	228,422
Goats					-	290,679	2,936	-	-	293,615
Sheep					-	3,951	40	-	-	3,991

Table 20b: Mbarara zone PSUT producers and consumers 2018

	Producer				Consumer					
	Gov.	Business	Households	Total	Govt.	Household	Business	Change in Inventory	Export	Total
Physical Supply SNA Goods and Services (Tonnes, 2018)										
Maize	-	-	-	166,524						
finger millet	-	-	-	27,029						
sorghum	-	-	-	6,694						
Rice	-	-	-	-						
Beans	-	-	-	111,707						
Field peas	-	-	-	-						
cowpeas	-	-	-	-						
pigeon peas	-	-	-	-						
G.nuts	-	-	-	23,776						
Sim sim	-	-	-	223						
Soybean	-	-	-	605						
All bananas	-	-	-	2,626,564						
Cassava	-	-	-	178,049						
Sweet potatoes	-	-	-	93,506						
Irish potato	-	-	-	48,571						
Coffee	-	-	-	40,818						
Cattle	-	-	-	133,995						
Goats	-	-	-	100,992						
Sheep	-	-	-	58,570						
Physical Use SNA Goods and Services (Tonnes, 2018)										
Maize					-	49,302	117,222	-	-	166,524
finger millet					-	20,523	6,506	-	-	27,029
sorghum					-	6,446	248	-	-	6,694
Rice					-	-	-	-	-	-
Beans					-	88,798	22,909	-	-	111,707
Field peas					-	-	-	-	-	-
cowpeas					-	-	-	-	-	-
pigeon peas					-	-	-	-	-	-
G.nuts					-	14,560	9,216	-	-	23,776
Sim sim					-	220	3	-	-	223
Soybean					-	605	-	-	-	605
All bananas					-	2,446,067	180,497	-	-	2,626,564
Cassava					-	163,610	14,439	-	-	178,049
Sweet potatoes					-	83,531	9,975	-	-	93,506
Irish potato					-	31,649	16,922	-	-	48,571
Coffee					-	-	40,818	-	-	40,818
Cattle					-	121,936	12,060	-	-	126,377
Goats					-	99,982	1,010	-	-	354,156
Sheep					-	57,985	586	-	-	34,032

6.1.5 Physical Supply and Use Tables for Mukono zone

As Table 20 shows, the Mukono zone showed large increase in nearly all crops, with the exception of finger millet and sorghum. The largest percentage increase was for Irish potatoes, 945%. The Irish potatoes increased from 4,689t to 48,991t between 2009 and 2018. Soybean, rice, sim sim, maize, cassava sweet potatoes and bananas increased by 775%, 435%, 251%, 157%, 97%, 78% and 73%, respectively (Table

21a&b, 22a&b). The crop output increases are likely the result of the increase in both the cropped and planted area of the ZONE. In addition, for crops such as maize, rice, soybean, Irish potatoes, and cassava, technology innovations and seeds mean that farmers are able to use higher yielding varieties. Outside of the larger fertilizer importers engaged in tea, coffee, sugar cane plantations, the zone was a major user of the fertilisers imported in the country, and surveys showed access to extension services on both organic and inorganic fertilisers with an access rate of 12.6% for inorganic fertilisers. (UBOS/MAAIF 2015).

Table 21a: Mukono zone PSUT Economic Units and Ecosystem types 2009

	Economic Unit				Ecosystem types		
	Gov.	Businesses	Households	Total	Cropland	Grassland	Total
Physical Supply Food Provisioning Ecosystem Services (Tonnes, 2009)							
Maize					415,506	-	415,506
finger millet					11,466	-	11,466
sorghum					1,007	-	1,007
Rice					2,174	-	2,174
Beans					143,639	-	143,639
Field peas					301	-	301
cowpeas					267	-	267
pigeon peas					-	-	-
G.nuts					30,411	-	30,411
Sim sim					126	-	126
Soybean					192	-	192
All bananas					763,289	-	763,289
Cassava					378,384	-	378,384
Sweet potatoes					295,941	-	295,941
Irish potato					4,689	-	4,689
Cattle					-	361,228	361,228
Goats					-	294,824	294,824
Sheep					-	4,263	4,263
Physical Use Food Provisioning Ecosystem Services (Tonnes, 2009)							
Maize	-	-	-	415,506			
finger millet	-	-	-	11,466			
sorghum	-	-	-	1,007			
Rice	-	-	-	2,174			
Beans	-	-	-	143,639			
Field peas	-	-	-	301			
cowpeas	-	-	-	267			
pigeon peas	-	-	-	-			
G.nuts	-	-	-	30,411			
Sim sim	-	-	-	126			
Soybean	-	-	-	192			
All bananas	-	-	-	763,289			
Cassava	-	-	-	378,384			
Sweet potatoes	-	-	-	295,941			
Irish potato	-	-	-	4,689			
Cattle	-	-	-	361,228			
Goats	-	-	-	294,824			
Sheep	-	-	-	4,263			

Table 21b: Mukono zone PSUT Economic Units and Ecosystem types 2018

	Economic Unit				Ecosystem types		
	Gov.	Businesses	Households	Total	Cropland	Grassland	Total
Physical Supply Food Provisioning Ecosystem Services (Tonnes, 2018)							
Maize					1,068,615	-	1,068,615
finger millet					2,159	-	2,159
sorghum					448	-	448
Rice					11,635	-	11,635
Beans					193,109	-	193,109
Field peas					-	-	-
cowpeas					-	-	-
pigeon peas					-	-	-
G.nuts					30,694	-	30,694
Sim sim					442	-	442
Soybean					1,680	-	1,680
All bananas					1,359,478	-	1,359,478
Cassava					745,493	-	745,493
Sweet potatoes					511,200	-	511,200
Irish potato					48,991	-	48,991
Coffee					92,512	-	92,512
Cattle					-	215,758	215,758
Goats					-	295,420	295,420
Sheep					-	29,666	29,666
Physical Use Food Provisioning Ecosystem Services (Tonnes, 2018)							
Maize	-	-	-	1,068,615			
finger millet	-	-	-	2,159			
sorghum	-	-	-	448			
Rice	-	-	-	11,635			
Beans	-	-	-	193,109			
Field peas	-	-	-	-			
cowpeas	-	-	-	-			
pigeon peas	-	-	-	-			
G.nuts	-	-	-	30,694			
Sim sim	-	-	-	442			
Soybean	-	-	-	1,680			
All bananas	-	-	-	1,359,478			
Cassava	-	-	-	745,493			
Sweet potatoes	-	-	-	511,200			
Irish potato	-	-	-	48,991			
Coffee	-	-	-	92,512			
Cattle	-	-	-	215,758			
Goats	-	-	-	295,420			
Sheep	-	-	-	29,666			

Table 22a: Mukono zone PSUT producers and consumers 2009

	Producer				Consumer					
	Gov.	Business	H.holds	Total	Govt.	Household	Business	Change in Inventory	Export	Total
Physical Supply SNA Goods and Services (Tonnes, 2009)										
Maize	-	-	-	415,506						
finger millet	-	-	-	11,466						
sorghum	-	-	-	1,007						
Rice	-	-	-	2,174						
Beans	-	-	-	143,639						
Field peas	-	-	-	301						
cowpeas	-	-	-	267						
pigeon peas	-	-	-	-						
G.nuts	-	-	-	30,411						
Sim sim	-	-	-	126						
Soybean	-	-	-	192						
All bananas	-	-	-	763,289						
Cassava	-	-	-	378,384						
Sweet potatoes	-	-	-	295,941						
Irish potato	-	-	-	4,689						
Cattle	-	-	-	361,228						
Goats	-	-	-	294,824						
Sheep	-	-	-	4,263						
Physical Use SNA Goods and Services (Tonnes, 2009)										
Maize					-	123,016	292,490	-	-	415,506
finger millet					-	8,706	2,760	-	-	11,466
sorghum					-	970	37	-	-	1,007
Rice					-	117	2,057	-	-	2,174
Beans					-	114,181	29,458	-	-	143,639
Field peas					-	301	-	-	-	301
cowpeas					-	267	-	-	-	267
pigeon peas					-	-	-	-	-	-
G.nuts					-	18,624	11,787	-	-	30,411
Sim sim					-	124	2	-	-	126
Soybean					-	192	-	-	-	192
All bananas					-	710,836	52,453	-	-	763,289
Cassava					-	347,698	30,686	-	-	378,384
Sweet potatoes					-	264,371	31,570	-	-	295,941
Irish potato					-	3,055	1,634	-	-	4,689
Cattle					-	328,717	32,510	-	-	361,228
Goats					-	291,876	2,948	-	-	294,824
Sheep					-	4,220	43	-	-	4,263

Table 22b: Mukono zone PSUT producers and consumers 2018

	Producer				Consumer					
	Gov.	Business	Households	Total	Govt.	Household	Business	Change in Inventory	Export	Total
Physical Supply SNA Goods and Services (Tonnes, 2018)										
Maize	-	-	-	1,068,615						
finger millet	-	-	-	2,159						
sorghum	-	-	-	448						
Rice	-	-	-	11,635						
Beans	-	-	-	193,109						
Field peas	-	-	-	-						
cowpeas	-	-	-	-						
pigeon peas	-	-	-	-						
G.nuts	-	-	-	30,694						
Sim sim	-	-	-	442						
Soybean	-	-	-	1,680						
All bananas	-	-	-	1,359,478						
Cassava	-	-	-	745,493						
Sweet potatoes	-	-	-	511,200						
Irish potato	-	-	-	48,991						
Coffee	-	-	-	92,512						
Cattle	-	-	-	215,758						
Goats	-	-	-	295,420						
Sheep	-	-	-	29,666						
Physical Use SNA Goods and Services (Tonnes, 2018)										
Maize					-	316,377	752,238	-	-	1,068,615
finger millet					-	1,639	520	-	-	2,159
sorghum					-	431	17	-	-	448
Rice					-	628	11,007	-	-	11,635
Beans					-	153,506	39,603	-	-	193,109
Field peas					-	-	-	-	-	-
cowpeas					-	-	-	-	-	-
pigeon peas					-	-	-	-	-	-
G.nuts					-	18,797	11,897	-	-	30,694
Sim sim					-	435	7	-	-	442
Soybean					-	1,680	-	-	-	1,680
All bananas					-	1,266,055	93,423	-	-	1,359,478
Cassava					-	685,035	60,458	-	-	745,493
Sweet potatoes					-	456,666	54,534	-	-	511,200
Irish potato					-	31,922	17,069	-	-	48,991
Coffee					-	-	92,512	-	-	92,512
Cattle					-	196,340	19,418	-	-	215,758
Goats					-	292,466	2,954	-	-	295,420
Sheep					-	29,370	297	-	-	29,666

6.2 Monetary supply and use tables

The Monetary Supply and Use Tables (MSUTs) present the same information on the food provisioning ecosystem service and associated SNA production and consumption as the PSUTs but in monetary terms. The monetary value of the crops is based on the harvest approach described in the SEEA EEA (UN et al., 2014). Basically, market prices have been used to impute a proxy value for the food provisioning

ecosystem service. These prices were obtained from Annual Agricultural surveys for 2009 and 2018. It should be noted that this overestimates the value of the ecosystem service contribution to the values recorded in the MSUT for SNA and Goods and Services. This is because the 'farm gate price' also reflects the value of other inputs, such as labour and capital investment. Nonetheless, the MSUTs provide an important insight into the level of economic activity supported by cropland and grassland ecosystems that can be integrated with the information presented in other ecosystem accounts.

6.2.1 National Monetary Supply and Use Tables

The national MSUT are presented in (Tables 23a to 24b). Whilst coffee supply is captured in the PSUTS, it is not recorded in the MSUTS. This is because information on coffee harvest / production is not recorded in the Annual Agricultural Survey for 2009. Therefore, the decision was made to exclude it from the 2018 MSUTs to enable a more consistent comparative analysis on monetary indicators linked to crop and livestock provisioning ecosystem services. It is acknowledged that this treatment needs further consideration, particularly as coffee is a major export. Ideally, the crops considered should be expanded for both years. This is discussed further in the conclusions.

The national MSUT (Tables 23a to 24b) shows that supply and use accounts were in balance for both 2009 and 2018. The national aggregate MSUT economic units and ecosystem types supply and use show the value of crop and livestock production increased by 148% from UGX 4.7 trillion in 2009 (Table 23a) to UGX 11.8 trillion in 2018 (Table 23b). The supply and use of crop products increased by 166% from UGX 3.6 trillion to UGX 9.6 trillion, while the supply and use of livestock products increased by 90% from 1.1 trillion to 2.1 trillion between 2009 and 2018. The proportion of sector economic activity from croplands increased from 76% in 2009 to 82% in 2018. The economic supply and use activity were dominated by crop products, as the economic activity for livestock decreased from 22% of total value of agricultural production to 18%.

Table 23a: National MSUT economic units and ecosystem types for 2009

	Economic Unit				Ecosystem types		
	Gov.	Business	Households	Total	Cropland	Grassland	Total
Monetary Supply Food Provisioning Ecosystem Services (million UGX 2009)							
Maize					590,489	-	590,489
Finger millet					111,466	-	111,466
Sorghum					94,143	-	94,143
Rice					161,937	-	161,937
Beans					429,325	-	429,325
Field peas					9,617	-	9,617
Cowpeas					6,462	-	6,462
Pigeon peas					6,005	-	6,005
G.nuts					155,224	-	155,224
Sim sim					65,224	-	65,224
Soybean					11,181	-	11,181
All bananas					717,657	-	717,657
Cassava					930,520	-	930,520
Sweet potatoes					266,450	-	266,450
Irish potato					68,029	-	68,029
Cattle					-	1,005,399	1,005,399
Goats					-	107,603	107,603
Sheep					-	2,721	2,721
Total					3,623,732	1,115,723	4,739,455
Monetary Use Food Provisioning Ecosystem Services (UGX million, 2009)							
Maize	-	-	-	590,489			
Finger millet	-	-	-	111,466			
Sorghum	-	-	-	94,143			
Rice	-	-	-	161,937			
Beans	-	-	-	429,325			
Field peas	-	-	-	9,617			
Cowpeas	-	-	-	6,462			
Pigeon peas	-	-	-	6,005			
G. nuts	-	-	-	155,224			
Sim sim	-	-	-	65,224			
Soybean	-	-	-	11,181			
All bananas	-	-	-	717,657			
Cassava	-	-	-	930,520			
Sweet potatoes	-	-	-	266,450			
Irish potato	-	-	-	68,029			
Cattle	-	-	-	1,005,399			
Goats	-	-	-	107,603			
Sheep	-	-	-	2,721			
Total				4,739,455			

Table 23b: National MSUT economic units and ecosystem types for 2018

	Economic Unit				Ecosystem types		
	Gov.	Business	Households	Total	Cropland	Grassland	Total
Monetary Supply Food Provisioning Ecosystem Services (UGX million, 2018)							
Maize					1,803,662	-	1,803,662
Finger millet					119,769	-	119,769
Sorghum					144,336	-	144,336
Rice					354,561	-	354,561
Beans					704,556	-	704,556
Field peas					-	-	-
Cowpeas					-	-	-
Pigeon peas					-	-	-
G.nuts					338,396	-	338,396
Sim sim					63,695	-	63,695
Soybean					116,951	-	116,951
All bananas					2,272,911	-	2,272,911
Cassava					2,958,138	-	2,958,138
Sweet potatoes					455,689	-	455,689
Irish potato					302,194	-	302,194
Cattle					-	1,830,411	1,830,411
Goats					-	230,771	230,771
Sheep					-	60,108	60,108
Total					9,634,858	2,121,290	11,756,148
Monetary Use Food Provisioning Ecosystem Services (UGX million, 2018)							
Maize	-	-	-	1,803,662			
Finger millet	-	-	-	119,769			
Sorghum	-	-	-	144,336			
Rice	-	-	-	354,561			
Beans	-	-	-	704,556			
Field peas	-	-	-	-			
Cowpeas	-	-	-	-			
Pigeon peas	-	-	-	-			
G.nuts	-	-	-	338,396			
Sim sim	-	-	-	63,695			
Soybean	-	-	-	116,951			
All bananas	-	-	-	2,272,911			
Cassava	-	-	-	2,958,138			
Sweet potatoes	-	-	-	455,689			
Irish potato	-	-	-	302,194			
Cattle	-	-	-	1,830,411			
Goats	-	-	-	230,771			
Sheep	-	-	-	60,108			
Total				11,756,148			

The MSUT producers and consumers also showed a 148% increase in aggregate economic activity between 2009 and 2018 (Tables 24a and 24b). The household and business consumptive use were stable at 78-79% and 21-22%, respectively. Even when the level of production increased the proportions of distribution in consumptive use remained the same. Therefore, increased use for industry and innovation may not be the incentives and/or limiting factors for the agriculture sector. Instead, the limiting factors for economic activity for the agricultural sector, crop and livestock production and consumption, are likely to be the

growth household demand linked to the population growth rate, and the productivity of the crop and livestock sector, which seems to largely aligned to meeting the household consumptive use. The transformative opportunity would be in increasing productivity beyond the household consumptive need and increasing options for business use of crop and livestock products that add value to national and local economies

Table 24a: National MSUT producers and consumers for 2009

	Producer				Consumer					
	Gov.	Business	H.holds	Total	Govt.	Household	Business	Change in Inventory	Export	Total
Monetary Supply SNA Goods and Services (UGX million, 2009)										
Maize	-	-	-	590,489						
Finger millet	-	-	-	111,466						
Sorghum	-	-	-	94,143						
Rice	-	-	-	161,937						
Beans	-	-	-	429,325						
Field peas	-	-	-	9,617						
Cowpeas	-	-	-	6,462						
Pigeon peas	-	-	-	6,005						
G.nuts	-	-	-	155,224						
Sim sim	-	-	-	65,224						
Soybean	-	-	-	11,181						
All bananas	-	-	-	717,657						
Cassava	-	-	-	930,520						
Sweet potatoes	-	-	-	266,450						
Irish potato	-	-	-	68,029						
Cattle	-	-	-	1,005,399						
Goats	-	-	-	107,603						
Sheep	-	-	-	2,721						
Total				4,739,455						
Monetary Use SNA Goods and Services (UGX million, 2009)										
Maize					-	174,822	415,667	-	-	590,489
Finger millet					-	84,636	26,830	-	-	111,466
Sorghum					-	90,659	3,485	-	-	94,143
Rice					-	8,736	153,200	-	-	161,937
Beans					-	341,278	88,047	-	-	429,325
Field peas					-	9,617	-	-	-	9,617
Cowpeas					-	6,462	-	-	-	6,462
Pigeon peas					-	6,005	-	-	-	6,005
G.nuts					-	95,059	60,166	-	-	155,224
Sim sim					-	64,223	1,001	-	-	65,224
Soybean					-	11,181	-	-	-	11,181
All bananas					-	668,340	49,317	-	-	717,657
Cassava					-	855,057	75,463	-	-	930,520
Sweet potatoes					-	238,026	28,424	-	-	266,450
Irish potato					-	44,328	23,702	-	-	68,029
Cattle					-	914,913	90,486	-	-	1,005,399
Goats					-	106,527	1,076	-	-	107,603
Sheep					-	2,694	27	-	-	2,721
Total						3,722,563	1,016,892	-	-	4,739,455

Table 24b: National MSUT producers and consumers for 2018

	Producer				Consumer					
	Gov.	Business	H.holds	Total	Govt.	Household	Business	Change in Inventory	Export	Total
Monetary Supply SNA Goods and Services (UGX million, 2018)										
Maize	-	-	-	1,803,662						
Finger millet	-	-	-	119,769						
Sorghum	-	-	-	144,336						
Rice	-	-	-	354,561						
Beans	-	-	-	704,556						
Field peas	-	-	-	-						
Cowpeas	-	-	-	-						
Pigeon peas	-	-	-	-						
G.nuts	-	-	-	338,396						
Sim sim	-	-	-	63,695						
Soybean	-	-	-	116,951						
All bananas	-	-	-	2,272,911						
Cassava	-	-	-	2,958,138						
Sweet potatoes	-	-	-	455,689						
Irish potato	-	-	-	302,194						
Cattle	-	-	-	1,830,411						
Goats	-	-	-	230,771						
Sheep	-	-	-	60,108						
Total	-	-	-	11,756,148						
Monetary Use SNA Goods and Services (UGX million, 2018)										
Maize					-	533,998	1,269,665	-	-	1,803,662
Finger millet					-	90,940	28,829	-	-	119,769
Sorghum					-	138,993	5,342	-	-	144,336
Rice					-	19,128	335,433	-	-	354,561
Beans					-	560,064	144,492	-	-	704,556
Field peas					-	-	-	-	-	-
Cowpeas					-	-	-	-	-	-
Pigeon peas					-	-	-	-	-	-
G.nuts					-	207,232	131,164	-	-	338,396
Sim sim					-	62,717	978	-	-	63,695
Soybean					-	116,951	-	-	-	116,951
All bananas					-	2,116,717	156,194	-	-	2,272,911
Cassava					-	2,718,239	239,899	-	-	2,958,138
Sweet potatoes					-	407,077	48,612	-	-	455,689
Irish potato					-	196,909	105,285	-	-	302,194
Cattle					-	1,665,674	164,737	-	-	1,830,411
Goats					-	228,463	2,308	-	-	230,771
Sheep					-	59,506	601	-	-	60,108
Total					-	9,122,610	2,633,538	-	-	11,756,148

6.2.2 Monetary Supply and Use Tables for Abi zone

The MSUT economic units and ecosystem units for the Abi zone shows that the monetary supply and use were in balance in both 2009 and 2018 (Table 25a&b). The total monetary supply and use increased by 73% from UGX 393 billion in 2009 to UGX 687 billion in 2018. The monetary crop supply and use increased by 75% from UGX 305 billion in 2009 to UGX 538 billion in 2018 while the monetary livestock supply and use increased by 67% from 88 billion in 2009 to 147 billion in 2018.

Table 25a: Abi zone MSUT economic units and ecosystem types 2009

	Economic Units				Ecosystem types		
	Gov.	Businesses	Households	Total	Cropland	Grassland	Total
Monetary Supply Food Provisioning Ecosystem Services (UGX million, 2009)							
Maize					34,105	-	34,105
Finger millet					5,749	-	5,749
Sorghum					13,552	-	13,552
Rice					3,988	-	3,988
Beans					18,802	-	18,802
Field peas					1,655	-	1,655
Cowpeas					1,059	-	1,059
Pigeon peas					761	-	761
G.nuts					20,800	-	20,800
Sim sim					11,287	-	11,287
Soybean					259	-	259
All bananas					4,925	-	4,925
Cassava					165,430	-	165,430
Sweet potatoes					22,177	-	22,177
Irish potato					554	-	554
Cattle					-	73,117	73,117
Goats					-	14,655	14,655
Sheep					-	325	325
Total					305,103	88,097	393,200
Monetary Use Food Provisioning Ecosystem Services (UGX million, 2009)							
Maize	-	-	-	34,105			
Finger millet	-	-	-	5,749			
Sorghum	-	-	-	13,552			
Rice	-	-	-	3,988			
Beans	-	-	-	18,802			
Field peas	-	-	-	1,655			
Cowpeas	-	-	-	1,059			
Pigeon peas	-	-	-	761			
G.nuts	-	-	-	20,800			
Sim sim	-	-	-	11,287			
Soybean	-	-	-	259			
All bananas	-	-	-	4,925			
Cassava	-	-	-	165,430			
Sweet potatoes	-	-	-	22,177			
Irish potato	-	-	-	554			
Cattle	-	-	-	73,117			
Goats	-	-	-	14,655			
Sheep	-	-	-	325			
Total				393,200			

Table 25b: Abi zone MSUT economic units and ecosystem types 2018

	Economic Units				Ecosystem types		
	Gov.	Businesses	Households	Total	Cropland	Grassland	Total
Monetary Supply Food Provisioning Ecosystem Services (UGX million, 2018)							
Maize					42,341	-	42,341
Finger millet					7,056	-	7,056
Sorghum					8,047	-	8,047
Rice					7,783	-	7,783
Beans					8,716	-	8,716
Field peas					-	-	-
Cowpeas					-	-	-
Pigeon peas					-	-	-
G.nuts					29,765	-	29,765
Sim sim					10,053	-	10,053
Soybean					723	-	723
All bananas					6,943	-	6,943
Cassava					382,705	-	382,705
Sweet potatoes					30,059	-	30,059
Irish potato					5,566	-	5,566
Cattle					-	117,887	117,887
Goats					-	26,781	26,781
Sheep					-	2,753	2,753
Total					539,757	147,420	687,177
Monetary Use Food Provisioning Ecosystem Services (UGX million 2018)							
Maize	-	-	-	42,341			
Finger millet	-	-	-	7,056			
Sorghum	-	-	-	8,047			
Rice	-	-	-	7,783			
Beans	-	-	-	8,716			
Field peas	-	-	-	-			
Cowpeas	-	-	-	-			
Pigeon peas	-	-	-	-			
G.nuts	-	-	-	29,765			
Sim sim	-	-	-	10,053			
Soybean	-	-	-	723			
All bananas	-	-	-	6,943			
Cassava	-	-	-	382,705			
Sweet potatoes	-	-	-	30,059			
Irish potato	-	-	-	5,566			
Cattle	-	-	-	117,887			
Goats	-	-	-	26,781			
Sheep	-	-	-	2,753			
Total	-	-	-	687,177			

The MSUT producers and consumers for the Abi zone shows that the consumptive use for households increased by 79% from UGX 328 billion in 2009 to UGX 587 billion in 2018. The business consumptive uses also increased but by only 54%, from UGX 65 billion in 2009 to UGX 100 billion in 2018 (Table 26a&b).

Table 26a: Abi zone MSUT producers and consumers, 2009

	Producer				Consumer					
	Gov.	Business	H.holds	Total	Govt.	H.hold	Business	Change in Inventory	Export	Total
Monetary Supply SNA Goods and Services (UGX million, 2009)										
Maize	-	-	-	34,105						
Finger millet	-	-	-	5,749						
Sorghum	-	-	-	13,552						
Rice	-	-	-	3,988						
Beans	-	-	-	18,802						
Field peas	-	-	-	1,655						
Cowpeas	-	-	-	1,059						
Pigeon peas	-	-	-	761						
G.nuts	-	-	-	20,800						
Sim sim	-	-	-	11,287						
Soybean	-	-	-	259						
All bananas	-	-	-	4,925						
Cassava	-	-	-	165,430						
Sweet potatoes	-	-	-	22,177						
Irish potato	-	-	-	554						
Cattle	-	-	-	73,117						
Goats	-	-	-	14,655						
Sheep	-	-	-	325						
Total	-	-	-	393,200						
Monetary Use SNA Goods and Services (UGX million, 2009)										
Maize					-	10,097	24,008	-	-	34,105
Finger millet					-	4,365	1,384	-	-	5,749
Sorghum					-	13,050	502	-	-	13,552
Rice					-	215	3,773	-	-	3,988
Beans					-	14,947	3,856	-	-	18,802
Field peas					-	1,655	-	-	-	1,655
Cowpeas					-	1,059	-	-	-	1,059
Pigeon peas					-	761	-	-	-	761
G.nuts					-	12,738	8,062	-	-	20,800
Sim sim					-	11,114	173	-	-	11,287
Soybean					-	259	-	-	-	259
All bananas					-	4,586	338	-	-	4,925
Cassava					-	152,014	13,416	-	-	165,430
Sweet potatoes					-	19,811	2,366	-	-	22,177
Irish potato					-	361	193	-	-	554
Cattle					-	66,537	6,581	-	-	73,117
Goats					-	14,508	147	-	-	14,655
Sheep					-	322	3	-	-	325
Total					-	328,399	64,800	-	-	393,200

Table 26b: Abi zone MSUT producers and consumers, 2018

	Producers				Consumers					
	Govt.	Business	H.holds	Total	Govt.	H.hold	Business	Change in Inventory	Export	Total
Monetary Supply SNA Goods and Services (UGX million, 2018)										
Maize	-	-	-	42,341						
Finger millet	-	-	-	7,056						
Sorghum	-	-	-	8,047						
Rice	-	-	-	7,783						
Beans	-	-	-	8,716						
Field peas	-	-	-	-						
Cowpeas	-	-	-	-						
Pigeon peas	-	-	-	-						
G.nuts	-	-	-	29,765						
Sim sim	-	-	-	10,053						
Soybean	-	-	-	723						
All bananas	-	-	-	6,943						
Cassava	-	-	-	382,705						
Sweet potatoes	-	-	-	30,059						
Irish potato	-	-	-	5,566						
Cattle	-	-	-	117,887						
Goats	-	-	-	26,781						
Sheep	-	-	-	2,753						
Total	-	-	-	687,177						
Monetary Use SNA Goods and Services (UGX million 2018)										
Maize					-	12,536	29,806	-	-	42,341
Finger millet					-	5,357	1,698	-	-	7,056
Sorghum					-	7,750	298	-	-	8,047
Rice					-	420	7,363	-	-	7,783
Beans					-	6,929	1,787	-	-	8,716
Field peas					-	-	-	-	-	-
Cowpeas					-	-	-	-	-	-
Pigeon peas					-	-	-	-	-	-
G.nuts					-	18,228	11,537	-	-	29,765
Sim sim					-	9,898	154	-	-	10,053
Soybean					-	723	0	-	-	723
All bananas					-	6,466	477	-	-	6,943
Cassava					-	351,669	31,037	-	-	382,705
Sweet potatoes					-	26,852	3,207	-	-	30,059
Irish potato					-	3,626	1,940			5,566
Cattle					-	107,277	10,610	-	-	117,887
Goats					-	26,513	268	-	-	26,781
Sheep					-	2,725	28	-	-	2,753
Total					-	586,969	100,209	-	-	687,177

6.2.3 Monetary Supply and Use Tables for Buginyanya zone

The MSUT economic units and ecosystem types were in balance between supply and use in both 2009 and 2018. The supply and use increased by 69%, from UGX 985 billion in 2009 to UGX 1,622 billion in 2018 (Table 27a&b). The crop supply and use increased by 71%, from 835 billion to UGX 1,428 billion, while the livestock supply and use increased by 56% from UGX 150 billion to UGX 234 billion.

Table 27a: Buginyanya zone MSUT economic units and ecosystem types for 2009

	Economic Unit				Ecosystem types		
	Gov.	Businesses	Households	Total	Cropland	Grassland	Total
Monetary Supply Food Provisioning Ecosystem Services (UGX million 2009)							
Maize					233,770	-	233,770
Finger millet					26,491	-	26,491
Sorghum					12,789	-	12,789
Rice					86,472	-	86,472
Beans					37,134	-	37,134
Field peas					1,281	-	1,281
Cowpeas					926	-	926
Pigeon peas					66	-	66
G.nuts					24,293	-	24,293
Sim sim					972	-	972
Soybean					2,864	-	2,864
All bananas					57,061	-	57,061
Cassava					254,555	-	254,555
Sweet potatoes					94,026	-	94,026
Irish potato					2,037	-	2,037
Cattle					-	134,497	134,497
Goats					-	15,764	15,764
Sheep					-	104	104
Total					834,738	150,364	985,102
Monetary Use Food Provisioning Ecosystem Services UGX million 2009)							
Maize	-	-	-	233,770			
Finger millet	-	-	-	26,491			
Sorghum	-	-	-	12,789			
Rice	-	-	-	86,472			
Beans	-	-	-	37,134			
Field peas	-	-	-	1,281			
Cowpeas	-	-	-	926			
Pigeon peas	-	-	-	66			
G.nuts	-	-	-	24,293			
Sim sim	-	-	-	972			
Soybean	-	-	-	2,864			
All bananas	-	-	-	57,061			
Cassava	-	-	-	254,555			
Sweet potatoes	-	-	-	94,026			
Irish potato	-	-	-	2,037			
Cattle	-	-	-	134,497			
Goats	-	-	-	15,764			
Sheep	-	-	-	104			
Total	-	-	-	985,102			

Table 27b: Buginyanya zone MSUT economic units and ecosystem types for 2018

	Economic Unit				Ecosystem types		
	Gov.	Businesses	Households	Total	Cropland	Grassland	Total
Monetary Supply Food Provisioning Ecosystem Services (UGX million, 2018)							
Maize					325,572	-	325,572
Finger millet					21,593	-	21,593
Sorghum					8,794	-	8,794
Rice					182,056	-	182,056
Beans					89,098	-	89,098
Field peas					-	-	-
Cowpeas					-	-	-
Pigeon peas					-	-	-
G.nuts					60,298	-	60,298
Sim sim					880	-	880
Soybean					21,281	-	21,281
All bananas					177,582	-	177,582
Cassava					402,177	-	402,177
Sweet potatoes					99,636	-	99,636
Irish potato					39,124	-	39,124
Cattle					-	210,104	210,104
Goats					-	23,238	23,238
Sheep					-	726	726
Total					1,428,092	234,068	1,662,160
Monetary Use Food Provisioning Ecosystem Services (UGX million, 2018)							
Maize	-	-	-	325,572			
Finger millet	-	-	-	21,593			
Sorghum	-	-	-	8,794			
Rice	-	-	-	182,056			
Beans	-	-	-	89,098			
Field peas	-	-	-	-			
Cowpeas	-	-	-	-			
Pigeon peas	-	-	-	-			
G.nuts	-	-	-	60,298			
Sim sim	-	-	-	880			
Soybean	-	-	-	21,281			
All bananas	-	-	-	177,582			
Cassava	-	-	-	402,177			
Sweet potatoes	-	-	-	99,636			
Irish potato	-	-	-	39,124			
Cattle	-	-	-	210,104			
Goats	-	-	-	23,238			
Sheep	-	-	-	726			
Total	-	-	-	1,662,160			

The producer and consumer MSUT shows that the consumptive use for households increased by 69% from UGX 667 billion in 2009 to UGX 1,125 billion. The business consumptive uses also increased by 69% from UGX 318 billion in 2009 to UGX 537 billion in 2018 (Table 28a&b). In the Buginyanya zone, the ratio of supply from the croplands to the economic units was 85% in both 2009 and 2018. Like in all the other

zone's crop products were dominant over livestock. The dominance of crops over livestock products was higher in Buginyanya zone than the national average.

Table 28a: Buginyanya zone MSUT producers and consumers for 2009

	Producer				Consumer					
	Gov.	Business	H.holds	Total	Govt.	H.hold	Business	Change in Inventory	Export	Total
Monetary Supply SNA Goods and Services UGX million 2009)										
Maize	-	-	-	233,770						
Finger millet	-	-	-	26,491						
Sorghum	-	-	-	12,789						
Rice	-	-	-	86,472						
Beans	-	-	-	37,134						
Field peas	-	-	-	1,281						
Cowpeas	-	-	-	926						
Pigeon peas	-	-	-	66						
G.nuts	-	-	-	24,293						
Sim sim	-	-	-	972						
Soybean	-	-	-	2,864						
All bananas	-	-	-	57,061						
Cassava	-	-	-	254,555						
Sweet potatoes	-	-	-	94,026						
Irish potato	-	-	-	2,037						
Cattle	-	-	-	134,497						
Goats	-	-	-	15,764						
Sheep	-	-	-	104						
Total	-	-	-	985,102						
Monetary Use SNA Goods and Services (UGX million, 2009)										
Maize					-	69,211	164,559	-	-	233,770
Finger millet					-	20,114	6,376	-	-	26,491
Sorghum					-	12,315	473	-	-	12,789
Rice					-	4,665	81,807	-	-	86,472
Beans					-	29,519	7,616	-	-	37,134
Field peas					-	1,281	-	-	-	1,281
Cowpeas					-	926	-	-	-	926
Pigeon peas					-	66	-	-	-	66
G.nuts					-	14,877	9,416	-	-	24,293
Sim sim					-	957	15	-	-	972
Soybean					-	2,864	-	-	-	2,864
All bananas					-	53,140	3,921	-	-	57,061
Cassava					-	233,911	20,644	-	-	254,555
Sweet potatoes					-	83,996	10,031	-	-	94,026
Irish potato					-	1,328	710	-	-	2,037
Cattle					-	122,392	12,105	-	-	134,497
Goats					-	15,606	158	-	-	15,764
Sheep					-	103	1	-	-	104
Total					-	667,271	317,832	-	-	985,102

Table 28b: Buginyanya zone MSUT producers and consumers for 2018

	Producer				Consumer					
	Gov.	Business	H.holds	Total	Govt.	H.hold	Business	Change in Inventory	Export	Total
Monetary Supply SNA Goods and Services (million UGX 2018)										
Maize	-	-	-	325,572.1						
Finger millet	-	-	-	21,593.4						
Sorghum	-	-	-	8,793.6						
Rice	-	-	-	182,056.1						
Beans	-	-	-	89,098.3						
Field peas	-	-	-	-						
Cowpeas	-	-	-	-						
Pigeon peas	-	-	-	-						
G.nuts	-	-	-	60,298.3						
Sim sim	-	-	-	879.7						
Soybean	-	-	-	21,281.4						
All bananas	-	-	-	177,581.9						
Cassava	-	-	-	402,176.9						
Sweet potatoes	-	-	-	99,635.5						
Irish potato	-	-	-	39,124.3						
Cattle	-	-	-	210,104.2						
Goats	-	-	-	23,238.3						
Sheep	-	-	-	725.6						
Total	-	-	-	1,662,160						
Monetary Use SNA Goods and Services (million UGX, 2018)										
Maize					-	96,390	229,182	-	-	325,572
Finger millet					-	16,396	5,198	-	-	21,593
Sorghum					-	8,468	326	-	-	8,794
Rice					-	9,822	172,234.4	-	-	182,056
Beans					-	70,826	18,272.5	-	-	89,098
Field peas					-	-	-	-	-	-
Cowpeas					-	-	-	-	-	-
Pigeon peas					-	-	-	-	-	-
G.nuts					-	36,926	23,372	-	-	60,298
Sim sim					-	866	14	-	-	880
Soybean					-	21,281	-	-	-	21,281
All bananas					-	165,379	12,203	-	-	177,582
Cassava					-	369,561	32,616	-	-	402,177
Sweet potatoes					-	89,007	10,629	-	-	99,636
Irish potato					-	25,493	13,631	-	-	39,124
Cattle					-	191,195	18,909	-	-	210,104
Goats					-	23,006	232	-	-	23,238
Sheep					-	718	7	-	-	726
Total					-	1,125,334	536,826	-	-	1,662,160

6.2.4 Monetary Supply and Use Tables for Mbarara zone

The MSUT economic units and ecosystem types (Tables 28a and 28b) for the Mbarara zone showed a doubling in the aggregate monetary supply and use for crops and livestock products from UGX 751 billion in 2009 to UGX 1,504 billion in 2018. The supply and use sides of the accounts were in balance. Crop production supply and use increased by 123% from UGX 614 billion in 2009 to 1,367 billion in 2018.

Livestock supply and use was unchanged at 137 billion between 2009 and 2018, despite a 71% increase in the livestock price between 2009 and 2018 (Tables 29a&b).

Table 29a: Mbarara zone MSUT economic units and ecosystem types for 2009

	Economic Unit				Ecosystem types		
	Gov.	Businesses	Households	Total	Cropland	Grassland	Total
Monetary Supply Food Provisioning Ecosystem Services (million UGX, 2009)							
Maize					35,285	-	35,285
Finger millet					18,288.0	-	18,288
Sorghum					8,706	-	8,706
Rice					88	-	88
Beans					108,813	-	108,813
Field peas					255	-	255
Cowpeas					46	-	46
Pigeon peas					-	-	-
G.nuts					10,345	-	10,345
Sim sim					-	-	-
Soybean					108	-	108
All bananas					373,724	-	373,724
Cassava					31,376	-	31,376
Sweet potatoes					15,972	-	15,972
Irish potato					10,708	-	10,708
Cattle					-	124,257	124,257
Goats					-	12,948	12,948
Sheep					-	188	188
Total					613,714	137,393	751,107
Monetary Use Food Provisioning Ecosystem Services (million UGX 2009)							
Maize	-	-	-	35,285			
Finger millet	-	-	-	18,288			
Sorghum	-	-	-	8,706			
Rice	-	-	-	88			
Beans	-	-	-	108,813			
Field peas	-	-	-	255			
Cowpeas	-	-	-	46			
Pigeon peas	-	-	-	0			
G.nuts	-	-	-	10,345			
Sim sim	-	-	-	0			
Soybean	-	-	-	108			
All bananas	-	-	-	373,724			
Cassava	-	-	-	31,376			
Sweet potatoes	-	-	-	15,972			
Irish potato	-	-	-	10,708			
Cattle	-	-	-	124,257			
Goats	-	-	-	12,948			
Sheep	-	-	-	188			
Total				751,107			

The livestock production from the Mbarara livestock largely transition from the supply of live animals to supply of products particularly milk from cattle. Dairy cattle increased while the beef cattle reduced resulting into a lower output of live cattle.

Table 29b: Mbarara zone MSUT economic units and ecosystem types for 2018

	Economic Unit				Ecosystem types		
	Gov.	Businesses	Households	Total	Cropland	Grassland	Total
Monetary Supply SNA Goods and Services (million UGX 2018)							
Maize					87,250	-	87,250
Finger millet					22,801	-	22,801
Sorghum					3,599	-	3,599
Rice					-	-	-
Beans					108,161	-	108,161
Field peas					-	-	-
Cowpeas					-	-	-
Pigeon peas					-	-	-
G.nuts					31,766	-	31,766
Sim sim					319	-	319
Soybean					657	-	657
All bananas					919,294	-	919,294
Cassava					119,969	-	119,969
Sweet potatoes					28,710	-	28,710
Irish potato					44,841	-	44,841
Cattle					-	124,993	124,993
Goats					-	7,637	7,637
Sheep					-	4,738	4,738
Total					1,367,367	137,368	1,504,735
Monetary Use Food Provisioning Ecosystem Services (million UGX 2018)							
Maize	-	-	-	87,250			
Finger millet	-	-	-	22,801			
Sorghum	-	-	-	3,599			
Rice	-	-	-	-			
Beans	-	-	-	108,161			
Field peas	-	-	-	-			
Cowpeas	-	-	-	-			
Pigeon peas	-	-	-	-			
G.nuts	-	-	-	31,766			
Sim sim	-	-	-	319			
Soybean	-	-	-	657			
All bananas	-	-	-	919,294			
Cassava	-	-	-	119,969			
Sweet potatoes	-	-	-	28,710			
Irish potato	-	-	-	44,841			
Cattle	-	-	-	124,993			
Goats	-	-	-	7,637			
Sheep	-	-	-	4,738			
Total				1,504,735			

The MSUT producers and consumers was balanced and the aggregate monetary supply and use doubled from UGX 751 billion in 2009 to UGX 1,504 billion in 2018 (Tables 30a&b). The household consumptive use doubled from UGX 650 billion to UGX 1,300 billion, while the business consumptive uses also doubled from UGX 101 billion in 2009 to UGX 205 billion in 2018. Household consumption as a proportion of total consumption remained stable at approximately 86%. The absolute increase in business consumption suggests that the Mbarara zone produced more agricultural products in excess of household demand, and that there was an increase in value addition in proportion to the household consumption.

Table 30a: Mbarara zone MSUT producers and consumers for 2009

	Producer				Consumer					
	Gov.	Business	H. holds	Total	Govt.	H. hold	Business	Change in Inventory	Export	Total
Monetary Supply SNA Goods and Services (UGX million, 2009)										
Maize	-	-	-	35,285						
Finger millet	-	-	-	18,288						
Sorghum	-	-	-	8,706						
Rice	-	-	-	88						
Beans	-	-	-	108,813						
Field peas	-	-	-	255						
Cowpeas	-	-	-	46						
Pigeon peas	-	-	-	-						
G.nuts	-	-	-	10,345						
Sim sim	-	-	-	-						
Soybean	-	-	-	108						
All bananas	-	-	-	373,724						
Cassava	-	-	-	31,376						
Sweet potatoes	-	-	-	15,972						
Irish potato	-	-	-	10,708						
Cattle	-	-	-	124,257						
Goats	-	-	-	12,948						
Sheep	-	-	-	188						
Total				751,107						
Monetary Use SNA Goods and Services (UGX million, 2009)										
Maize					-	10,446	24,838	-	-	35,285
Finger millet					-	13,886	4,402	-	-	18,288
Sorghum					-	8,383	322	-	-	8,706
Rice					-	5	84	-	-	88
Beans					-	86,497	22,316	-	-	108,813
Field peas					-	255	-	-	-	255
Cowpeas					-	46	-	-	-	46
Pigeon peas					-	-	-	-	-	-
G.nuts					-	6,335	4,010	-	-	10,345
Sim sim					-	-	-	-	-	-
Soybean					-	108	-	-	-	108
All bananas					-	348,042	25,682	-	-	373,724
Cassava					-	28,831	2,544	-	-	31,376
Sweet potatoes					-	14,268	1,704	-	-	15,972
Irish potato					-	6,977	3,731	-	-	10,708
Cattle					-	113,074	11,183	-	-	124,257
Goats					-	12,818	129	-	-	12,948
Sheep					-	186	2	-	-	188
Total						650,160	100,947	-	-	751,107

Table 30b: Mbarara zone MSUT producers and consumers for 2018

	Producer				Consumer					
	Gov.	Business	H.holds	Total	Govt.	H.hold	Business	Change in Inventory	Export	Total
Monetary Supply SNA Goods and Services (UGX million, 2018)										
Maize	-	-	-	87,250						
Finger millet	-	-	-	22,801						
Sorghum	-	-	-	3,599						
Rice	-	-	-	-						
Beans	-	-	-	108,161						
Field peas	-	-	-	-						
Cowpeas	-	-	-	-						
Pigeon peas	-	-	-	-						
G.nuts	-	-	-	31,766						
Sim sim	-	-	-	319						
Soybean	-	-	-	657						
All bananas	-	-	-	919,294						
Cassava	-	-	-	119,969						
Sweet potatoes	-	-	-	28,710						
Irish potato	-	-	-	44,841						
Cattle	-	-	-	124,993						
Goats	-	-	-	7,637						
Sheep	-	-	-	4,738						
Total	-	-	-	1,504,735						
Monetary Use SNA Goods and Services (UGX million, 2018)										
Maize					-	25,832	61,419	-	-	87,250
finger millet					-	17,312	5,488	-	-	22,801
sorghum					-	3,465	133	-	-	3,599
Rice					-	-	-	-	-	-
Beans					-	85,979	22,182	-	-	108,161
Field peas					-	-	-	-	-	-
cowpeas					-	-	-	-	-	-
pigeon peas					-	-	-	-	-	-
G.nuts					-	19,454	12,313	-	-	31,766
Sim sim					-	314	5	-	-	319
Soybean					-	657	-	-	-	657
All bananas					-	856,120	63,174	-	-	919,294
Cassava					-	110,240	9,729	-	-	119,969
Sweet potatoes					-	25,647	3,063	-	-	28,710
Irish potato					-	29,218	15,623	-	-	44,841
Cattle					-	113,744	11,249	-	-	124,993
Goats					-	7,560	76	-	-	7,637
Sheep					-	4,690	47	-	-	4,738
Total					-	1,300,234	204,501	-	-	1,504,735

6.2.5 Monetary Supply and Use Tables for Mukono zone

The economic units and ecosystem type MSUT for Mukono zone was in balance for the supply and use. The total supply and use increased by 217% from UGX 701 billion 2009 to UGX 2,219 (Table 30a). The monetary value of crop supply and use increased four times from UGX 491 billion to UGX 1,993 billion while

livestock supply and use increased by only 8% from UGX 210 billion to UGX 226 billion between 2009 and 2018 (Tables 31a&b). Nearly, all the increase in economic activity from the ecosystem types into the economic units was from expansion of the crop component of the agriculture sector.

Table 31a: Mukono zone MSUT economic units and ecosystem types for 2009

	Economic Unit				Ecosystem types		
	Gov.	Businesses	Households	Total	Cropland	Grassland	Total
Monetary Supply Food Provisioning Ecosystem Services (UGX million, 2009)							
Maize					103,877	-	103,877
Finger millet					4,615	-	4,615
Sorghum					258	-	258
Rice					1,846	-	1,846
Beans					66,361	-	66,361
Field peas					176	-	176
Cowpeas					156	-	156
Pigeon peas					-	-	-
G.nuts					19,387	-	19,387
Sim sim					86	-	86
Soybean					100	-	100
All bananas					127,469	-	127,469
Cassava					121,650	-	121,650
Sweet potatoes					43,355	-	43,355
Irish potato					2,066	-	2,066
Cattle					-	196,501	196,501
Goats					-	13,001	13,001
Sheep					-	201	201
Total					491,402	209,703	701,105
Monetary Use Food Provisioning Ecosystem Services (UGX million, 2009)							
Maize	-	-	-	103,877			
Finger millet	-	-	-	4,615			
Sorghum	-	-	-	258			
Rice	-	-	-	1,846			
Beans	-	-	-	66,361			
Field peas	-	-	-	176			
Cowpeas	-	-	-	156			
Pigeon peas	-	-	-	-			
G.nuts	-	-	-	19,387			
Sim sim	-	-	-	86			
Soybean	-	-	-	100			
All bananas	-	-	-	127,469			
Cassava	-	-	-	121,650			
Sweet potatoes	-	-	-	43,355			
Irish potato	-	-	-	2,066			
Cattle	-	-	-	196,501			
Goats	-	-	-	13,001			
Sheep	-	-	-	201			
Total				701,105			

Table 31b: Mukono zone MSUT economic units and ecosystem types for 2018

	Gov.	Businesses	Households	Total	Cropland	Grassland	Total
Monetary Supply Food Provisioning Ecosystem Services (UGX million, 2018)							
Maize					559,901	-	559,901
Finger millet					1,821	-	1,821
Sorghum					241	-	241
Rice					20,703	-	20,703
Beans					186,980	-	186,980
Field peas					-	-	-
Cowpeas					-	-	-
Pigeon peas					-	-	-
G.nuts					41,009	-	41,009
Sim sim					632	-	632
Soybean					1,826	-	1,826
All bananas					475,815	-	475,815
Cassava					502,313	-	502,313
Sweet potatoes					156,956	-	156,956
Irish potato					45,228	-	45,228
Cattle					-	201,264	201,264
Goats					-	22,339	22,339
Sheep					-	2,400	2,400
Total					1,993,425	226,003	2,219,428
Monetary Use Food Provisioning Ecosystem Services (UGX million, 2018)							
Maize	-	-	-	559,901			
Finger millet	-	-	-	1,821			
Sorghum	-	-	-	241			
Rice	-	-	-	20,703			
Beans	-	-	-	186,980			
Field peas	-	-	-	-			
Cowpeas	-	-	-	-			
Pigeon peas	-	-	-	-			
G.nuts	-	-	-	41,009			
Sim sim	-	-	-	632			
Soybean	-	-	-	1,826			
All bananas	-	-	-	475,815			
Cassava	-	-	-	502,313			
Sweet potatoes	-	-	-	156,956			
Irish potato	-	-	-	45,228			
Cattle	-	-	-	201,264			
Goats	-	-	-	22,339			
Sheep	-	-	-	2,400			
Total	-	-	-	2,219,428			

The producer and consumer MSUT showed household consumptive use increased by 190% from UGX 562 billion in 2009 to UGX 1,543 billion, while the business consumption increased by 330% from UGX 139 billion to UGX 576 billion over the same period (Table 32a&b).

Table 32a: Mukono zone MSUT producers and consumers for 2009

	Producer				Consumer					
	Gov.	Business	H.holds	Total	Govt.	Household	Business	Change in Inventory	Export	Total
Monetary Supply SNA Goods and Services (UGX million, 2009)										
Maize	-	-	-	103,877						
Finger millet	-	-	-	4,615						
Sorghum	-	-	-	258						
Rice	-	-	-	1,846						
Beans	-	-	-	66,361						
Field peas	-	-	-	176						
Cowpeas	-	-	-	156						
Pigeon peas	-	-	-	-						
G.nuts	-	-	-	19,387						
Sim sim	-	-	-	86						
Soybean	-	-	-	100						
All bananas	-	-	-	127,469						
Cassava	-	-	-	121,650						
Sweet potatoes	-	-	-	43,355						
Irish potato	-	-	-	2,066						
Cattle	-	-	-	196,501						
Goats	-	-	-	13,001						
Sheep	-	-	-	201						
Total				701,105						
Monetary Use SNA Goods and Services (UGX million, 2009)										
Maize					-	30,754	73,123	-	-	103,877
Finger millet					-	3,504	1,111	-	-	4,615
Sorghum					-	249	10	-	-	258
Rice					-	100	1,746	-	-	1,846
Beans					-	52,752	13,610	-	-	66,361
Field peas					-	176	-	-	-	176
Cowpeas					-	156	-	-	-	156
Pigeon peas					-	-	-	-	-	-
G.nuts					-	11,873	7,514	-	-	19,387
Sim sim					-	85	1	-	-	86
Soybean					-	100	-	-	-	100
All bananas					-	118,710	8,760	-	-	127,469
Cassava					-	111,785	9,866	-	-	121,650
Sweet potatoes					-	38,730	4,625	-	-	43,355
Irish potato					-	1,346	720	-	-	2,066
Cattle					-	178,816	17,685	-	-	196,501
Goats					-	12,871	130	-	-	13,001
Sheep					-	199	2	-	-	201
Total						562,204	138,902	-	-	701,105

The proportion of household consumption of crop and livestock products reduced from 80% in 2009 to 73% in 2018, with a corresponding increase in business consumption from 20% to 27%. The increase in business consumption suggests that the zone was likely to have produced more crop and livestock products in excess of household demand, and that there was an increase in value addition in proportion to the household consumption.

Table 32b: Mukono zone MSUT producers and consumers for 2018

	Producer				Consumer					
	Gov.	Business	H.holds	Total	Govt.	Household	Business	Change in Inventory	Export	Total
Monetary Supply SNA Goods and Services (UGX million, 2018)										
Maize	-	-	-	559,901						
Finger millet	-	-	-	1,821						
Sorghum	-	-	-	241						
Rice	-	-	-	20,703						
Beans	-	-	-	186,980						
Field peas	-	-	-	-						
Cowpeas	-	-	-	-						
Pigeon peas	-	-	-	-						
G.nuts	-	-	-	41,009						
Sim sim	-	-	-	632						
Soybean	-	-	-	1,826						
All bananas	-	-	-	475,815						
Cassava	-	-	-	502,313						
Sweet potatoes	-	-	-	156,956						
Irish potato	-	-	-	45,228						
Cattle	-	-	-	201,264						
Goats	-	-	-	22,339						
Sheep	-	-	-	2,400						
Total	-	-	-	2,219,428						
Monetary Use SNA Goods and Services (UGX million, 2018)										
Maize					-	165,766	394,135	-	-	559,901
Finger millet					-	1,383	438	-	-	1,821
Sorghum					-	232	9	-	-	241
Rice					-	1,117	19,586	-	-	20,703
Beans					-	148,633	38,346	-	-	186,980
Field peas					-	-	-	-	-	-
Cowpeas					-	-	-	-	-	-
Pigeon peas					-	-	-	-	-	-
G.nuts					-	25,114	15,895	-	-	41,009
Sim sim					-	623	10	-	-	632
Soybean					-	1,826	-	-	-	1,826
All bananas					-	443,117	32,698	-	-	475,815
Cassava					-	461,576	40,737	-	-	502,313
Sweet potatoes					-	140,212	16,744	-	-	156,956
Irish potato					-	29,471	15,758	-	-	45,228
Cattle					-	183,150	18,114	-	-	201,264
Goats					-	22,116	223	-	-	22,339
Sheep					-	2,376	24	-	-	2,400
Total					-	1,626,712	592,716	-	-	2,219,428

7. INTEGRATED ANALYSIS

7.1 Overview of the integrated analysis

The integrated analysis is intended to provide a holistic interpretation of the full set of Land and Soil Improvement Accounts compiled at the national and ZONE levels. These accounts also provide an insight into SDG 15.3.1, the proportion of land that is degraded over total area, using ecosystem extent accounts and information on nutrient balance and the implications of changing land use configurations on Net Primary Production and Soil Organic Carbon. In combination with the ecosystem supply and use tables, this integrated set of accounts can inform responses to several key policy questions that formed the basis for the accounts development. The key policy questions identified during stakeholder workshops are:

- i) What are the trends in soil fertility/ land degradation/distribution?
- ii) How can soil management practices be improved in order to ensure sustainable agriculture and alleviate poverty?
- iii) How can soil management practices be improved to reduce pressure to convert natural ecosystems and species habitat?
- iv) How should investments be targeted to improve soil management?
- v) How should economic instruments be designed to deliver improved soil management where it matters?
- vi) How should we ensure sustainable production of food to remain a leading food basket for the region?
- vii) Where and how should we address land degradation to ensure food security, particularly for those most vulnerable?
- viii) Are we using land efficiently? Is there underutilization of land in some areas and over use in others?
- ix) How is land degradation related to shifting crop patterns? What are the implications on the biodiversity, economy, livelihood and food security?
- x) How do we maintain the drought-resistant crops and species in order to reduce upcoming tendencies of reclaiming wetlands for crop growing?
- xi) How do we report on SDG 15.3.1 (proportion of land that is degraded over total land area)?

7.2 Integrated synthesis of all the accounts results

7.2.1 Ecosystem extent

Within these accounts, land degradation based on land-cover change, was identified on the basis of forestlands and wetlands being converted for anthropogenic activities (i.e., into the IPCC cropland or settlement classes) while improvement occurred when cropland or settlement classes were converted unto either forest lands and/or wetlands. This indicator was developed in response to government targets to increase the extent of these ecosystems. Other indicators could be developed for other land degradation issues and to inform on trends in other ecosystem types that provide important ecosystem services and important for biodiversity.

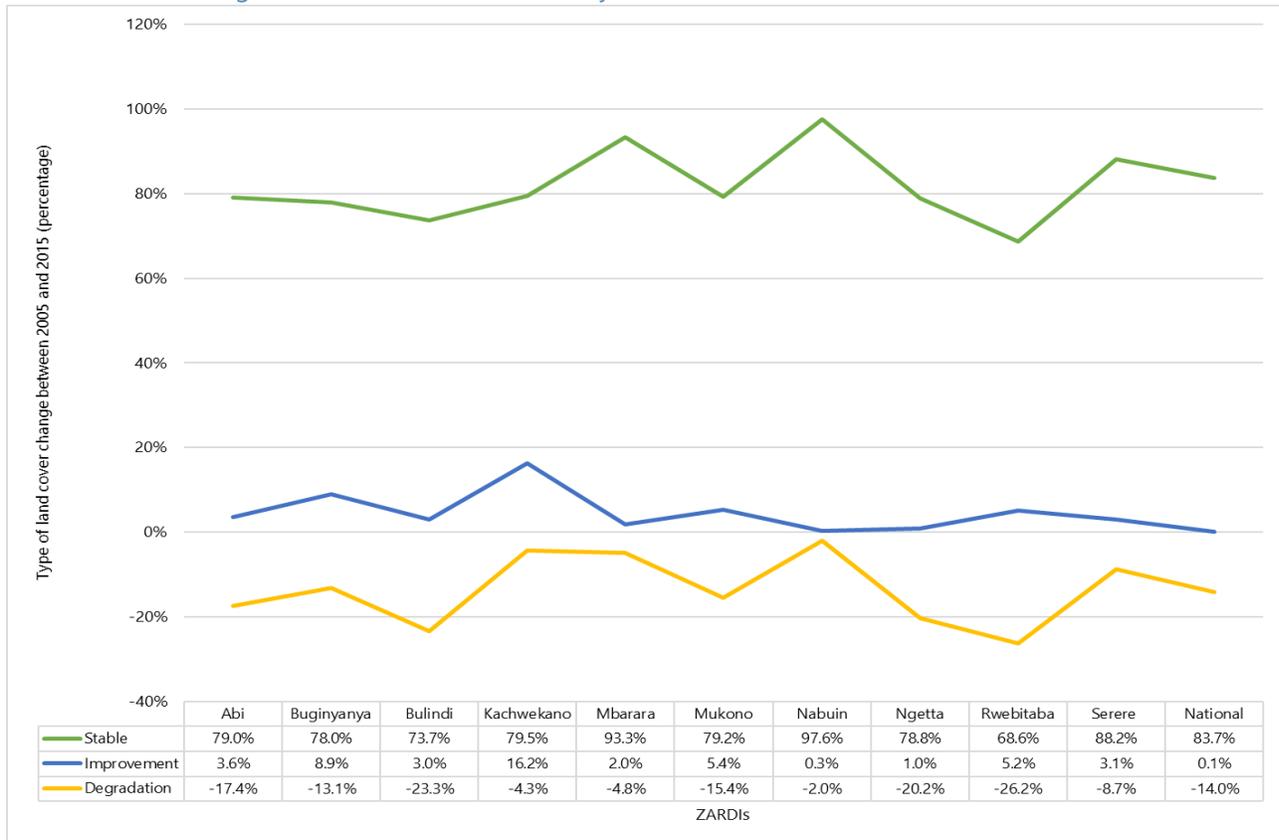
At the national level, Croplands, grasslands and settlements increased as forestlands, bushlands and wetlands reduced. The largest pressure was on forests, which lost 46% of their covers between 2005 and

2015. Similarly, bushlands lost 34% of their cover over the same period. In contrast, croplands gained 18% of their cover (albeit starting from higher absolute extents of cover) while grasslands gained 25% of their cover. The wetlands contracted by 5% and settlements expanded by 39% between 2005 and 2015.

Figure 21 summarises the total land cover flows for each ZONE in terms of flows indicative of degradation (i.e., conversion of forest or wetland to cropland or settlement), indicative of improvement and stable flows (i.e., those not indicative of degradation or improvement). At the ZONE level, the ecosystem extent accounts show that the highest proportion of land cover flows indicative of degradation between 2005 and 2015 was in the Ngetta zone, at 10% of total land cover. This is equivalent to 20% of all the land cover transition between 2005 and 2015 in this ZONE. Whereas, land cover flows indicative of improvement was 1%. For the remaining zones:

- Rwebitaba zone had the second largest land cover flows indicative of degradation, representing 9% for overall land area. This is equivalent to 26% of the land transitions in the zone between 2005 and 2015, transitions indicative of improvement was 5%.
- In the Nabuin zone, the land cover flows indicative of degradation was 2% and improvement only 0.3% of all land cover flows. The land cover flows indicative of degradation in the zone represented 1% of the total zone area.
- In Serere zone, land-cover flows indicative of degradation was 9% and improvement 3% between 2005 and 2015. The land cover flows indicative of degradation in the zone represented 2% of the total zone.
- For Mukono zone, land cover flows indicative of degradation was 15% and improvement 5%. The land cover flows indicative of degradation in the zone represented 1% of the total zone.
- For Mbarara zone, transitional land cover change indicative of degradation was 5% and improvement 2%. The land cover indicative of degradation between 2005 and 2015 in this zone represented 2% of the total area.
- For Kachwekano zone, transitional land cover change indicative of degradation was 4%, and improvement 16% of total land cover flows. The land cover flows indicative of degradation between 2005 and 2015 in this zone represented 1% of total area.
- For Bulindi zone, transitional land cover change indicative of degradation was 23% and improvement 3%. The land cover flows indicative of degradation between 2005 and 2015 in this ZONE represented 8% of total area.
- For Buginyanya zone, out of all the land cover changes between 2005 and 2015, 13% were considered indicative of land degradation and 9% improvement. The land cover flows indicative of degradation between 2005 and 2015 in this zone represented 2% of total area
- For the Abi zone, transitional land cover change indicative of degradation was 17% and improvement 4% of all land cover changes. The land cover flows indicative of degradation between 2005 and 2015 in this zone represented 7% of total area.

Figure 21: Transition in land ecosystem extent between 2005 and 2015



7.2.2 Soil Nutrient Flow Accounts

The national aggregate trends in soil nutrients showed an increase in net nutrient imbalance by 30%, 27% and 35% for nitrogen, phosphorous and potassium between 2009 and 2018. Overall net nutrient outflow increased from 341,964t to 442,929t, from 112,482t to 142,590t, and from 419,614t to 546,750t respectively.

In the Abi and Buginyanya zones the net nutrient outflows decreased while in the Mbarara and Mukono ZONES the net nutrient outflows increased. The net nutrient outflow for the Abi zone, decreased by 14%, and 8%, while that for the Buginyanya zone, decreased by 5%, 11% and 5% for nitrogen, phosphorous and potassium respectively between 2009 and 2018. The increases in net soil nutrient outflow were highest in the Bulindi and Nabuin zones between 2009 and 2018. For Bulindi zone they were and were 174% for Nitrogen, 196% for Phosphorus and 177% for Potassium and for Nabuin they were 114% for Nitrogen, 189% for Phosphorus and 239% for Potassium. Net soil nutrient outflow for Mbarara zone, increased by 8%, 3% and 18% while that for the Mukono zone, increased by 59%, 60% and 62% for nitrogen, phosphorous and potassium over the same period.

Out of the 10 zones assessed for the accounts, only three (Abi, Buginyanya and Serere) showed a decrease in nutrient outflows; the other seven (Bulindi, Kachwekano, Mbarara, Mukono, Nabuin, Ngetta and Rwebitaba) showed an increase in nutrient outflow. The increased net nutrient outflows show the gap between nutrient outflows and nutrient inflows expanded due to increased production, i.e. expansion of planted and/or crop area, and/or due to lower additions of nutrients compared to reductions. Generally, the nutrient inflows from organic and inorganic fertilisers, BNF, crop residue, and atmospheric depositions

were outweighed by nutrient outflows from crop harvest, soil erosion and leaching. The absence of spatially described data on nutrient outflows for organic and inorganic fertilizer also impacted the nutrient balance results

7.2.3 Thematic carbon accounts

The thematic carbon accounts reinforced the finding of nutrient outflows on the status of land and soil improvement. The net accumulation of biomass stock in mtc/year in above ground biomass decreased by 64% from the period between 1990-2000 to the 2010-2015. This result is driven by loss of forest, which is more effective in accumulating biomass carbon than cropland because of the relatively high biomass accumulation of this ecosystem type. This has implication with respect to the capacity of Uganda's landscape to supply climate regulating services linked to climate change mitigation (i.e., carbon sequestration and storage). The biomass accumulation results also reveal a significant trade-off associated with using landscapes for crop provisioning services rather than other biomass provisioning ecosystem services (e.g., non-timber forest products, firewood supply, carbon sequestration and storage)

The thematic carbon accounts reveal the aggregate net organic soil SOC loses are very high in croplands due to the relatively high carbon emission factors from soil associated with conversion of natural ecosystems to crop production. This reveals how changing patterns of land use for agriculture may, potentially, lead to degradation of organic soils due to SOC loses and reduced soil quality in croplands if not properly managed.

7.2.4 Ecosystem supply and use

The physical supply and use tables (PSUT) accounts showed increased output for some crops and a reduction for others, an increase for goats and sheep production and a reduction for cattle. However, the synthesis of crop yield trend between 2009 and 2018 and the accompanying changes in croplands shows that the increase in crop output was largely due to the 54% increase in cropped area from 5.3 million ha in 2009 to 8.1 million ha in 2018. The decrease in crops like finger millet, sorghum and sim-sim are linked to the poor performance in the zones were the crops are dominant that is Ngetta, Serere and Nabuin. Cattle output decreased because it was measured in terms of live animal sales, however there was increased specialization in dairy, which was not reflected in the accounts. Overall, the yield for maize, millet, rice, beans, groundnuts, sweet potatoes, Irish potatoes decreased between 2009 and 2018 while that for bananas and cassava improved.

The monetary supply and use tables (MSUT) show that national supply and use of crops and livestock products increased by 148% from UGX 4.7 trillion to UGX 11.8 trillion between 2009 and 2018. The increase in monetary value was both the result of a 106% increase in average product prices for both crops and livestock, and net increase in output over the two time periods. However, the yields were lower for maize, millet, rice, beans, groundnuts, sweet potatoes and Irish potatoes.² The only increase in yield registered were for cassava and bananas.

Whereas the increase in monetary value suggests an improvement in economic welfare linked to the accounts, the net weighted increase linked to crop output was only 42%, over the nine-year period between

² The accounts could be adjusted to reflect constant prices to mitigate the price effect

2009 and 2018. The average annual increases are likely to be further diminished by other factors such as the high population growth rate 3.03% (UBOS 2016) and compounded by the depletion of soil nutrients.

7.3 Integrating poverty statistics with the accounts

Given the central national development concern of addressing poverty alleviation, a number of poverty incidence maps have been produced for Uganda. Mapping poverty incidence offers government authorities and development partners a clear view of the evolving incidence of poverty across localities. They also provide crucial spatial information to inform the formulation, implementation and monitoring of poverty-reduction policies at different levels of government.

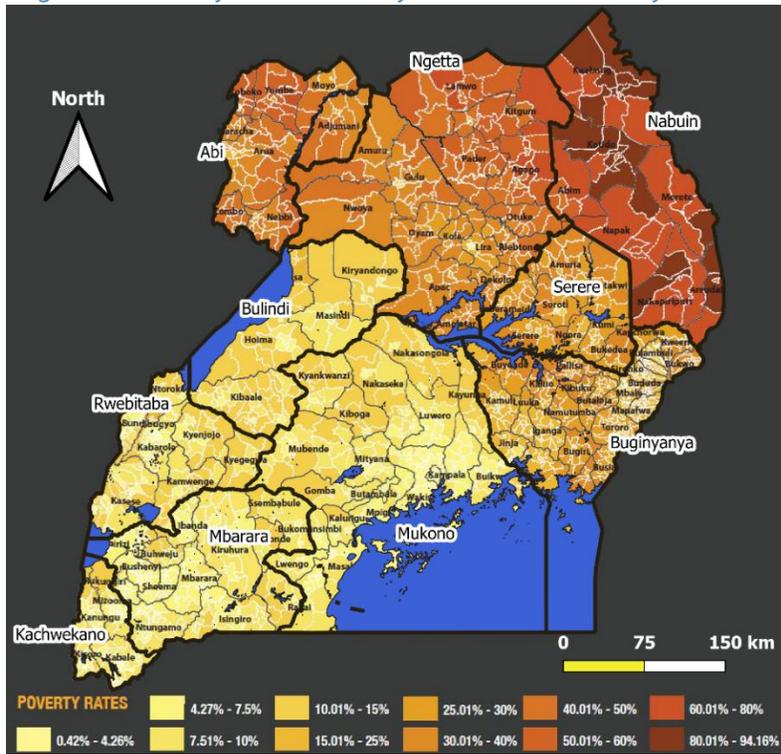
UBOS has produced poverty maps for the sub-county level using Small Area Estimation (SAE) methods as part of a joint project with support from the World Bank and UNICEF. The most recent sets of poverty maps combines data from the 2012/2013 and 2016/2017 Uganda National Household Survey and the 2014 National Housing and Population Census to estimate poverty incidence at sub-county scale (UBOS, 2019). This is broadly considered to relate to the 2012/2013 and 2016/17 situations. Figures 22 and 23, present these poverty data at the sub-county and district scale, respectively, aligned to the zone boundaries.³

In areas of high poverty incidence, people are likely to be particularly vulnerable to the impacts of land degradation on their livelihoods and food security. Given their common spatial nature, the land and soil improvement accounts can be aligned to information from poverty maps to support integrated analyses. Specifically, to assist in identifying investments to address land degradation and improve the productive capacity of agricultural ecosystems may best support poverty alleviation and reduce pressure on biodiversity from shifting agriculture and extraction of resources from natural ecosystems.

The highest levels of poverty by zone for both 2012/13 and 2016/17 were in the Nabuin zone followed by the east-central part of Ngetta and parts of Bukedi and Busoga sub-regions in the Buginyanya zone. The lowest levels of poverty were the Mukono and Mbarara zones, South central parts of Ngetta zone, and Central parts of Rwebitaba zone (Figure 22 and Figure 23). The soil land and soil improvement accounts can provide some insights into possible relationships (or correlations) between relatively high poverty incidence, land use, land degradation and agricultural production. Although, it is very much recognized that poverty is a multi-faceted development issue requiring well-coordinated policy responses over several development issues.

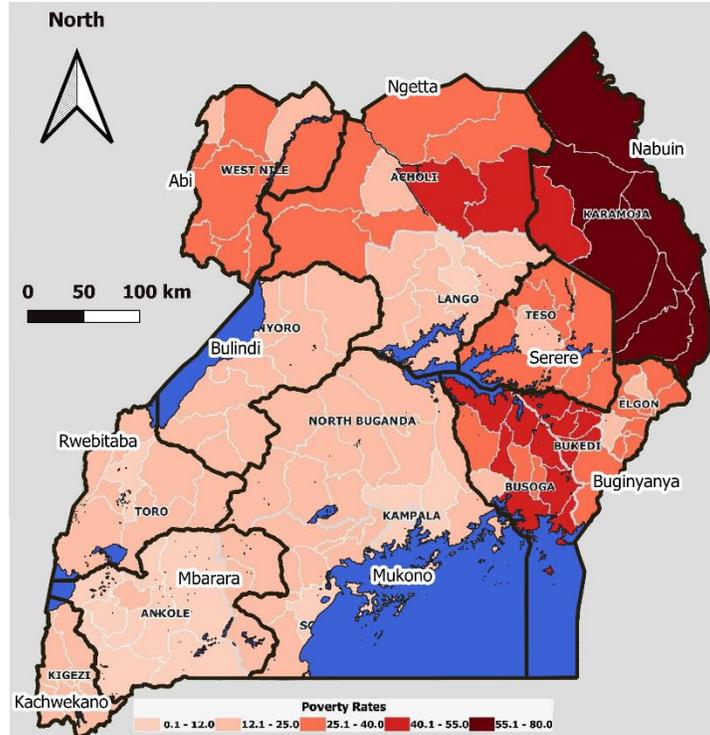
³ Based on this UBOS Presentation: https://www.ubos.org/wp-content/uploads/publications/02_2020Presentation_-_Uganda_Poverty_Maps_2016-20177.pdf

Figure 22: Poverty Headcounts by zone and sub-county. 2012/13



Source: adapted from UBOS (2019)

Figure 22: Poverty Headcounts by zone and District, 2016/17



Source: adapted from UBOS (2019)

Table 33 presents a summary of some key indicators from the soil and improvement accounts for the three ZONEs with the highest poverty incidence. Total area, change in cropland extent and land cover degradation flows (i.e., conversion of forest or wetland to cropland or settlement) were obtained from the ecosystem extent accounts. Change in NPK, reflects the change in the net balance all nutrients in aggregate. A negative value implies an increasing amount of nutrient being extracted from the soil. The change in planted area is from the Annual Agricultural Survey. Both sets of values are obtained from the nutrient flow accounts in the Annexes. The change in crop, cattle and goat production were obtained from the PSUTs for the food provisioning service. Changes in crop production are aggregated across all crops.

Table 33: Key land and soil improvement accounts indicators for high poverty incidence zones

Aspect	Nabuin	Ngetta	Buginyanya
Total area (ha)	2,759,806	4,202,341	2,661,505
Cropland area (ha, opening extent)	366,240	1,548,947	1,354,464
Cropland (Net change 2005 to 2015 to opening extent, %)	-10%	59%	4%
Cropland (Gross change* 2005 to 2015 to opening extent, %)	86%	87%	16%
Area planted (Net change 2009 to 2018, ha)	246,641	120,036	456,268
Land cover degradation flows (Net 2005 to 2015, ha)	26,048	413,965	42,305
Change NPK balance (2009 to 2018, tonnes / yr)	(15,365)	(29,936)	12,539
Crop production (Net change 2009 to 2018, tonnes)	282,361	618,052	(623,052)
Cattle production (Net change 2009 to 2018, tonnes)	317,277	73,726	(22,009)
Goat production (Net change 2009 to 2018, tonnes)	624,788	95,810	(50,170)

***Gross changes is the sum of additions and reductions to cropland extent**

Unlike most other zones (with the exception of Rwebitaba), Table 33 reveals that the extent of cropland in the Nabuin zone reduced between 2005 and 2011 (-1%). However, the area planted and the gross crop production both increase between 2009 and 2018. This suggests the loss of cropland has not impacted negatively on crop production, although further analysis of shifts in cropping systems would be required to fully evaluate this. The gross changes in cropland extent are also large (86%), indicating substantial turnover in areas used for agriculture. The nutrient imbalance also becomes substantially more negative in Nabuin between 2009 and 2018 (-15,365), Inspection of the nutrient flow accounts in the Annexes, reveals this is driven by increases in crop nutrient uptake.

As land cover degradation flows in Table 33 reveals, approximately 26,000 ha of forest and wetland was converted to cropland or settlement in the Nabuin zone. This may have impacted on the welfare of vulnerable people in Nabuin that have a dependence on these natural ecosystems.

Whilst not shown in Table 33, over 50% of land cover change in Nabuin between 2005 and 2015 was due to expansion of grasslands. Under the pastoral farming system in Karamoja, the wealth from cattle is measured in numbers and the economic activity associated with livestock is relatively low. On the other hand, crops are used for subsistence household consumption and surplus for sale. A reduction in cropland

and increase in grasslands could indicate short term reduction in income even if the long-term stocks of cattle do improve as Table 32 reveals, livestock production has increased significantly in the Nabuin zone between 2009 and 2018.

Table 33 reveals relatively high net and gross changes in the extent of croplands between 2005 and 2015 in the Ngetta zone. Between 2005 and 2015, the area of cropland increased substantially (by 59%). The gross changes (87%), reveal dynamic and shifting land use patterns involving agriculture. Interestingly, the area actually planted remains relatively stable, when compared to the Nabuin and Buginyanya zones. Nonetheless, the nutrient imbalance become increasing more negative between 2009 and 2018 (-29,936 tonnes / year). This is due to combination of increasing the area of land used for crop cultivation and increasing crop production. As Table 32 reveals, relatively high land cover flows indicative of degradation were observed in the Ngetta zone. Approximately 414,000 ha of forest and wetland was converted to cropland or settlement in the Ngetta zone. This may have impacted on those with a dependence on these natural ecosystems for their livelihoods.

A key observation from Table 33 for the Buginyanya zone is that despite increasing cropland extent and area planted, crop production has decreased substantially between 2009 and 2018 (-623,052 tonnes). This is compounded by reductions in livestock output over the same period.

By contrast, the Mbarara zone benefited from a reduction in poverty from between 4-10% in 2012/13 to a range of 0.42% to 7.5% in 2016/17. The livestock production in the Mbarara zone results into livestock products of milk and live animals, which are traded and competitive alongside commercial smallholder value chains for bananas. One of the lessons from the Mbarara zone experience is the building of a commercial livestock value chain that seeks to achieve an economic optimum with the land allocated to grasslands as livestock forage areas. A characteristic for the Buginyanya zone is the low value crop value chain of maize compared to dairy livestock and bananas in from the Mbarara zone.

8. CONCLUSIONS AND RECOMMENDATIONS

8.1 Conclusions

- The national ecosystem extent accounts showed around 1.16 million ha of gross additions to cropland and around 7,000 ha for settlement between 2005 and 2015 are considered land cover flows indicative of degradation (i.e., conversion of forest or wetland to cropland or settlement). This was equivalent to 5% of the aggregate national land cover that was degraded due to conversion of forest and wetland to other non-natural ecosystem types (mainly cropland) between 2005 and 2015. At the national level, improvement with respect to increasing forest and wetland extent based on land-cover change was only approximately 240,000ha between 2005 and 2015.
- The proportion of land change that was considered indicative of land degradation was highest in the Rwebitaba, Bulindi and Ngetta zones at 26%, 23% and 20% respectively. It was below 20% at 17% in the Abi zone, 13% in Buginyanya zone, 4% in the Kachwekano zone, 5% in Mbarara zone, 15% in the Mukono zone, 2% in the Nabuin zone, and 9% in the Serere zone. The land-cover change between 2005 and 2015, indicative of land degradation as a proportion of total area, was 7% in the Abi ZONE, 2% in the Buginyanya zone, 8% in the Bulindi zone, 1% in the Kachwekano ZONE, 2% in the Mbarara zone, 4% in the Mukono zone, 1% in the Nabuin zone, 10% in the Ngetta ZONE, 9% in the Rwebitaba zone, and 2% in the Serere zone. These land conversions are indicative of pressures manifesting on biodiversity in the form of forest and wetland ecosystem, and associated species habitat, loss. The Government of Uganda has targeted increasing the cover of these two ecosystems as part of its development planning. However, this should not be considered entirely equivalent to the land degradation sub-indicator associated with land cover change envisaged under SDG 15.3.1.
- The soil nutrient depletion increased by approximately 30% between 2009 and 2018. The high net nutrient outflow was the result of very low nutrient inflows in organic and inorganic fertilisers, crop residues, atmospheric deposition and BNF, compared to the outflows in crop harvest, soil erosion, and leaching. Given that crop harvests have to occur for the production cycle to exist, the effort in soil nutrient management lies in the largely manageable nutrient inflows of organic and inorganic fertilizer, and outflows of soil erosion. Therefore, the efforts of sustainable land management, combined with the increased organic and inorganic fertilizer inflows, will also reduce the pressure to convert natural ecosystems for agricultural production.
- The Annual biomass carbon accumulation was lower by 64% in 2010-2015 compared to 1990-2000. Increasing NPP will be managed through increased biomass cover, particularly through forest and tree cover restoration in all land cover, under SLM, REDD+ and smart agriculture practices. Net organic soil SOC loses are very high in croplands due to the relatively high carbon emission factors from soil associated with conversion of natural ecosystems to crop production. This reveals how changing patterns of land use for agriculture may, potentially, lead to degradation of organic soils due to SOC loses and reduced soil quality. SLM activities and additional efforts to increase organic manure and to support soil mineralization, through an increase in crop and plant residues and

creation of a micro-climate that enhances the mineralization of soils may be adopted to manage this issue where appropriate. The Net Biomass accumulation, Annual NPP and SOC were estimated based on international IPCC default factors; it would be prudent to improve the accuracy of the measurements.

- The ecosystem supply and use showed the aggregate crop output measured. Overall, the crop yields were lower for all but three of the crops considered for the accounts. The increase in crop output was largely due to expansion of planted area, with associated impacts on natural ecosystems. It would seem that the resultant increase in the expansion of planted area outweighed the decrease in yields; however, such a situation is not sustainable in part because the soil nutrients were much depleted. In addition, the MSUT only considered the gross revenue from crops and livestock production. If the costs considered included the economic costs of nutrient depletion, there is a high likelihood that the current production would appear unprofitable.
- The PSUT and MSUT also showed that 70-80% of the current crop and livestock production is for consumption by households, and only in a few cases, such as Mukono zone, where a high level of urbanization exists, the use by business (i.e., value addition activities) increased. There is an additional need to increase both production and value addition to increase revenue, and the incentives for the current value chains, as well as or increase products to mean the business and industrial needs as envisaged in the NDPIII.
- From a poverty alleviation perspective, the Nabuin, Ngetta and Buginyanya zone exhibit relatively high levels of poverty incidence and the benefits of addressing land degradation may deliver the highest social welfare benefits if targeted to these areas. This would also reduce pressures on natural ecosystems, wildlife reserves and other protected areas in the east and north of Uganda.

8.2 Recommendations

8.2.1 Policy recommendations

1. For the agriculture sector, soil nutrient depletion can be mitigated through a number of actions that lead to an increase in nutrient inflow from organic and inorganic fertilisers, BNF and crop residues. Concurrently, nutrient outflow can be reduced through actions to reduce the volume of crop residues that leave the farm during harvest, minimizing soil erosion and nutrient leaching. A comprehensive soil and land management (SLM) package comprising soil fertilizer application, and smart agriculture practices of agroforestry, minimum tillage, terracing, mulching and cover crops, prescribed in existing guidance need to be fast-tracked and prioritized in government budgets, and development support. Increasing land-use efficiency and productivity through such schemes will directly benefit rural population with a high dependence on subsistence agriculture. This would also have significant benefits for biodiversity by reducing pressure to convert natural ecosystems (including forest and wetlands) for permanent or shifting agricultural production.
2. For the national environmental regulator and MAAIF, the use of economic incentives associated with voluntary and verified carbon credit schemes both through national and international schemes

needs to be scaled up, leading to an increase in above ground biomass/carbon stock accumulation and SOC. The system for economic incentives under the Environment Act 2019 needs to be detailed, and accompanying regulations developed to support the opportunities that biomass based and soil organic carbon can create. In addition, partnerships in developing indices for measurement and engagement with potential buyers need to be promoted. This could also create incentives for restoring forests and wetlands due in order to secure associated climate change mitigation benefits.

3. Land-use efficiency, soil nutrient depletion and carbon stock accumulation would benefit from improved land-use planning, as highlighted in the natural SLM guidance and NDP/III. Land-use planning for optimal use is generally conducted by local government and communities with support from civil society. Land-use planning would enable land users to make optimal choices, whether for subsistence use and/or communal use. This is highly relevant for ZONEs with high poverty incidence, such as Nabuin, Ngetta and Buginyanya and where poverty is associated with falling crop production (as is the case for Buginyanya). In addition, the integration of incentive measures and soil fertility improvement generally benefits from the existence of land-use plans. This integrated approach to land-use planning can also deliver much better outcomes for biodiversity by reducing future land requirements for agriculture and conserving natural ecosystems (including forests and wetlands) and their extent. It could also, potentially, create space for forest and wetland restoration to support the sustainable supply of other biomass related provisioning and other ecosystem services. This may be particularly relevant for the Abi, Rwebitaba and Ngetta zones where land cover flows indicative of degradation is relatively high.
4. Given the high nutrient depletion in the country it is evident that the farmers in the country adopt and use the most efficient technology options on seeds, soil fertility improvement and agronomic practices of optimal planting spaces, timing and crop rotation. This may be particularly relevant in ZONEs where large increases in nutrient imbalances are observed in recent years, such as Bulindi and Nabuin. The reduction in net nutrient outflow in Abi, Buginyanya and Serere zones, and some improved productivity in the Mukono and Mbarara zone, are linked to adaptive production practices in the face of depleting soil nutrients.
5. Land and soil nutrient depletion and other indicators of soil quality degradation (e.g., SOC) needs to be included in the macroeconomic indicators, under a sustainable wealth indicator such as a green GDP. The use of a sustainable indicator will serve as a continuous reminder for the central government and local governments on the need for actions to reserve the soil/land from degradation. Additionally, use of a sustainable wealth indicator will allow for streamlining of value chains, and market structures to ensure that there are more incentives i.e. revenue distribution in the value chains to enhance resource rents from value chains linked to land and soils, and investment in land and soil replenishment. The Thematic accounts presented in this report provide support the derivation of such indicators. However, the default factors and co-coefficients employed to create the accounts would benefit greatly from updating based on primary research studies, improved modelling and, ideally, systematic sampling across all zones and AEZs.

6. Increased value addition for crop and livestock value chains will be critical to generating sustainable market led incentives for re-investment in land and soil resources, alongside streamlining the commodity value chains, as envisaged in the NDPIII.

8.2.2 Recommendations for research

1. The integrated set of accounts compiled have been developed from existing information in UBOS Annual Agricultural Survey and National Physical Land Asset Accounts. The thematic nutrient flow and carbon accounts have been developed using known default coefficients and factors. There are data gaps of the soil nutrient balance, particularly with organic and inorganic fertilizer by zone. There is need to include data collection on fertilizer and manure in the AAs and UNHS to address the existing gaps. These accounts would also be improved by investment in soil monitoring, ideally at ZONE level, and modeling of updated national coefficients to support accounts compilation. The thematic carbon relied on default factors from the IPCC. There is a need to develop Tier II and Tier III default factors to increase precision of measures, which will ultimately improve policy recommendations and implementation.
2. It would be useful to develop indicators on land use efficiency from the accounts. These could be achieved via integration of information in the ecosystem extant accounts and planted area and production data from the Annual Agricultural Surveys. This would be a, potentially, very useful indicator land use and arable agriculture planning.
3. Better understanding of what is happening to these ecosystems would be provided with improved ecological detail, particularly for wetlands where on the ground surveying is often required to identify full extent of these ecosystems. The analysis is structured on forests and wetlands, there will be other important ecosystems supplying important services to people and supporting important biodiversity. Other indicators could be developed to communicate to the relationship between evolving land use and these wider environmental development issues.
4. The supply and use tables only covered 15 crops, with output gaps or field peas, cow peas and pigeon peas in 2018. As more data is collected within the Annual Agriculture Survey System and others, the size of the PSUT and MSUT will have to be expanded to have representation of commercial crops. Particularly coffee in the MSUTS and, more generally, cotton, tea, sugarcane, vegetables and fruits, among others. Nevertheless, these land and soil improvements provide a strong foundation for the improvement required.
5. As momentum for development of natural capital accounts grows, there will be increased need to integrate the results of the accounts development into the system of national accounts (SNA). The set of land and soil improvement accounts provide an articulation of the relationship between agricultural goods in the SNA and land and soil assets underpinning their supply. Further analytical integration could include development of an environmentally extended Social Accounting Matrix (SAM) and to undertake economic applications through simulations of the macroeconomic models

to demonstrate the value of the natural capital accounts to the quality of policy and decision making in the country.

6. The development of these accounts means that there is sufficient information to further develop the types of economic instruments that ensure optimal investments to enhance integrated approach to sustainable land management in the country, which recognizes and secures the ecosystem services supplied by agricultural and natural ecosystems, such as forests and wetlands. The applied research would build on existing examples, under REDD+ and voluntary carbon projects via the thematic carbon accounts, among others.

REFERENCES

Batjes, N. H. 2009 IPCC Default soil classes derived from harmonized World Soil Database Version 1.0, Carbon Benefits Project (CBP) and World Soil Information (ISRIC), Wageningen. The Netherlands. Available at https://www.isic.org
Chow, J 2016 Advancing the SEEA Experimental Ecosystem Accounting – Experience from the UN pilot project. Environmental Economic Accounts Section United Nations Statistics Division. A Community on Ecosystem Services (ACES) Conference 2016 Jacksonville, USA, 5-9 December 2016. http://www.unsd.org
Clark, D.A., Brown, S., Kicklighter, D. W., Chambers, J. Q., Thomlinson, J. R. and Ni, J. (2001), measuring net primary production in forests: concepts and field methods. <i>Ecological Applications</i> , 11: 356-370. Doi:10.1890/1051-0761(2001)011[0356: MNPPIF] 2.0.CO;2
FAO 2006 Plant nutrition for food security: A guide for integrated nutrient management, FAO Fertilizer and Plant Nutrition Bulletin 16, Food and Agriculture Organization of the United Nations Rome, 2006
FAO 2017. Soil Organic Carbon: the hidden potential. Food and Agriculture Organization of the United Nations Rome, Italy
FAO and UNSD (2018) System of Environmental-Economic Accounting for Agriculture, Forestry and Fisheries: SEEA AFF White Cover version. Rome, FAO. Available at: http://www.fao.org/fileadmin/templates/ess/ess_test_folder/Publications/Agrienvironmental/SEEA_AFF_White_Cover.pdf .
FAO and ITPS. 2015. Status of the World's Soil Resources, Rome: s.n
GoU 2014 Uganda Strategic Investment Framework for Sustainable Land Management 2010 – 2020, United Nations Development Programme (UNDP), Kampala. http://www.undp.org
UBOS 2019 Land Physical Asset Accounts for Uganda: Technical Report, Uganda Bureau of Statistics, Kampala
Hamilton, K., Bayon, R., Turner, G., Higgins, D. 2007 State of the Voluntary Carbon Markets 2007: Picking Up Steam, New Carbon Finance 71 Gloucester Place London W1U 8JW and The Ecosystem Marketplace 1050 Potomac St. NW Washington, DC 200071, www.ecosystemmarketplace.com
IPCC 2006, 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Intergovernmental Panel on Climate Change (IPCC), IPCC/OECD/IEA, Paris, France.
Ivanov, E. D., Young, H. R., Weber, J.L. 2011 Constructing the Net Primary Production and Biomass accounts and Ecosystem Carbon Balance Index: A Methodological Note Paper prepared for discussion at the expert meeting on ecosystem accounting organised by the UNSD, the EEA and the World Bank, hosted by Defra and ONS, London, 5 – 7 December 2011. Nottingham, UK. https://unstats.un.org/unsd/envaccounting/seeales/egm/Issue4_Ivanov.pdf
Karamage, F., Zhang, C., Liu, T., Maganda, A. and Isabwe, A. (2017) Soil Erosion Risk Assessment in Uganda, <i>Forests</i> 2017, 8, 52; doi:10.3390/f8020052;

<p>Kloeppel, B.D.; M.E. Harmon; T.J. Fahey. 2007. Estimating aboveground net primary productivity in forest-dominated ecosystems. Pages 5 63-81 In Fahey, T.J.; A. K. Knapp, editors. Principles and Standards for Measuring Primary Production. Oxford University Press, New York. 268 pp.</p>
<p>Kraybill, D. and Kidoido M. 2009 Analysis of relative profitability of key Ugandan agricultural enterprises by agricultural production zone, Uganda Strategy Support Program (USSP) Background Paper no. USSP 04, International Food Policy Research Institute. Washington, DC. http://www.ifpri.org</p>
<p>MAAIF (2018) National Adaptation Plan for the Agricultural sector (NAP-Ag), Ministry of Agriculture, Animal Industry and Fisheries (MAAIF), UN Food and Agriculture Organisation and United Nations Development Programme, Entebbe. Also available at http://www.agriculture.go.ug</p>
<p>MAAIF/ UBOS 2015 Fertilizer consumption and fertilizer use by crop in Uganda, Uganda Bureau of Statistics, Kampala. http://www.ubos.org</p>
<p>Minai, J.O. 2015 Assessing the spatial variability of soils in Uganda, (2015). Open Access Theses. 581. https://docs.lib.purdue.edu/open_access_theses/581</p>
<p>Mugagga, F. Kakembo, V. and Mukadasi, B. 2011 Characterisation of the physical properties of soil and the implications for landslide occurrence on the slopes of Mount Elgon, Eastern Uganda, Journal of the International Society for the Prevention and Mitigation of Natural Hazards (Nat Hazards) DOI 10.1007/s11069-011-9896-3</p>
<p>Nakakaawa, C., J. Aune, and P. Vedeld. 2009. Changes in carbon stocks and tree diversity in agro-ecosystems in south western Uganda: what role for carbon sequestration payments? <i>New Forests</i>. 40 (1): 19-44.</p>
<p>NEMA, UBOS, NPA, UNEP WCMC, IIED and IDEEA 2018 Inception Report: Project for Integrating Natural Capital Accounts into Sustainable Decision Making, United Nations Environment World Conservation Monitoring Centre, Cambridge.</p>
<p>NEMA, UBOS, NPA, UNEP WCMC, IIED and IDEEA, 2019a Context Analysis: Project for Integrating Natural Capital Accounts into Sustainable Decision Making, United Nations Environment World Conservation Monitoring Centre, Cambridge.</p>
<p>NEMA, UBOS, NPA, UNEP WCMC, IIED and IDEEA, 2019b Draft SEEA Methodological Note: Land Degradation Accounts V01, Project for Integrating Natural Capital Accounts into Sustainable Decision Making, United Nations Environment World Conservation Monitoring Centre, Edinburgh Cambridge.</p>
<p>Richmond, A., Kaufmann, R. K., Myneni, R. B. (2007) Valuing ecosystem services: A shadow price for net primary production, <i>Ecological Economics</i> 64 (2007) 454 – 462</p>
<p>Sims, N.C., Green, C., Newnham, G. J., England, J. R., Held, A., Wulder, M. A., Martin Herold, M. Cox, S.J.D., Huete, A.R., Kumar, L., Viscarra-Rossel, R.A., Roxburgh, S.H., and McKenzie, N.J. (2017). Good Practice Guidance SDG Indicator 13.3.1: proportion of Land that is degraded over total land area. United Nations Convention to Combat Desertification (UNCCD), Bonn,</p>
<p>Stanley, M.P.- Hamilton, K., Marcello, T. and Sjardin, M. 2011 Back to the Future State of the Voluntary Carbon Markets 2011, A Report by Ecosystem Marketplace & Bloomberg New Energy Finance, The Ecosystem Marketplace. Washington, DC 200071, www.ecosystemmarketplace.com</p>

UBOS (2019) Poverty Maps of Uganda Mapping the Spatial Distribution of Poor Households and Child Poverty Based on Data from the 2016/17 Uganda National Household Survey and the 2014 National Housing and Population Census Technical Report October 2019, Kampala. http://www.ubos.org
UBOS 2009 Uganda Census of Agriculture 2008/2009: Volume IV: Crop Area and Production Report. Uganda Bureau of Statistics, Kampala. http://www.ubos.org
UBOS 2009 Uganda Census of Livestock 2008/2009: Volume IV: Crop Area and Production Report. Uganda Bureau of Statistics, Kampala. http://www.ubos.org
UBOS 2011 Consumer Price Index 2011, Uganda Bureau of Statistics, Kampala. http://www.ubos.org
UBOS 2017 Uganda National Household Survey 2016/17, Uganda Bureau of Statistics, Kampala. http://www.ubos.org
UBOS 2018 Consumer Price Index 2011, Uganda Bureau of Statistics, Kampala. http://www.ubos.org
UBOS 2020 Annual Agricultural Survey 2018, Uganda Bureau of Statistics, Kampala. http://www.ubos.org
United Nations 2014 System of Environmental-Economic Accounting— Experimental Ecosystem Accounting, ST/ESA/STAT/Ser.F/112, United Nations, New York, Available from http://unstats.un.org
UN et al. (2014a) System of Environmental Economic Accounting 2012—Central Framework. New York. Available at: http://unstats.un.org/unsd/envaccounting/seeaRev/SEEA_CF_Final_en.pdf .
UN et al. (2018) Technical Recommendations in support of the System of Environmental-Economic Accounting 2012. White cover publication. Available at: https://seea.un.org/sites/seea.un.org/files/technical_recommendations_in_support_of_the_seea_eea_final_white_cover.pdf .
UNEP-WCMC and IDEEA Group (2017) 'Experimental Ecosystem Accounts for Uganda'. Available at: www.wcmc.io/0524
UNSD (2021) System of Environmental-Economic Accounting—Ecosystem Accounting: Final Draft. New York. Available at: https://seea.un.org/ecosystem-accounting
World Bank 2005 Uganda Policy Options for Increasing Crop Productivity and Reducing Soil Nutrient Depletion and Poverty, Report No. 32971-UG. World Bank (AFTS2) Environmentally and Socially Sustainable Development, Africa Region, Washington DC
World Bank 2016 State and Trends of Carbon Pricing 2018 2018 International Bank for Reconstruction and Development / The World Bank 1818 H Street NW, Washington DC 20433 Telephone: 202-473-1000; Internet: www.worldbank.org
World Bank 2018 State and Trends of Carbon Pricing 2018 2018 International Bank for Reconstruction and Development / The World Bank 1818 H Street NW, Washington DC 20433 Telephone: 202-473-1000; Internet: www.worldbank.org

ANNEXES – FULL ACCOUNTING RESULTS

Annex I: Ecosystem Extent for other ZARDIs

Bulindi zone land and soil ecosystem extent account by IPCC land cover classes, 2005 to 2015

IPCC Land Cover Account	Bulindi 2005 to 2015							
	Cropland	Forest	Grassland	Wetland	Ordinary lands	Settlements	Open Water	Total
Opening Stock (ha)	625,920	564,545	174,935	27,810	258,658	2,652	307,685	1,962,205
<i>Total additions to stock</i>	270,136	110,713	138,157	18,426	121,530	3,555	1,879	664,395
<i>Total reductions in stock</i>	-67,628	-303,535	-77,194	-8,010	-205,219	-1,778	-1,031	-664,395
Net change in stock (ha)	202,508	-192,822	60,962	10,416	-83,688	1,777	847	0
<i>Improvement flows</i>	-	16,896	-	3,192	-	-	-	20,088
<i>Degradation flows</i>	-153,918	-	-	-	-	-556	-	-154,474
<i>Stable or stable flows</i>	674,509	354,828	231,104	35,033	142,326	3,873	307,840	1,749,515
Closing Stock (ha)	828,427	371,724	235,898	38,225	174,970	4,429	308,533	1,962,205

Kachwekano zone land and soil ecosystem extent account by IPCC land cover classes, 2005 to 2015

IPCC Land Cover Account	Kachwekano 2005 to 2015							
	Cropland	Forest	Grassland	Wetland	Ordinary lands	Settlements	Open Water	Total
Opening Stock (ha)	373,028	74,397	48,120	2,418	10,759	1,645	21,462	531,829
<i>Total additions to stock</i>	13,809	23,453	20,429	2,388	22,432	222	1,529	84,262
<i>Total reductions in stock</i>	-49,603	-15,720	-10,204	-1,209	-6,314	-1,050	-163	-84,262
Net change in stock (ha)	-35,793	7,733	10,225	1,179	16,118	-827	1,366	0
<i>Improvement flows</i>	-	12,302	-	1,375	-	-	-	13,678
<i>Degradation flows</i>	-3,601	-	-	-	-	-15	-	-3,617
<i>Stable or stable flows</i>	333,634	69,827	42,714	2,222	9,968	803	22,762	481,928
Closing Stock (ha)	337,235	82,129	58,345	3,597	26,877	818	22,828	531,829

Nabuin zone land and soil ecosystem extent account by IPCC land cover classes, 2005 to 2015

IPCC Land Cover Account	Nabuin 2005 to 2015							
	Cropland	Forest	Grassland	Wetland	Ordinary lands	Settlements	Open Water	Total
Opening Stock (ha)	366,240	386,995	1,293,144	3,575	708,892	928	32	2,759,806
<i>Total additions to stock</i>	139,744	103,591	725,374	1,293	315,980	2,542	262	1,288,784
<i>Total reductions in stock</i>	-174,675	-299,113	-285,055	-3,383	-525,856	-700	-2	-1,288,784
Net change in stock (ha)	-34,931	-195,523	440,319	-2,091	-209,876	1,841	260	0
<i>Improvement flows</i>	-	4,258	-	-	-	-	-	4,258
<i>Degradation flows</i>	-25,891	-	-	-	-	-157	-	-26,048
<i>Stable or stable flows</i>	305,419	187,214	1,616,889	1,484	447,200	2,612	221	2,561,039
Closing Stock (ha)	331,309	191,473	1,733,463	1,484	499,017	2,769	292	2,759,806

Ngetta zone land and soil ecosystem extent account by IPCC land cover classes, 2005 to 2015

IPCC Land Cover Account	Ngetta 2005 to 2015							
	Cropland	Forest	Grassland	Wetland	Ordinary lands	Settlements	Open Water	Total
Opening Stock (ha)	1,548,947	826,972	954,472	77,035	638,169	17,905	138,842	4,202,341
<i>Total additions to stock</i>	1,124,141	79,168	534,114	21,079	268,102	15,430	3,701	2,045,734
<i>Total reductions in stock</i>	-216,352	-698,645	-514,761	-41,816	-557,807	-12,839	-3,515	-2,045,734
Net change in stock (ha)	907,788	-619,477	19,353	-20,737	-289,704	2,591	185	0
<i>Improvement flows</i>	-	13,328	-	6,384	-	-	-	19,712
<i>Degradation flows</i>	-412,737	-	-	-	-	-1,228	-	-413,965
<i>Stable or stable flows</i>	2,043,998	194,167	878,734	49,914	260,720	19,268	136,775	3,583,575
Closing Stock (ha)	2,456,735	207,495	973,825	56,298	348,465	20,496	139,027	4,202,341

Rwebitaba zone land and soil ecosystem extent account by IPCC land cover classes, 2005 to 2015

IPCC Land Cover Account	Rwebitaba 2005 to 2015							
	Cropland	Forest	Grassland	Wetland	Ordinary lands	Settlements	Open Water	Total
Opening Stock (ha)	595,786	407,458	200,504	32,567	91,918	3,113	65,620	1,396,966
<i>Total additions to stock</i>	190,116	101,408	89,337	21,039	63,712	2,896	2,493	471,001
<i>Total reductions in stock</i>	-87,459	-224,083	-62,963	-12,917	-81,707	-1,470	-402	-471,001
Net change in stock (ha)	102,656	-122,675	26,374	8,122	-17,995	1,426	2,091	0
Improvement flows	-	20,161	-	4,186	-	-	-	24,347
Degradation flows	-123,070	-	-	-	-	-441	-	-123,511
Stable or stable flows	575,373	264,622	204,125	36,502	46,796	4,098	66,841	1,198,358
Closing Stock (ha)	698,443	284,783	226,878	40,689	73,923	4,539	67,711	1,396,966

Serere zone land and soil ecosystem extent account by IPCC land cover classes, 2005 to 2015

IPCC Land Cover Account	Serere 2005 to 2015							
	Cropland	Forest	Grassland	Wetland	Ordinary lands	Settlements	Open Water	Total
Opening Stock (ha)	770,016	20,848	169,131	120,805	97,916	4,909	102,807	1,286,433
<i>Total additions to stock</i>	120,274	5,151	52,547	44,441	68,597	2,604	6,487	300,101
<i>Total reductions in stock</i>	-72,235	-19,786	-95,268	-30,845	-78,012	-3,474	-482	-300,101
Net change in stock (ha)	48,039	-14,635	-42,720	13,596	-9,415	-870	6,005	0
Improvement flows	-	1,043	-	8,202	-	-	-	9,245
Degradation flows	-26,082	-	-	-	-	-103	-	-26,185
Stable or stable flows	791,973	5,170	100,688	126,199	53,527	3,935	103,159	1,184,651
Closing Stock (ha)	818,055	6,213	126,411	134,401	88,501	4,038	108,813	1,286,433

Annex II: Soil nutrient flows by zones for 2009

	Abi	Buginyanya	Bulindi	Kachwekano	Mbarara	Mukono	Nabuin	Ngetta	Rwebitaba	Serere	Total
	2009	2009	2009	2009	2009	2009	2009	2009	2009	2009	2009
Cropland (ha)	768,506	1,354,464	625,920	373,028	966,714	1,584,703	366,240	1,548,947	595,786	770,016	8,954,325
Planted Area (ha)	376,968	1,083,889	271,728	151,011	732,594	783,305	206,246	921,479	366,361	377,549	5,271,130
Additions											
Inorganic / Organic Fertilisers (Tonnes, 2009)											
N (t)											
P (t)											
K (t)											
Biological Nitrogen Fixation (Tonnes, 2009)											
N (t)	5,091	8,973	4,146	2,471	6,404	10,498	2,426	10,261	3,947	5,101	59,318
Crop residues (Tonnes, 2009)											
N (t)	-	2,855	276	153	744	1,683	-	-	372	-	6,083
P (t)	-	1,324	130	72	352	977	-	-	176	-	3,031
K (t)	-	8,859	540	300	1,456	8,132	-	-	728	-	20,016
Atmospheric deposition (Tonnes, 2009)											
N (t)	5,453	9,610	4,441	2,647	6,859	11,244	2,599	10,990	4,227	5,463	63,532
P (t)	659	1,161	537	320	829	1,359	314	1,328	511	660	7,677
K (t)	2,398	4,226	1,953	1,164	3,016	4,944	1,143	4,833	1,859	2,402	27,938
Total Additions											
N (t)	10,544	21,438	8,863	5,271	14,007	23,424	5,025	21,251	8,546	10,564	128,934
P (t)	659	2,485	667	392	1,180	2,335	314	1,328	687	660	10,708
K (t)	2,398	13,085	2,493	1,464	4,472	13,076	1,143	4,833	2,587	2,402	47,954
Reductions											
Crop harvest (Tonnes, 2009)											
N (t)	(12,745)	(46,677)	(11,171)	(5,331)	(30,177)	(27,731)	(2,067)	(24,349)	(16,123)	(13,316)	(189,687)
P (t)	(5,154)	(19,727)	(4,473)	(1,784)	(9,469)	(10,494)	(845)	(9,338)	(5,835)	(5,546)	(72,664)
K (t)	(13,381)	(56,186)	(11,161)	(8,292)	(57,634)	(36,961)	(2,037)	(19,943)	(23,663)	(14,557)	(243,815)
Soil Erosion (Tonnes, 2009)											
N (t)	(8,454)	(33,816)	(9,127)	(5,439)	(14,096)	(43,502)	(2,224)	(9,404)	(8,688)	(4,675)	(139,424)
P (t)	(4,252)	(14,281)	(2,411)	(1,437)	(3,724)	(15,838)	(854)	(3,611)	(2,295)	(1,795)	(50,498)
K (t)	(14,806)	(52,957)	(20,267)	(12,078)	(31,301)	(58,215)	(2,024)	(8,558)	(19,291)	(4,255)	(223,753)
Leaching (Tonnes, 2009)											
N (t)	(12,169)	(21,447)	(9,911)	(5,907)	(15,307)	(25,093)	(5,799)	(24,527)	(9,434)	(12,193)	(141,787)
Total Reductions											
N (t)	(33,367)	(101,941)	(30,209)	(16,677)	(59,581)	(96,326)	(10,090)	(58,280)	(34,244)	(30,184)	(470,898)
P (t)	(9,406)	(34,008)	(6,884)	(3,221)	(13,193)	(26,332)	(1,699)	(12,949)	(8,130)	(7,341)	(123,162)
K (t)	(28,187)	(109,144)	(31,428)	(20,371)	(88,935)	(95,176)	(4,060)	(28,501)	(42,954)	(18,811)	(467,568)
Net Balance											
N (t)	(22,823)	(80,503)	(21,345)	(11,406)	(45,574)	(72,901)	(5,065)	(37,029)	(25,698)	(19,619)	(341,964)
P (t)	(8,747)	(31,523)	(6,217)	(2,829)	(12,013)	(23,997)	(1,385)	(11,621)	(7,443)	(6,680)	(112,454)
K (t)	(25,790)	(96,058)	(28,935)	(18,907)	(84,463)	(82,100)	(2,917)	(23,669)	(40,367)	(16,409)	(419,614)

Annex III: Soil nutrient flows by zones for 2018

	Abi	Buginyanya	Bulindi	Kachwekano	Mbarara	Mukono	Nabuin	Ngetta	Rwebitaba	Serere	Total
	2018	2018	2018	2018	2018	2018	2018	2018	2018	2018	2018
Cropland (ha)	862,910	1,413,090	828,427	337,235	1,006,964	1,777,651	331,309	2,456,735	698,443	818,055	10,530,819
Planted Area (ha)	401,069	1,540,157	960,807	281,103	720,068	1,749,396	452,887	1,041,515	545,050	440,157	8,132,208
Additions											
Inorganic / Organic Fertilisers (Tonnes, 2018)											
N (t)											
P (t)											
K (t)											
Biological Nitrogen Fixation (Tonnes, 2018)											
N (t)	5,716	9,361	5,488	2,234	6,671	11,776	2,195	16,275	4,627	5,419	69,762
Crop residues (Tonnes, 2018)											
N (t)	-	4,057	975	285	731	3,758	-	-	553	-	10,361
P (t)	-	1,881	461	135	346	2,181	-	-	262	-	5,266
K (t)	-	12,589	1,910	559	1,431	18,162	-	-	1,083	-	35,733
Atmospheric deposition (Tonnes, 2018)											
N (t)	6,122	10,026	5,878	2,393	7,145	12,613	2,351	17,431	4,956	5,804	74,718
P (t)	740	1,212	710	289	863	1,524	284	2,106	599	701	9,029
K (t)	2,692	4,409	2,585	1,052	3,142	5,546	1,034	7,665	2,179	2,552	32,857
Total Additions											
N (t)	11,839	23,445	12,341	4,912	14,546	28,147	4,545	33,706	10,136	11,223	154,840
P (t)	740	3,093	1,171	424	1,209	3,705	284	2,106	860	701	14,295
K (t)	2,692	16,998	4,494	1,611	4,573	23,708	1,034	7,665	3,262	2,552	68,590
Reductions											
Crop harvest (Tonnes, 2018)											
N (t)	(8,412)	(42,184)	(45,708)	(7,519)	(33,170)	(67,345)	(8,125)	(29,083)	(24,960)	(7,185)	(273,691)
P (t)	(3,521)	(16,234)	(16,355)	(2,337)	(9,653)	(24,410)	(3,520)	(12,571)	(8,318)	(3,061)	(99,979)
K (t)	(9,729)	(52,858)	(57,878)	(11,330)	(71,291)	(91,447)	(9,090)	(30,960)	(40,607)	(8,114)	(383,305)
Soil Erosion (Tonnes, 2018)											
N (t)	(9,492)	(35,280)	(12,080)	(4,917)	(14,683)	(48,799)	(2,011)	(14,915)	(10,184)	(4,967)	(157,329)
P (t)	(4,774)	(14,900)	(3,191)	(1,299)	(3,879)	(17,767)	(772)	(5,727)	(2,690)	(1,907)	(56,906)
K (t)	(16,625)	(55,250)	(26,824)	(10,919)	(32,605)	(65,303)	(1,831)	(13,574)	(22,615)	(4,520)	(250,065)
Leaching (Tonnes, 2018)											
N (t)	(13,664)	(22,375)	(13,118)	(5,340)	(15,945)	(28,148)	(5,246)	(38,901)	(11,059)	(12,953)	(166,749)
Total Reductions											
N (t)	(31,568)	(99,839)	(70,906)	(17,776)	(63,798)	(144,291)	(15,383)	(82,899)	(46,204)	(25,105)	(597,769)
P (t)	(8,295)	(31,133)	(19,546)	(3,636)	(13,532)	(42,177)	(4,292)	(18,297)	(11,008)	(4,967)	(156,885)
K (t)	(26,354)	(108,108)	(84,702)	(22,250)	(103,895)	(156,751)	(10,921)	(44,534)	(63,222)	(12,634)	(633,370)
Net Balance											
N (t)	(19,729)	(76,394)	(58,565)	(12,864)	(49,252)	(116,144)	(10,837)	(49,193)	(36,068)	(13,882)	(442,929)
P (t)	(7,556)	(28,041)	(18,374)	(3,212)	(12,323)	(38,472)	(4,008)	(16,191)	(10,148)	(4,266)	(142,590)
K (t)	(23,662)	(91,110)	(80,208)	(20,639)	(99,322)	(133,042)	(9,887)	(36,869)	(59,959)	(10,081)	(564,780)

Annex IV: Status of soil loss in 2015

Mean soil loss (t/ha/year) for all lands and croplands in 2015

ZARDI	Mean loss (all lands) (t/ha/year)	Mean soil loss in crop lands (t/ha/year)
Abi zone	1.6	1.5
Nabuin zone	6.8	8.3
Ngetta zone	1.9	1.7
Serere zone	2.3	2.3
Buginyanya zone	1	1
Mbarara zone	1.5	1.5
Mukono zone	1	1.1
Bulindi zone	0.4	0.4
Rwebitaba zone	10.6	0.7
Kachwekano zone	2.8	2.5
National mean	3.2	1.5

Source: Karamagi et al. 2016

Annex V: The other Physical Supply and Use Tables

Bulindi zone PSUT Economic Units and Ecosystem types 2009

	Economic Unit				Ecosystem types		
	Gov.	Businesses	Households	Total	Cropland	Grassland	Total
Physical Supply Food Provisioning Ecosystem Services (Tonnes, 2009)							
Maize					173,568	-	173,568
Finger millet					5,947	-	5,947
Sorghum					2,554	-	2,554
Rice					14,639	-	14,639
Beans					60,260	-	60,260
Field peas					404	-	404
Cowpeas					62	-	62
Pigeon peas					80	-	80
G.nuts					24,015	-	24,015
Sim sim					565	-	565
Soybean					73	-	73
All bananas					77,144	-	77,144
Cassava					176,289	-	176,289
Sweet potatoes					57,700	-	57,700
Irish potato					7,320	-	7,320
Cattle					-	86,367	86,367
Goats					-	130,036	130,036
Sheep					-	1,333	1,333
Physical Use Food Provisioning Ecosystem Services (Tonnes, 2009)							
Maize	-	-	-	173,568			
finger millet	-	-	-	5,947			
sorghum	-	-	-	2,554			
Rice	-	-	-	14,639			
Beans	-	-	-	60,260			
Field peas	-	-	-	404			
cowpeas	-	-	-	62			
pigeon peas	-	-	-	80			
G.nuts	-	-	-	24,015			
Sim sim	-	-	-	565			
Soybean	-	-	-	73			
All bananas	-	-	-	77,144			
Cassava	-	-	-	176,289			
Sweet potatoes	-	-	-	57,700			
Irish potato	-	-	-	7,320			
Cattle	-	-	-	86,367			
Goats	-	-	-	130,036			
Sheep	-	-	-	1,333			

Bulindi zone PSUT Producers and Consumer 2009

	Producer				Consumer					
	Gov.	Business	H.holds	Total	Govt.	H.hold	Business	Change in Inventory	Export	Total
Physical Supply SNA Goods and Services (Tonnes, 2009)										
Maize	-	-	-	173,568						
Finger millet	-	-	-	5,947						
Sorghum	-	-	-	2,554						
Rice	-	-	-	14,639						
Beans	-	-	-	60,260						
Field peas	-	-	-	404						
Cowpeas	-	-	-	62						
Pigeon peas	-	-	-	80						
G.nuts	-	-	-	24,015						
Sim sim	-	-	-	565						
Soybean	-	-	-	73						
All bananas	-	-	-	77,144						
Cassava	-	-	-	176,289						
Sweet potatoes	-	-	-	57,700						
Irish potato	-	-	-	7,320						
Cattle	-	-	-	86,367						
Goats	-	-	-	130,036						
Sheep	-	-	-	1,333						
Physical Use SNA Goods and Services (Tonnes, 2009)										
Maize					-	51,387	122,181	-	-	173,568
Finger millet					-	4,516	1,431	-	-	5,947
Sorghum					-	2,459	95	-	-	2,554
Rice					-	790	13,849	-	-	14,639
Beans					-	47,902	12,358	-	-	60,260
Field peas					-	404	-	-	-	404
Cowpeas					-	62	-	-	-	62
Pigeon peas					-	80	-	-	-	80
G.nuts					-	14,707	9,308	-	-	24,015
Sim sim					-	556	9	-	-	565
Soybean					-	73	-	-	-	73
All bananas					-	71,843	5,301	-	-	77,144
Cassava					-	161,992	14,297	-	-	176,289
Sweet potatoes					-	51,545	6,155	-	-	57,700
Irish potato					-	4,770	2,550	-	-	7,320
Cattle					-	78,594	7,773	-	-	86,367
Goats					-	128,736	1,300	-	-	130,036
Sheep					-	1,319	13	-	-	1,333

Bulindi zone PSUT Economic Units and Ecosystem types 2018

	Economic Unit				Ecosystem types		
	Gov.	Businesses	Households	Total	Cropland	Grassland	Total
Physical Supply Food Provisioning Ecosystem Services (Tonnes, 2018)							
Maize					656,285	-	656,285
Finger millet					2,383	-	2,383
Sorghum					3,261	-	3,261
Rice					18,919	-	18,919
Beans					134,364	-	134,364
Field peas					-	-	-
Cowpeas					-	-	-
Pigeon peas					-	-	-
G.nuts					34,877	-	34,877
Sim sim					5,086	-	5,086
Soybean					248	-	248
All bananas					649,988	-	649,988
Cassava					602,450	-	602,450
Sweet potatoes					95,465	-	95,465
Irish potato					17,028	-	17,028
Coffee					82,656	-	82,656
Cattle					-	93,931	93,931
Goats					-	138,035	138,035
Sheep					-	9,956	9,956
Physical Use Food Provisioning Ecosystem Services (Tonnes, 2018)							
Maize	-	-	-	656,285			
Finger millet	-	-	-	2,383			
Sorghum	-	-	-	3,261			
Rice	-	-	-	18,919			
Beans	-	-	-	134,364			
Field peas	-	-	-	-			
Cowpeas	-	-	-	-			
Pigeon peas	-	-	-	-			
G.nuts	-	-	-	34,877			
Sim sim	-	-	-	5,086			
Soybean	-	-	-	248			
All bananas	-	-	-	649,988			
Cassava	-	-	-	602,450			
Sweet potatoes	-	-	-	95,465			
Irish potato	-	-	-	17,028			
Coffee	-	-	-	82,656			
Cattle	-	-	-	93,931			
Goats	-	-	-	138,035			
Sheep	-	-	-	9,956			

Bulindi zone PSUT Producers and Consumers 2018

	Producer				Consumer					
	Gov.	Business	H.holds	Total	Govt.	H.hold	Business	Change in Inventory	Export	Total
Physical Supply SNA Goods and Services (Tonnes, 2018)										
Maize	-	-	-	656,285						
Finger millet	-	-	-	2,383						
Sorghum	-	-	-	3,261						
Rice	-	-	-	18,919						
Beans	-	-	-	134,364						
Field peas	-	-	-	-						
Cowpeas	-	-	-	-						
Pigeon peas	-	-	-	-						
G.nuts	-	-	-	34,877						
Sim sim	-	-	-	5,086						
Soybean	-	-	-	248						
All bananas	-	-	-	649,988						
Cassava	-	-	-	602,450						
Sweet potatoes	-	-	-	95,465						
Irish potato	-	-	-	17,028						
Coffee	-	-	-	82,656						
Cattle	-	-	-	93,931						
Goats	-	-	-	138,035						
Sheep	-	-	-	9,956						
Physical Use SNA Goods and Services (Tonnes, 2018)										
Maize					-	194,302	461,983	-	-	656,285
Finger millet					-	1,809	574	-	-	2,383
Sorghum					-	3,140	121	-	-	3,261
Rice					-	1,021	17,898	-	-	18,919
Beans					-	106,808	27,556	-	-	134,364
Field peas					-	-	-	-	-	-
Cowpeas					-	-	-	-	-	-
Pigeon peas					-	-	-	-	-	-
G.nuts					-	21,359	13,518	-	-	34,877
Sim sim					-	5,008	78	-	-	5,086
Soybean					-	248	-	-	-	248
All bananas					-	605,321	44,667	-	-	649,988
Cassava					-	553,592	48,858	-	-	602,450
Sweet potatoes					-	85,281	10,184	-	-	95,465
Irish potato					-	11,095	5,933	-	-	17,028
Coffee					-	-	82,656	-	-	82,656
Cattle					-	85,477	8,454	-	-	93,931
Goats					-	136,654	1,380	-	-	138,035
Sheep					-	9,856	100	-	-	9,956

Kackwekano zone PSUT Economic Units and Ecosystem types 2009

	Economic Unit				Ecosystem types		
	Gov.	Business	H.holds	Total	Cropland	Grassland	Total
Physical Supply Food Provisioning Ecosystem Services (Tonnes, 2009)							
Maize					24,219	-	24,219
Finger millet					8,250	-	8,250
Sorghum					23,703	-	23,703
Rice					925	-	925
Beans					42,055	-	42,055
Field peas					1,348	-	1,348
Cowpeas					67	-	67
Pigeon peas					-	-	-
G.nuts					1,061	-	1,061
Sim sim					-	-	-
Soybean					464	-	464
All bananas					223,343	-	223,343
Cassava					27,149	-	27,149
Sweet potatoes					103,761	-	103,761
Irish potato					72,137	-	72,137
Cattle					-	35,285	35,285
Goats					-	105,579	105,579
Sheep					-	2,619	2,619
Physical Use Food Provisioning Ecosystem Services (Tonnes, 2009)							
Maize	-	-	-	24,219			
Finger millet	-	-	-	8,250			
Sorghum	-	-	-	23,703			
Rice	-	-	-	925			
Beans	-	-	-	42,055			
Field peas	-	-	-	1,348			
Cowpeas	-	-	-	67			
Pigeon peas	-	-	-	-			
G.nuts	-	-	-	1,061			
Sim sim	-	-	-	-			
Soybean	-	-	-	464			
All bananas	-	-	-	223,343			
Cassava	-	-	-	27,149			
Sweet potatoes	-	-	-	103,761			
Irish potato	-	-	-	72,137			
Cattle	-	-	-	35,285			
Goats	-	-	-	105,579			
Sheep	-	-	-	2,619			

Kackwekano zone PSUT producers and consumers 2009

	Producer				Consumer					
	Gov.	Business	H.holds	Total	Govt.	H.hold	Business	Change in Inventory	Export	Total
Physical Supply SNA Goods and Services (Tonnes, 2009)										
Maize	-	-	-	24,219						
Finger millet	-	-	-	8,250						
Sorghum	-	-	-	23,703						
Rice	-	-	-	925						
Beans	-	-	-	42,055						
Field peas	-	-	-	1,348						
Cowpeas	-	-	-	67						
Pigeon peas	-	-	-	-						
G.nuts	-	-	-	1,061						
Sim sim	-	-	-	-						
Soybean	-	-	-	464						
All bananas	-	-	-	223,343						
Cassava	-	-	-	27,149						
Sweet potatoes	-	-	-	103,761						
Irish potato	-	-	-	72,137						
Cattle	-	-	-	35,285						
Goats	-	-	-	105,579						
Sheep	-	-	-	2,619						
Physical Use SNA Goods and Services (Tonnes, 2009)										
Maize					-	7,170	17,049	-	-	24,219
Finger millet					-	6,264	1,986	-	-	8,250
Sorghum					-	22,826	877	-	-	23,703
Rice					-	50	875	-	-	925
Beans					-	33,430	8,625	-	-	42,055
Field peas					-	1,348	-	-	-	1,348
Cowpeas					-	67	-	-	-	67
Pigeon peas					-	-	-	-	-	-
G.nuts					-	650	411	-	-	1,061
Sim sim					-	-	-	-	-	-
Soybean					-	464	-	-	-	464
All bananas					-	207,995	15,348	-	-	223,343
Cassava					-	24,947	2,202	-	-	27,149
Sweet potatoes					-	92,692	11,069	-	-	103,761
Irish potato					-	47,004	25,133	-	-	72,137
Cattle					-	32,110	3,176	-	-	35,285
Goats					-	104,523	1,056	-	-	105,579
Sheep					-	2,592	26	-	-	2,619

Kackwekano zone PSUT Economic Units and Ecosystem types 2018

	Economic Unit				Ecosystem types		
	Gov.	Businesses	Households	Total	Cropland	Grassland	Total
Physical Supply Food Provisioning Ecosystem Services (Tonnes, 2018)							
Maize					26,279	-	26,279
Finger millet					10,935	-	10,935
Sorghum					17,630	-	17,630
Rice					6,032	-	6,032
Beans					47,399	-	47,399
Field peas					-	-	-
Cowpeas					-	-	-
Pigeon peas					-	-	-
G.nuts					6,138	-	6,138
Sim sim					-	-	-
Soybean					291	-	291
All bananas					260,163	-	260,163
Cassava					32,180	-	32,180
Sweet potatoes					104,790	-	104,790
Irish potato					82,806	-	82,806
Coffee					11,378	-	11,378
Cattle					-	27,231	27,231
Goats					-	91,434	91,434
Sheep					-	23,979	23,979
Physical Use Food Provisioning Ecosystem Services (Tonnes, 2018)							
Maize	-	-	-	26,279			
Finger millet	-	-	-	10,935			
Sorghum	-	-	-	17,630			
Rice	-	-	-	6,032			
Beans	-	-	-	47,399			
Field peas	-	-	-	-			
Cowpeas	-	-	-	-			
pigeon peas	-	-	-	-			
G.nuts	-	-	-	6,138			
Sim sim	-	-	-	-			
Soybean	-	-	-	291			
All bananas	-	-	-	260,163			
Cassava	-	-	-	32,180			
Sweet potatoes	-	-	-	104,790			
Irish potato	-	-	-	82,806			
Coffee	-	-	-	11,378			
Cattle	-	-	-	27,231			
Goats	-	-	-	91,434			
Sheep	-	-	-	23,979			

Kackwekano zone PSUT producers and consumers 2018

	Producer				Consumer					
	Gov.	Business	H.holds	Total	Govt.	H.hold	Business	Change in Inventory	Export	Total
Physical Supply SNA Goods and Services (Tonnes, 2018)										
Maize	-	-	-	26,279						
finger millet	-	-	-	10,935						
sorghum	-	-	-	17,630						
Rice	-	-	-	6,032						
Beans	-	-	-	47,399						
Field peas	-	-	-	-						
cowpeas	-	-	-	-						
pigeon peas	-	-	-	-						
G.nuts	-	-	-	6,138						
Sim sim	-	-	-	-						
Soybean	-	-	-	291						
All bananas	-	-	-	260,163						
Cassava	-	-	-	32,180						
Sweet potatoes	-	-	-	104,790						
Irish potato	-	-	-	82,806						
Coffee	-	-	-	11,378						
Cattle	-	-	-	27,231						
Goats	-	-	-	91,434						
Sheep	-	-	-	23,979						
Physical Use SNA Goods and Services (Tonnes, 2018)										
Maize					-	7,780	18,499	-	-	26,279
Finger millet					-	8,303	2,632	-	-	10,935
Sorghum					-	16,977	653	-	-	17,630
Rice					-	325	5,707	-	-	6,032
Beans					-	37,678	9,721	-	-	47,399
Field peas					-	-	-	-	-	-
Cowpeas					-	-	-	-	-	-
Pigeon peas					-	-	-	-	-	-
G.nuts					-	3,759	2,379	-	-	6,138
Sim sim					-	-	-	-	-	-
Soybean					-	291	-	-	-	291
All bananas					-	242,285	17,878	-	-	260,163
Cassava					-	29,570	2,610	-	-	32,180
Sweet potatoes					-	93,611	11,179	-	-	104,790
Irish potato					-	53,956	28,850	-	-	82,806
Coffee					-	-	11,378	-	-	11,378
Cattle					-	24,780	2,451	-	-	27,231
Goats					-	90,520	914	-	-	91,434
Sheep					-	23,739	240	-	-	23,979

Nabuin zone PSUT Economic Units and Ecosystem types 2009

	Economic Unit				Ecosystem types		
	Gov.	Businesses	Households	Total	Cropland	Grassland	Total
Physical Supply Food Provisioning Ecosystem Services (Tonnes, 2009)							
Maize					18,432	-	18,432
Finger millet					7,487	-	7,487
Sorghum					35,569	-	35,569
Rice					-	-	-
Beans					15,821	-	15,821
Field peas					60	-	60
Cowpeas					1,197	-	1,197
Pigeon peas					32	-	32
G.nuts					1,048	-	1,048
Sim sim					1,833	-	1,833
Soybean					-	-	-
All bananas					423	-	423
Cassava					2,392	-	2,392
Sweet potatoes					1,909	-	1,909
Irish potato					-	-	-
Cattle					-	365,143	365,143
Goats					-	396,957	396,957
Sheep					-	28,485	28,485
Physical Use Food Provisioning Ecosystem Services (Tonnes, 2009)							
Maize	-	-	-	18,432			
Finger millet	-	-	-	7,487			
Sorghum	-	-	-	35,569			
Rice	-	-	-	-			
Beans	-	-	-	15,821			
Field peas	-	-	-	60			
Cowpeas	-	-	-	1,197			
Pigeon peas	-	-	-	32			
G.nuts	-	-	-	1,048			
Sim sim	-	-	-	1,833			
Soybean	-	-	-	-			
All bananas	-	-	-	423			
Cassava	-	-	-	2,392			
Sweet potatoes	-	-	-	1,909			
Irish potato	-	-	-	-			
Cattle	-	-	-	365,143			
Goats	-	-	-	396,957			
Sheep	-	-	-	28,485			

Nabuin zone PSUT producers and consumers 2009

	Producer				Consumer					
	Gov.	Business	Hholds	Total	Govt.	Hhold	Business	Change in Inventory	Export	Total
Physical Supply SNA Goods and Services (Tonnes, 2009)										
Maize	-	-	-	18,432						
Finger millet	-	-	-	7,487						
Sorghum	-	-	-	35,569						
Rice	-	-	-	-						
Beans	-	-	-	15,821						
Field peas	-	-	-	60						
Cowpeas	-	-	-	1,197						
Pigeon peas	-	-	-	32						
G.nuts	-	-	-	1,048						
Sim sim	-	-	-	1,833						
Soybean	-	-	-	-						
All bananas	-	-	-	423						
Cassava	-	-	-	2,392						
Sweet potatoes	-	-	-	1,909						
Irish potato	-	-	-	-						
Cattle	-	-	-	365,143						
Goats	-	-	-	396,957						
Sheep	-	-	-	28,485						
Physical Use SNA Goods and Services (Tonnes, 2009)										
Maize					-	5,457	12,975	-	-	18,432
Finger millet					-	5,685	1,802	-	-	7,487
Sorghum					-	34,252	1,317	-	-	35,569
Rice					-	-	-	-	-	-
Beans					-	12,576	3,245	-	-	15,821
Field peas					-	60	-	-	-	60
Cowpeas					-	1,197	-	-	-	1,197
Pigeon peas					-	32	-	-	-	32
G.nuts					-	642	406	-	-	1,048
Sim sim					-	1,805	28	-	-	1,833
Soybean					-	-	-	-	-	-
All bananas					-	394	29	-	-	423
Cassava					-	2,198	194	-	-	2,392
Sweet potatoes					-	1,705	204	-	-	1,909
Irish potato					-	-	-	-	-	-
Cattle					-	332,280	32,863	-	-	365,143
Goats					-	392,988	3,970	-	-	396,957
Sheep					-	28,200	285	-	-	28,485

Nabuin zone PSUT Economic Units and Ecosystem types 2018

	Economic Unit				Ecosystem types		
	Gov.	Businesses	Households	Total	Cropland	Grassland	Total
Physical Supply Food Provisioning Ecosystem Services (Tonnes, 2018)							
Maize					134,685	-	134,685
Finger millet					6,988	-	6,988
Sorghum					132,138	-	132,138
Rice					-	-	-
Beans					15,218	-	15,218
Field peas					-	-	-
Cowpeas					-	-	-
Pigeon peas					-	-	-
G.nuts					14,229	-	14,229
Sim sim					-	-	-
Soybean					-	-	-
All bananas					1,079	-	1,079
Cassava					48,665	-	48,665
Sweet potatoes					15,562	-	15,562
Irish potato					-	-	-
Coffee					-	-	-
Cattle					-	682,420	682,420
Goats					-	1,021,745	1,021,745
Sheep					-	498,008	498,008
Physical Use Food Provisioning Ecosystem Services (Tonnes, 2018)							
Maize	-	-	-	134,685			
Finger millet	-	-	-	6,988			
Sorghum	-	-	-	132,138			
Rice	-	-	-	-			
Beans	-	-	-	15,218			
Field peas	-	-	-	-			
Cowpeas	-	-	-	-			
Pigeon peas	-	-	-	-			
G.nuts	-	-	-	14,229			
Sim sim	-	-	-	-			
Soybean	-	-	-	-			
All bananas	-	-	-	1,079			
Cassava	-	-	-	48,665			
Sweet potatoes	-	-	-	15,562			
Irish potato	-	-	-	-			
Coffee	-	-	-	-			
Cattle	-	-	-	682,420			
Goats	-	-	-	1,021,745			
Sheep	-	-	-	498,008			

Nabuin zone PSUT producers and consumers 2018

	Producer				Consumer					
	Gov.	Business	H.holds	Total	Govt.	Hhold	Business	Change in Inventory	Export	Total
Physical Supply SNA Goods and Services (Tonnes, 2018)										
Maize	-	-	-	134,685						
Finger millet	-	-	-	6,988						
Sorghum	-	-	-	132,138						
Rice	-	-	-	-						
Beans	-	-	-	15,218						
Field peas	-	-	-	-						
Cowpeas	-	-	-	-						
Pigeon peas	-	-	-	-						
G.nuts	-	-	-	14,229						
Sim sim	-	-	-	-						
Soybean	-	-	-	-						
All bananas	-	-	-	1,079						
Cassava	-	-	-	48,665						
Sweet potatoes	-	-	-	15,562						
Irish potato	-	-	-	-						
Coffee	-	-	-	-						
Cattle	-	-	-	682,420						
Goats	-	-	-	1,021,745						
Sheep	-	-	-	498,008						
Physical Use SNA Goods and Services (Tonnes, 2018)										
Maize					-	39,875	94,810	-	-	134,685
Finger millet					-	5,306	1,682	-	-	6,988
Sorghum					-	127,247	4,891	-	-	132,138
Rice					-	-	-	-	-	-
Beans					-	12,097	3,121	-	-	15,218
Field peas					-	-	-	-	-	-
Cowpeas					-	-	-	-	-	-
Pigeon peas					-	-	-	-	-	-
G.nuts					-	8,714	5,515	-	-	14,229
Sim sim					-	-	-	-	-	-
Soybean					-	-	-	-	-	-
All bananas					-	1,005	74	-	-	1,079
Cassava					-	44,718	3,947	-	-	48,665
Sweet potatoes					-	13,902	1,660	-	-	15,562
Irish potato					-	-	-	-	-	-
Coffee					-	-	-	-	-	-
Cattle					-	621,003	61,418	-	-	682,420
Goats					-	1,011,528	10,217	-	-	1,021,745
Sheep					-	493,028	4,980	-	-	498,008

Ngetta zone PSUT Economic Units and Ecosystem types 2009

	Economic Unit				Ecosystem types		
	Gov.	Businesses	Households	Total	Cropland	Grassland	Total
Physical Supply Food Provisioning Ecosystem Services (Tonnes, 2009)							
Maize					150,945	-	150,945
Finger millet					56,803	-	56,803
Sorghum					79,923	-	79,923
Rice					39,022	-	39,022
Beans					194,700	-	194,700
Field peas					7,537	-	7,537
Cowpeas					421	-	421
Pigeon peas					9,564	-	9,564
G.nuts					48,311	-	48,311
Sim sim					69,730	-	69,730
Soybean					13,184	-	13,184
All bananas					1,714	-	1,714
Cassava					466,176	-	466,176
Sweet potatoes					139,647	-	139,647
Irish potato					53	-	53
Cattle					-	131,565	131,565
Goats					-	196,110	196,110
Sheep					-	2,714	2,714
Physical Use Food Provisioning Ecosystem Services (Tonnes, 2009)							
Maize	-	-	-	150,945			
Finger millet	-	-	-	56,803			
Sorghum	-	-	-	79,923			
Rice	-	-	-	39,022			
Beans	-	-	-	194,700			
Field peas	-	-	-	7,537			
Cowpeas	-	-	-	421			
Pigeon peas	-	-	-	9,564			
G.nuts	-	-	-	48,311			
Sim sim	-	-	-	69,730			
Soybean	-	-	-	13,184			
All bananas	-	-	-	1,714			
Cassava	-	-	-	466,176			
Sweet potatoes	-	-	-	139,647			
Irish potato	-	-	-	53			
Cattle	-	-	-	131,565			
Goats	-	-	-	196,110			
Sheep	-	-	-	2,714			

Ngetta zone PSUT producers and consumers 2009

	Producer				Consumer					
	Gov.	Business	H.holds	Total	Govt.	H.hold	Business	Change in Inventory	Export	Total
Physical Supply SNA Goods and Services (Tonnes, 2009)										
Maize	-	-	-	150,945						
Finger millet	-	-	-	56,803						
Sorghum	-	-	-	79,923						
Rice	-	-	-	39,022						
Beans	-	-	-	194,700						
Field peas	-	-	-	7,537						
Cowpeas	-	-	-	421						
Pigeon peas	-	-	-	9,564						
G.nuts	-	-	-	48,311						
Sim sim	-	-	-	69,730						
Soybean	-	-	-	13,184						
All bananas	-	-	-	1,714						
Cassava	-	-	-	466,176						
Sweet potatoes	-	-	-	139,647						
Irish potato	-	-	-	53						
Cattle	-	-	-	131,565						
Goats	-	-	-	196,110						
Sheep	-	-	-	2,714						
Physical Use SNA Goods and Services (Tonnes, 2009)										
Maize					-	44,689	106,256	-	-	150,945
Finger millet					-	43,130	13,673	-	-	56,803
Sorghum					-	76,965	2,958	-	-	79,923
Rice					-	2,105	36,917	-	-	39,022
Beans					-	154,770	39,930	-	-	194,700
Field peas					-	7,537	-	-	-	7,537
Cowpeas					-	421	-	-	-	421
Pigeon peas					-	9,564	-	-	-	9,564
G.nuts					-	29,585	18,726	-	-	48,311
Sim sim					-	68,660	1,070	-	-	69,730
Soybean					-	13,184	-	-	-	13,184
All bananas					-	1,596	118	-	-	1,714
Cassava					-	428,370	37,806	-	-	466,176
Sweet potatoes					-	124,750	14,897	-	-	139,647
Irish potato					-	35	18	-	-	53
Cattle					-	119,724	11,841	-	-	131,565
Goats					-	194,149	1,961	-	-	196,110
Sheep					-	2,687	27	-	-	2,714

Ngetta zone PSUT Economic Units and Ecosystem types 2018

	Economic Unit				Ecosystem types		
	Gov.	Businesses	Households	Total	Cropland	Grassland	Total
Physical Supply Food Provisioning Ecosystem Services (Tonnes, 2018)							
Maize					328,371	-	328,371
Finger millet					36,573	-	36,573
Sorghum					34,394	-	34,394
Rice					40,901	-	40,901
Beans					49,896	-	49,896
Field peas					-	-	-
Cowpeas					-	-	-
Pigeon peas					-	-	-
G.nuts					28,658	-	28,658
Sim sim					27,758	-	27,758
Soybean					80,129	-	80,129
All bananas					33,779	-	33,779
Cassava					1,109,205	-	1,109,205
Sweet potatoes					126,118	-	126,118
Irish potato					-	-	-
Coffee					-	-	-
Cattle					-	205,291	205,291
Goats					-	291,920	291,920
Sheep					-	37,778	37,778
Physical Use Food Provisioning Ecosystem Services (Tonnes, 2018)							
Maize	-	-	-	328,371			
Finger millet	-	-	-	36,573			
Sorghum	-	-	-	34,394			
Rice	-	-	-	40,901			
Beans	-	-	-	49,896			
Field peas	-	-	-	-			
Cowpeas	-	-	-	-			
Pigeon peas	-	-	-	-			
G.nuts	-	-	-	28,658			
Sim sim	-	-	-	27,758			
Soybean	-	-	-	80,129			
All bananas	-	-	-	33,779			
Cassava	-	-	-	1,109,205			
Sweet potatoes	-	-	-	126,118			
Irish potato	-	-	-	-			
Coffee	-	-	-	-			
Cattle	-	-	-	205,291			
Goats	-	-	-	291,920			
Sheep	-	-	-	37,778			

Ngetta zone PSUT producers and consumers 2009

	Producer				Consumer					
	Gov.	Business	Hholds	Total	Govt.	Hhold	Business	Change in Inventory	Export	Total
Physical Supply SNA Goods and Services (Tonnes, 2018)										
Maize	-	-	-	328,371						
Finger millet	-	-	-	36,573						
Sorghum	-	-	-	34,394						
Rice	-	-	-	40,901						
Beans	-	-	-	49,896						
Field peas	-	-	-	-						
Cowpeas	-	-	-	-						
Pigeon peas	-	-	-	-						
G.nuts	-	-	-	28,658						
Sim sim	-	-	-	27,758						
Soybean	-	-	-	80,129						
All bananas	-	-	-	33,779						
Cassava	-	-	-	1,109,205						
Sweet potatoes	-	-	-	126,118						
Irish potato	-	-	-	-						
Coffee	-	-	-	-						
Cattle	-	-	-	205,291						
Goats	-	-	-	291,920						
Sheep	-	-	-	37,778						
Physical Use SNA Goods and Services (Tonnes, 2018)										
Maize					-	97,219	231,152	-	-	328,371
Finger millet					-	27,770	8,803	-	-	36,573
Sorghum					-	33,121	1,273	-	-	34,394
Rice					-	2,207	38,694	-	-	40,901
Beans					-	39,663	10,233	-	-	49,896
Field peas					-	-	-	-	-	-
Cowpeas					-	-	-	-	-	-
Pigeon peas					-	-	-	-	-	-
G.nuts					-	17,550	11,108	-	-	28,658
Sim sim					-	27,332	426	-	-	27,758
Soybean					-	80,129	-	-	-	80,129
All bananas					-	31,458	2,321	-	-	33,779
Cassava					-	1,019,251	89,954	-	-	1,109,205
Sweet potatoes					-	112,664	13,454	-	-	126,118
Irish potato					-	-	-	-	-	-
Coffee					-	-	-	-	-	-
Cattle					-	186,815	18,476	-	-	205,291
Goats					-	289,001	2,919	-	-	291,920
Sheep					-	37,401	378	-	-	37,778

Rwebitaba zone PSUT Economic Units and Ecosystem types 2009

	Economic Unit				Ecosystem types		
	Gov.	Businesses	Households	Total	Cropland	Grassland	Total
Physical Supply Food Provisioning Ecosystem Services (Tonnes, 2009)							
Maize					193,171	-	193,171
Finger millet					20,422	-	20,422
Sorghum					4,190	-	4,190
Rice					981	-	981
Beans					97,742	-	97,742
Field peas					302	-	302
Cowpeas					66	-	66
Pigeon peas					-	-	-
G.nuts					12,539	-	12,539
Sim sim					-	-	-
Soybean					1,140	-	1,140
All bananas					621,841	-	621,841
Cassava					170,587	-	170,587
Sweet potatoes					112,275	-	112,275
Irish potato					40,047	-	40,047
Cattle					-	102,663	102,663
Goats					-	181,091	181,091
Sheep					-	1,989	1,989
Physical Use Food Provisioning Ecosystem Services (Tonnes, 2009)							
Maize	-	-	-	193,171			
Finger millet	-	-	-	20,422			
Sorghum	-	-	-	4,190			
Rice	-	-	-	981			
Beans	-	-	-	97,742			
Field peas	-	-	-	302			
Cowpeas	-	-	-	66			
Pigeon peas	-	-	-	-			
G.nuts	-	-	-	12,539			
Sim sim	-	-	-	-			
Soybean	-	-	-	1,140			
All bananas	-	-	-	621,841			
Cassava	-	-	-	170,587			
Sweet potatoes	-	-	-	112,275			
Irish potato	-	-	-	40,047			
Cattle	-	-	-	102,663			
Goats	-	-	-	181,091			
Sheep	-	-	-	1,989			

Rwebitaba zone PSUT producers and consumers 2009

	Producer				Consumer					
	Gov.	Business	Hhold	Total	Govt.	Hhold	Business	Change in Inventory	Export	Total
Physical Supply SNA Goods and Services (Tonnes, 2009)										
Maize	-	-	-	193,171						
Finger millet	-	-	-	20,422						
Sorghum	-	-	-	4,190						
Rice	-	-	-	981						
Beans	-	-	-	97,742						
Field peas	-	-	-	302						
Cowpeas	-	-	-	66						
Pigeon peas	-	-	-	-						
G.nuts	-	-	-	12,539						
Sim sim	-	-	-	-						
Soybean	-	-	-	1,140						
All bananas	-	-	-	621,841						
Cassava	-	-	-	170,587						
Sweet potatoes	-	-	-	112,275						
Irish potato	-	-	-	40,047						
Cattle	-	-	-	102,663						
Goats	-	-	-	181,091						
Sheep	-	-	-	1,989						
Physical Use SNA Goods and Services (Tonnes, 2009)										
Maize					-	57,191	135,980	-	-	193,171
Finger millet					-	15,506	4,916	-	-	20,422
Sorghum					-	4,035	155	-	-	4,190
Rice					-	53	928	-	-	981
Beans					-	77,697	20,045	-	-	97,742
Field peas					-	302	-	-	-	302
Cowpeas					-	66	-	-	-	66
Pigeon peas					-	-	-	-	-	-
G.nuts					-	7,679	4,860	-	-	12,539
Sim sim					-	-	-	-	-	-
Soybean					-	1,140	-	-	-	1,140
All bananas					-	579,108	42,733	-	-	621,841
Cassava					-	156,753	13,834	-	-	170,587
Sweet potatoes					-	100,298	11,977	-	-	112,275
Irish potato					-	26,095	13,952	-	-	40,047
Cattle					-	93,423	9,240	-	-	102,663
Goats					-	179,280	1,811	-	-	181,091
Sheep					-	1,969	20	-	-	1,989

Rwebitaba zone PSUT Economic Units and Ecosystem types 2018

	Economic Unit				Ecosystem types		
	Gov.	Businesses	Households	Total	Cropland	Grassland	Total
Physical Supply Food Provisioning Ecosystem Services (Tonnes, 2018)							
Maize					287,440	-	287,440
Finger millet					4,483	-	4,483
Sorghum					7,603	-	7,603
Rice					5,108	-	5,108
Beans					72,168	-	72,168
Field peas					-	-	-
Cowpeas					-	-	-
Pigeon peas					-	-	-
G.nuts					25,336	-	25,336
Sim sim					422	-	422
Soybean					1,438	-	1,438
All bananas					1,032,174	-	1,032,174
Cassava					138,623	-	138,623
Sweet potatoes					57,456	-	57,456
Irish potato					81,398	-	81,398
Coffee					34,838	-	34,838
Cattle					-	205,871	205,871
Goats					-	284,543	284,543
Sheep					-	33,046	33,046
Physical Use Food Provisioning Ecosystem Services (Tonnes, 2018)							
Maize	-	-	-	287,440			
Finger millet	-	-	-	4,483			
Sorghum	-	-	-	7,603			
Rice	-	-	-	5,108			
Beans	-	-	-	72,168			
Field peas	-	-	-	-			
Cowpeas	-	-	-	-			
Pigeon peas	-	-	-	-			
G.nuts	-	-	-	25,336			
Sim sim	-	-	-	422			
Soybean	-	-	-	1,438			
All bananas	-	-	-	1,032,174			
Cassava	-	-	-	138,623			
Sweet potatoes	-	-	-	57,456			
Irish potato	-	-	-	81,398			
Coffee	-	-	-	34,838			
Cattle	-	-	-	205,871			
Goats	-	-	-	284,543			
Sheep	-	-	-	33,046			

Rwebitaba zone PSUT producers and consumers 2018

	Producer				Consumer					
	Gov.	Business	Hholds	Total	Govt.	Household	Business	Change in Inventory	Export	Total
Physical Supply SNA Goods and Services (Tonnes, 2018)										
Maize	-	-	-	287,440						
Finger millet	-	-	-	4,483						
Sorghum	-	-	-	7,603						
Rice	-	-	-	5,108						
Beans	-	-	-	72,168						
Field peas	-	-	-	-						
Cowpeas	-	-	-	-						
Pigeon peas	-	-	-	-						
G.nuts	-	-	-	25,336						
Sim sim	-	-	-	422						
Soybean	-	-	-	1,438						
All bananas	-	-	-	1,032,174						
Cassava	-	-	-	138,623						
Sweet potatoes	-	-	-	57,456						
Irish potato	-	-	-	81,398						
Coffee	-	-	-	34,838						
Cattle	-	-	-	205,871						
Goats	-	-	-	284,543						
Sheep	-	-	-	33,046						
Physical Use SNA Goods and Services (Tonnes, 2018)										
Maize					-	85,100	202,340	-	-	287,440
Finger millet					-	3,404	1,079	-	-	4,483
Sorghum					-	7,322	281	-	-	7,603
Rice					-	276	4,832	-	-	5,108
Beans					-	57,368	14,800	-	-	72,168
Field peas					-	-	-	-	-	-
Cowpeas					-	-	-	-	-	-
Pigeon peas					-	-	-	-	-	-
G.nuts					-	15,516	9,820	-	-	25,336
Sim sim					-	416	6	-	-	422
Soybean					-	1,438	-	-	-	1,438
All bananas					-	961,243	70,931	-	-	1,032,174
Cassava					-	127,381	11,242	-	-	138,623
Sweet potatoes					-	51,327	6,129	-	-	57,456
Irish potato					-	53,039	28,359	-	-	81,398
Coffee					-	-	34,838	-	-	34,838
Cattle					-	187,343	18,528	-	-	205,871
Goats					-	281,698	2,845	-	-	284,543
Sheep					-	32,715	330	-	-	33,046

Serere zone PSUT Economic Units and Ecosystem types 2009

	Economic Unit				Ecosystem types		
	Gov.	Businesses	Households	Total	Cropland	Grassland	Total
Physical Supply Food Provisioning Ecosystem Services (Tonnes, 2009)							
Maize					173,477	-	173,477
Finger millet					41,026	-	41,026
Sorghum					83,451	-	83,451
Rice					26,344	-	26,344
Beans					18,456	-	18,456
Field peas					1,042	-	1,042
Cowpeas					5,500	-	5,500
Pigeon peas					94	-	94
G.nuts					39,142	-	39,142
Sim sim					5,351	-	5,351
Soybean					280	-	280
All bananas					552	-	552
Cassava					269,413	-	269,413
Sweet potatoes					205,321	-	205,321
Irish potato					-	-	-
Cattle					-	155,891	155,891
Goats					-	152,114	152,114
Sheep					-	3,195	3,195
Physical Use Food Provisioning Ecosystem Services (Tonnes, 2009)							
Maize	-	-	-	173,477			
Finger millet	-	-	-	41,026			
Sorghum	-	-	-	83,451			
Rice	-	-	-	26,344			
Beans	-	-	-	18,456			
Field peas	-	-	-	1,042			
Cowpeas	-	-	-	5,500			
Pigeon peas	-	-	-	94			
G.nuts	-	-	-	39,142			
Sim sim	-	-	-	5,351			
Soybean	-	-	-	280			
All bananas	-	-	-	552			
Cassava	-	-	-	269,413			
Sweet potatoes	-	-	-	205,321			
Irish potato	-	-	-	-			
Cattle	-	-	-	155,891			
Goats	-	-	-	152,114			
Sheep	-	-	-	3,195			

Serere zone PSUT producers and consumers 2009

	Producer				Consumer					
	Gov.	Business	H.holds	Total	Govt.	H.hold	Business	Change in Inventory	Export	Total
Physical Supply SNA Goods and Services (Tonnes, 2009)										
Maize	-	-	-	173,477						
Finger millet	-	-	-	41,026						
Sorghum	-	-	-	83,451						
Rice	-	-	-	26,344						
Beans	-	-	-	18,456						
Field peas	-	-	-	1,042						
Cowpeas	-	-	-	5,500						
Pigeon peas	-	-	-	94						
G.nuts	-	-	-	39,142						
Sim sim	-	-	-	5,351						
Soybean	-	-	-	280						
All bananas	-	-	-	552						
Cassava	-	-	-	269,413						
Sweet potatoes	-	-	-	205,321						
Irish potato	-	-	-	-						
Cattle	-	-	-	155,891						
Goats	-	-	-	152,114						
Sheep	-	-	-	3,195						
Physical Use SNA Goods and Services (Tonnes, 2009)										
Maize					-	51,360	122,117	-	-	173,477
Finger millet					-	31,151	9,875	-	-	41,026
Sorghum					-	80,362	3,089	-	-	83,451
Rice					-	1,421	24,923	-	-	26,344
Beans					-	14,671	3,785	-	-	18,456
Field peas					-	1,042	-	-	-	1,042
Cowpeas					-	5,500	-	-	-	5,500
Pigeon peas					-	94	-	-	-	94
G.nuts					-	23,970	15,172	-	-	39,142
Sim sim					-	5,269	82	-	-	5,351
Soybean					-	280	-	-	-	280
All bananas					-	514	38	-	-	552
Cassava					-	247,564	21,849	-	-	269,413
Sweet potatoes					-	183,418	21,903	-	-	205,321
Irish potato					-	-	-	-	-	-
Cattle					-	141,861	14,030	-	-	155,891
Goats					-	150,593	1,521	-	-	152,114
Sheep					-	3,163	32	-	-	3,195

Serere zone PSUT Economic Units and Ecosystem types 2018

	Economic Unit				Ecosystem types		
	Gov.	Businesses	Households	Total	Cropland	Grassland	Total
Physical Supply Food Provisioning Ecosystem Services (Tonnes, 2018)							
Maize					72,041	-	72,041
Finger millet					17,469	-	17,469
Sorghum					34,999	-	34,999
Rice					9,980	-	9,980
Beans					2,770	-	2,770
Field peas					-	-	-
Cowpeas					-	-	-
Pigeon peas					-	-	-
G.nuts					22,160	-	22,160
Sim sim					2,956	-	2,956
Soybean					2,983	-	2,983
All bananas					3,616	-	3,616
Cassava					370,709	-	370,709
Sweet potatoes					57,654	-	57,654
Irish potato					131	-	131
Coffee					29	-	29
Cattle					-	46,123	46,123
Goats					-	166,245	166,245
Sheep					-	9,101	9,101
Physical Use Food Provisioning Ecosystem Services (Tonnes, 2018)							
Maize	-	-	-	72,041			
Finger millet	-	-	-	17,469			
Sorghum	-	-	-	34,999			
Rice	-	-	-	9,980			
Beans	-	-	-	2,770			
Field peas	-	-	-	-			
Cowpeas	-	-	-	-			
Pigeon peas	-	-	-	-			
G.nuts	-	-	-	22,160			
Sim sim	-	-	-	2,956			
Soybean	-	-	-	2,983			
All bananas	-	-	-	3,616			
Cassava	-	-	-	370,709			
Sweet potatoes	-	-	-	57,654			
Irish potato	-	-	-	131			
Coffee	-	-	-	29			
Cattle	-	-	-	46,123			
Goats	-	-	-	166,245			
Sheep	-	-	-	9,101			

Serere zone PSUT producers and consumers 2018

	Producer				Consumer					
	Gov.	Business	H.holds	Total	Govt.	H.hold	Business	Change in Inventory	Export	Total
Physical Supply SNA Goods and Services (Tonnes, 2018)										
Maize	-	-	-	72,041						
Finger millet	-	-	-	17,469						
Sorghum	-	-	-	34,999						
Rice	-	-	-	9,980						
Beans	-	-	-	2,770						
Field peas	-	-	-	-						
Cowpeas	-	-	-	-						
Pigeon peas	-	-	-	-						
G.nuts	-	-	-	22,160						
Sim sim	-	-	-	2,956						
Soybean	-	-	-	2,983						
All bananas	-	-	-	3,616						
Cassava	-	-	-	370,709						
Sweet potatoes	-	-	-	57,654						
Irish potato	-	-	-	131						
Coffee	-	-	-	29						
Cattle	-	-	-	46,123						
Goats	-	-	-	166,245						
Sheep	-	-	-	9,101						
Physical Use SNA Goods and Services (Tonnes, 2018)										
Maize					-	21,329	50,712	-	-	72,041
Finger millet					-	13,264	4,205	-	-	17,469
Sorghum					-	33,704	1,295	-	-	34,999
Rice					-	538	9,442	-	-	9,980
Beans					-	2,202	568	-	-	2,770
Field peas					-	-	-	-	-	-
Cowpeas					-	-	-	-	-	-
Pigeon peas					-	-	-	-	-	-
G.nuts					-	13,571	8,589	-	-	22,160
Sim sim					-	2,911	45	-	-	2,956
Soybean					-	2,983	-	-	-	2,983
All bananas					-	3,368	248	-	-	3,616
Cassava					-	340,645	30,064	-	-	370,709
Sweet potatoes					-	51,504	6,150	-	-	57,654
Irish potato					-	85	46	-	-	131
Coffee					-	-	29	-	-	29
Cattle					-	41,972	4,151	-	-	46,123
Goats					-	164,582	1,662	-	-	166,245
Sheep					-	9,010	91	-	-	9,101

Annex VI: The other Monetary Supply and Use Tables

Bulindi zone MSUT Economic Units and Ecosystem types 2009

	Economic Unit				Ecosystem types		
	Gov.	Businesses	Households	Total	Cropland	Grassland	Total
Monetary Supply Food Provisioning Ecosystem Services (UGX million, 2009)							
Maize					43,392	-	43,392
Finger millet					2,394	-	2,394
Sorghum					655	-	655
Rice					12,429	-	12,429
Beans					27,840	-	27,840
Field peas					236	-	236
Cowpeas					36	-	36
Pigeon peas					42	-	42
G.nuts					15,310	-	15,310
Sim sim					386	-	386
Soybean					38	-	38
All bananas					12,883	-	12,883
Cassava					56,677	-	56,677
Sweet potatoes					8,453	-	8,453
Irish potato					3,224	-	3,224
Cattle					-	46,982	46,982
Goats					-	5,734	5,734
Sheep					-	63	63
Total					183,995	52,779	236,774
Monetary Use Food Provisioning Ecosystem Services (UGX million, 2009)							
Maize	-	-	-	43,392			
finger millet	-	-	-	2,394			
sorghum	-	-	-	655			
Rice	-	-	-	12,429			
Beans	-	-	-	27,840			
Field peas	-	-	-	236			
cowpeas	-	-	-	36			
pigeon peas	-	-	-	42			
G.nuts	-	-	-	15,310			
Sim sim	-	-	-	386			
Soybean	-	-	-	38			
All bananas	-	-	-	12,883			
Cassava	-	-	-	56,677			
Sweet potatoes	-	-	-	8,453			
Irish potato	-	-	-	3,224			
Cattle	-	-	-	46,982			
Goats	-	-	-	5,734			
Sheep	-	-	-	63			
Total	-	-	-	236,774			

Bulindi zone MSUT producers and consumers 2009

	Producer				Consumer					
	Gov.	Business	Hholds	Total	Govt.	Hhold	Business	Change in Inventory	Export	Total
Monetary Supply SNA Goods and Services (UGX million, 2009)										
Maize	-	-	-	43,392						
finger millet	-	-	-	2,394						
sorghum	-	-	-	655						
Rice	-	-	-	12,429						
Beans	-	-	-	27,840						
Field peas	-	-	-	236						
cowpeas	-	-	-	36						
pigeon peas	-	-	-	42						
G.nuts	-	-	-	15,310						
Sim sim	-	-	-	386						
Soybean	-	-	-	38						
All bananas	-	-	-	12,883						
Cassava	-	-	-	56,677						
Sweet potatoes	-	-	-	8,453						
Irish potato	-	-	-	3,224						
Cattle	-	-	-	46,982						
Goats	-	-	-	5,734						
Sheep	-	-	-	63						
Total	-	-	-	236,774						
Monetary Use SNA Goods and Services (UGX million, 2009)										
Maize					-	12,847	30,545	-	-	43,392
finger millet					-	1,818	576	-	-	2,394
sorghum					-	631	24	-	-	655
Rice					-	671	11,758	-	-	12,429
Beans					-	22,131	5,710	-	-	27,840
Field peas					-	236	-	-	-	236
cowpeas					-	36	-	-	-	36
pigeon peas					-	42	-	-	-	42
G.nuts					-	9,376	5,934	-	-	15,310
Sim sim					-	380	6	-	-	386
Soybean					-	38	-	-	-	38
All bananas					-	11,998	885	-	-	12,883
Cassava					-	52,081	4,596	-	-	56,677
Sweet potatoes					-	7,551	902	-	-	8,453
Irish potato					-	2,101	1,123	-	-	3,224
Cattle					-	42,754	4,228	-	-	46,982
Goats					-	5,677	57	-	-	5,734
Sheep					-	62	1	-	-	63
Total					-	170,428	66,346	-	-	236,774

Bulindi zone MSUT Economic Units and Ecosystem types 2018

	Economic Unit				Ecosystem types		
	Gov.	Business	Households	Total	Cropland	Grassland	Total
Monetary Supply Food Provisioning Ecosystem Services (UGX million, 2018)							
Maize					343,861	-	343,861
finger millet					2,010	-	2,010
sorghum					1,753	-	1,753
Rice					33,663	-	33,663
Beans					130,099	-	130,099
Field peas					-	-	-
cowpeas					-	-	-
pigeon peas					-	-	-
G.nuts					46,598	-	46,598
Sim sim					7,275	-	7,275
Soybean					269	-	269
All bananas					227,495	-	227,495
Cassava					405,931	-	405,931
Sweet potatoes					29,311	-	29,311
Irish potato					15,720	-	15,720
Cattle					-	87,621	87,621
Goats					-	10,438	10,438
Sheep					-	805	805
Total					1,243,986	98,864	1,342,849
Monetary Use Food Provisioning Ecosystem Services (UGX million, 2018)							
Maize	-	-	-	343,861			
Finger millet	-	-	-	2,010			
Sorghum	-	-	-	1,753			
Rice	-	-	-	33,663			
Beans	-	-	-	130,099			
Field peas	-	-	-	-			
Cowpeas	-	-	-	-			
Pigeon peas	-	-	-	-			
G.nuts	-	-	-	46,598			
Sim sim	-	-	-	7,275			
Soybean	-	-	-	269			
All bananas	-	-	-	227,495			
Cassava	-	-	-	405,931			
Sweet potatoes	-	-	-	29,311			
Irish potato	-	-	-	15,720			
Cattle	-	-	-	87,621			
Goats	-	-	-	10,438			
Sheep	-	-	-	805			
Total	-	-	-	1,342,849			

Bulindi zone MSUT producers and consumers 2018

	Producer				Consumer					
	Gov.	Business	H.holds	Total	Govt.	H.hold	Business	Change in Inventory	Export	Total
Monetary Supply SNA Goods and Services (UGX million, 2018)										
Maize	-	-	-	343,861						
Finger millet	-	-	-	2,010						
Sorghum	-	-	-	1,753						
Rice	-	-	-	33,663						
Beans	-	-	-	130,099						
Field peas	-	-	-	-						
Cowpeas	-	-	-	-						
Pigeon peas	-	-	-	-						
G.nuts	-	-	-	46,598						
Sim sim	-	-	-	7,275						
Soybean	-	-	-	269						
All bananas	-	-	-	227,495						
Cassava	-	-	-	405,931						
Sweet potatoes	-	-	-	29,311						
Irish potato	-	-	-	15,720						
Cattle	-	-	-	87,621						
Goats	-	-	-	10,438						
Sheep	-	-	-	805						
Total	-	-	-	1,342,849						
Monetary Use SNA Goods and Services (UGX million, 2018)										
Maize					-	101,804	242,056	-	-	343,861
Finger millet					-	1,526	484	-	-	2,010
Sorghum					-	1,688	65	-	-	1,753
Rice					-	1,816	31,847	-	-	33,663
Beans					-	103,418	26,681	-	-	130,099
Field peas					-	-	-	-	-	-
Cowpeas					-	-	-	-	-	-
Pigeon peas					-	-	-	-	-	-
G.nuts					-	28,537	18,062	-	-	46,598
Sim sim					-	7,163	112	-	-	7,275
Soybean					-	269	-	-	-	269
All bananas					-	211,862	15,633	-	-	227,495
Cassava					-	373,010	32,920	-	-	405,931
Sweet potatoes					-	26,184	3,127	-	-	29,311
Irish potato					-	10,243	5,477	-	-	15,720
Cattle					-	79,735	7,886	-	-	87,621
Goats					-	10,334	104	-	-	10,438
Sheep					-	797	8	-	-	805
Total					-	958,387	384,462	-	-	1,342,849

Kachwekano zone MSUT Economic Units and Ecosystem types 2009

	Economic Unit				Ecosystem types		
	Gov.	Businesses	Households	Total	Cropland	Grassland	Total
Monetary Supply Food Provisioning Ecosystem Services (UGX million, 2009)							
Maize					6,055	-	6,055
Finger millet					3,321	-	3,321
Sorghum					6,080	-	6,080
Rice					785	-	785
Beans					19,429	-	19,429
Field peas					788	-	788
Cowpeas					39	-	39
Pigeon peas					-	-	-
G.nuts					676	-	676
Sim sim					-	-	-
Soybean					241	-	241
All bananas					37,298	-	37,298
Cassava					8,728	-	8,728
Sweet potatoes					15,201	-	15,201
Irish potato					31,776	-	31,776
Cattle					-	19,195	19,195
Goats					-	4,656	4,656
Sheep					-	124	124
Total					130,418	23,974	154,392
Monetary Use Food Provisioning Ecosystem Services (UGX million, 2009)							
Maize	-	-	-	6,055			
Finger millet	-	-	-	3,321			
Sorghum	-	-	-	6,080			
Rice	-	-	-	785			
Beans	-	-	-	19,429			
Field peas	-	-	-	788			
Cowpeas	-	-	-	39			
Pigeon peas	-	-	-	-			
G.nuts	-	-	-	676			
Sim sim	-	-	-	-			
Soybean	-	-	-	241			
All bananas	-	-	-	37,298			
Cassava	-	-	-	8,728			
Sweet potatoes	-	-	-	15,201			
Irish potato	-	-	-	31,776			
Cattle	-	-	-	19,195			
Goats	-	-	-	4,656			
Sheep	-	-	-	124			
Total	-	-	-	154,392			

Kachwekano zone MSUT producers and consumers 2009

	Producer				Consumer					
	Gov.	Business	Households	Total	Govt.	Hhold	Business	Change in Inventory	Export	Total
Monetary Supply SNA Goods and Services (UGX million, 2009)										
Maize	-	-	-	6,055						
Finger millet	-	-	-	3,321						
Sorghum	-	-	-	6,080						
Rice	-	-	-	785						
Beans	-	-	-	19,429						
Field peas	-	-	-	788						
Cowpeas	-	-	-	39						
Pigeon peas	-	-	-	-						
G.nuts	-	-	-	676						
Sim sim	-	-	-	-						
Soybean	-	-	-	241						
All bananas	-	-	-	37,298						
Cassava	-	-	-	8,728						
Sweet potatoes	-	-	-	15,201						
Irish potato	-	-	-	31,776						
Cattle	-	-	-	19,195						
Goats	-	-	-	4,656						
Sheep	-	-	-	124						
Total	-	-	-	154,392						
Monetary Use SNA Goods and Services (UGX million, 2009)										
Maize					-	1,793	4,262	-	-	6,055
Finger millet					-	2,521	799	-	-	3,321
Sorghum					-	5,855	225	-	-	6,080
Rice					-	42	743	-	-	785
Beans					-	15,445	3,985	-	-	19,429
Field peas					-	788	-	-	-	788
Cowpeas					-	39	-	-	-	39
Pigeon peas					-	-	-	-	-	-
G.nuts					-	414	262	-	-	676
Sim sim					-	-	-	-	-	-
Soybean					-	241	-	-	-	241
All bananas					-	34,735	2,563	-	-	37,298
Cassava					-	8,021	708	-	-	8,728
Sweet potatoes					-	13,579	1,622	-	-	15,201
Irish potato					-	20,705	11,071	-	-	31,776
Cattle					-	17,467	1,728	-	-	19,195
Goats					-	4,609	47	-	-	4,656
Sheep					-	122	1	-	-	124
Total					-	126,377	28,015	-	-	154,392

Kachwekano zone MSUT Economic Units and Ecosystem types 2018

	Economic Unit				Ecosystem types		
	Gov.	Businesses	Households	Total	Cropland	Grassland	Total
Monetary Supply Food Provisioning Ecosystem Services (UGX million, 2018)							
Maize					13,769	-	13,769
Finger millet					9,224	-	9,224
Sorghum					9,477	-	9,477
Rice					10,733	-	10,733
Beans					45,895	-	45,895
Field peas					-	-	-
Cowpeas					-	-	-
Pigeon peas					-	-	-
G.nuts					8,201	-	8,201
Sim sim					-	-	-
Soybean					316	-	316
All bananas					91,057	-	91,057
Cassava					21,683	-	21,683
Sweet potatoes					32,174	-	32,174
Irish potato					76,446	-	76,446
Cattle					-	25,402	25,402
Goats					-	6,914	6,914
Sheep					-	1,940	1,940
Total					318,975	34,255	353,231
Monetary Use Food Provisioning Ecosystem Services UGX million, 2018)							
Maize	-	-	-	13,769			
Finger millet	-	-	-	9,224			
Sorghum	-	-	-	9,477			
Rice	-	-	-	10,733			
Beans	-	-	-	45,895			
Field peas	-	-	-	-			
Cowpeas	-	-	-	-			
Pigeon peas	-	-	-	-			
G.nuts	-	-	-	8,201			
Sim sim	-	-	-	-			
Soybean	-	-	-	316			
All bananas	-	-	-	91,057			
Cassava	-	-	-	21,683			
Sweet potatoes	-	-	-	32,174			
Irish potato	-	-	-	76,446			
Cattle	-	-	-	25,402			
Goats	-	-	-	6,914			
Sheep	-	-	-	1,940			
Total	-	-	-	353,231			

Kachwekano zone MSUT producers and consumers 2018

	Producer				Consumer					
	Gov.	Business	Hholds	Total	Govt.	Hhold	Business	Change in Inventory	Export	Total
Monetary Supply SNA Goods and Services (UGX million, 2018)										
Maize	-	-	-	13,769						
Finger millet	-	-	-	9,224						
Sorghum	-	-	-	9,477						
Rice	-	-	-	10,733						
Beans	-	-	-	45,895						
Field peas	-	-	-	-						
Cowpeas	-	-	-	-						
Pigeon peas	-	-	-	-						
G.nuts	-	-	-	8,201						
Sim sim	-	-	-	-						
Soybean	-	-	-	316						
All bananas	-	-	-	91,057						
Cassava	-	-	-	21,683						
Sweet potatoes	-	-	-	32,174						
Irish potato	-	-	-	76,446						
Cattle	-	-	-	25,402						
Goats	-	-	-	6,914						
Sheep	-	-	-	1,940						
Total	-	-	-	353,231						
Monetary Use SNA Goods and Services (UGX million, 2018)										
Maize					-	4,076	9,692	-	-	13,769
Finger millet					-	7,004	2,220	-	-	9,224
Sorghum					-	9,127	351	-	-	9,477
Rice					-	579	10,154	-	-	10,733
Beans					-	36,482	9,412	-	-	45,895
Field peas					-	-	-	-	-	-
Cowpeas					-	-	-	-	-	-
Pigeon peas					-	-	-	-	-	-
G.nuts					-	5,022	3,179	-	-	8,201
Sim sim					-	-	-	-	-	-
Soybean					-	316	-	-	-	316
All bananas					-	84,799	6,257	-	-	91,057
Cassava					-	19,924	1,758	-	-	21,683
Sweet potatoes					-	28,742	3,432	-	-	32,174
Irish potato					-	49,812	26,634	-	-	76,446
Cattle					-	23,116	2,286	-	-	25,402
Goats					-	6,845	69	-	-	6,914
Sheep					-	1,920	19	-	-	1,940
Total					-	277,766	75,465	-	-	353,231

Nabuin zone MSUT Economic Units and Ecosystem types 2009

	Economic Unit				Ecosystem types		
	Gov.	Business	Hholds	Total	Cropland	Grassland	Total
Monetary Supply Food Provisioning Ecosystem Services (UGX million, 2009)							
Maize					4,608	-	4,608
Finger millet					3,014	-	3,014
Sorghum					9,123	-	9,123
Rice					-	-	-
Beans					7,309	-	7,309
Field peas					35	-	35
Cowpeas					700	-	700
Pigeon peas					17	-	17
G.nuts					668	-	668
Sim sim					1,251	-	1,251
Soybean					-	-	-
All bananas					71	-	71
Cassava					769	-	769
Sweet potatoes					280	-	280
Irish potato					-	-	-
Cattle					-	198,631	198,631
Goats					-	17,505	17,505
Sheep					-	1,344	1,344
Total					27,844	217,480	245,324
Monetary Use Food Provisioning Ecosystem Services (UGX million, 2009)							
Maize	-	-	-	4,608			
Finger millet	-	-	-	3,014			
Sorghum	-	-	-	9,123			
Rice	-	-	-	-			
Beans	-	-	-	7,309			
Field peas	-	-	-	35			
Cowpeas	-	-	-	700			
Pigeon peas	-	-	-	17			
G.nuts	-	-	-	668			
Sim sim	-	-	-	1,251			
Soybean	-	-	-	-			
All bananas	-	-	-	71			
Cassava	-	-	-	769			
Sweet potatoes	-	-	-	280			
Irish potato	-	-	-	-			
Cattle	-	-	-	198,631			
Goats	-	-	-	17,505			
Sheep	-	-	-	1,344			
Total	-	-	-	245,324			

Nabuin zone MSUT producers and consumers 2009

	Producer				Consumer					
	Gov.	Business	Hholds	Total	Govt.	Hhold	Business	Change in Inventory	Export	Total
Monetary Supply SNA Goods and Services (UGX million, 2009)										
Maize	-	-	-	4,608						
finger millet	-	-	-	3,014						
sorghum	-	-	-	9,123						
Rice	-	-	-	-						
Beans	-	-	-	7,309						
Field peas	-	-	-	35						
cowpeas	-	-	-	700						
pigeon peas	-	-	-	17						
G.nuts	-	-	-	668						
Sim sim	-	-	-	1,251						
Soybean	-	-	-	-						
All bananas	-	-	-	71						
Cassava	-	-	-	769						
Sweet potatoes	-	-	-	280						
Irish potato	-	-	-	-						
Cattle	-	-	-	198,631						
Goats	-	-	-	17,505						
Sheep	-	-	-	1,344						
Total	-	-	-	245,324						
Monetary Use SNA Goods and Services (UGX million, 2009)										
Maize					-	1,364	3,244	-	-	4,608
Finger millet					-	2,288	725	-	-	3,014
Sorghum					-	8,786	338	-	-	9,123
Rice					-	-	-	-	-	-
Beans					-	5,810	1,499	-	-	7,309
Field peas					-	35	-	-	-	35
Cowpeas					-	700	-	-	-	700
Pigeon peas					-	17	-	-	-	17
G.nuts					-	409	259	-	-	668
Sim sim					-	1,232	19	-	-	1,251
Soybean					-	-	-	-	-	-
All bananas					-	66	5	-	-	71
Cassava					-	707	62	-	-	769
Sweet potatoes					-	250	30	-	-	280
Irish potato					-	-	-	-	-	-
Cattle					-	180,755	17,877	-	-	198,631
Goats					-	17,330	175	-	-	17,505
Sheep					-	1,330	13	-	-	1,344
Total					-	221,078	24,246	-	-	245,324

Nabuin zone MSUT Economic Units and Ecosystem types 2018

	Economic Unit				Ecosystem types		
	Gov.	Business	Hholds	Total	Cropland	Grassland	Total
Monetary Supply Food Provisioning Ecosystem Services (UGX million, 2018)							
Maize					70,568	-	70,568
Finger millet					5,895	-	5,895
Sorghum					71,034	-	71,034
Rice					-	-	-
Beans					14,735	-	14,735
Field peas					-	-	-
Cowpeas					-	-	-
Pigeon peas					-	-	-
G.nuts					19,011	-	19,011
Sim sim					-	-	-
Soybean					-	-	-
All bananas					378	-	378
Cassava					32,790	-	32,790
Sweet potatoes					4,778	-	4,778
Irish potato					-	-	-
Cattle					-	636,576	636,576
Goats					-	77,262	77,262
Sheep					-	40,282	40,282
Total					219,189	754,121	973,310
Monetary Use Food Provisioning Ecosystem Services (UGX million, 2018)							
Maize	-	-	-	70,568			
Finger millet	-	-	-	5,895			
Sorghum	-	-	-	71,034			
Rice	-	-	-	-			
Beans	-	-	-	14,735			
Field peas	-	-	-	-			
Cowpeas	-	-	-	-			
Pigeon peas	-	-	-	-			
G.nuts	-	-	-	19,011			
Sim sim	-	-	-	-			
Soybean	-	-	-	-			
All bananas	-	-	-	378			
Cassava	-	-	-	32,790			
Sweet potatoes	-	-	-	4,778			
Irish potato	-	-	-	-			
Cattle	-	-	-	636,576			
Goats	-	-	-	77,262			
Sheep	-	-	-	40,282			
Total	-	-	-	973,310			

Nabun zone MSUT producers and consumers 2018

	Producer				Consumer					
	Gov.	Business	Hholds	Total	Govt.	Hhold	Business	Change in Inventory	Export	Total
Monetary Supply SNA Goods and Services (UGX million, 2018)										
Maize	-	-	-	70,568						
Finger millet	-	-	-	5,895						
Sorghum	-	-	-	71,034						
Rice	-	-	-	-						
Beans	-	-	-	14,735						
Field peas	-	-	-	-						
Cowpeas	-	-	-	-						
Pigeon peas	-	-	-	-						
G.nuts	-	-	-	19,011						
Sim sim	-	-	-	-						
Soybean	-	-	-	-						
All bananas	-	-	-	378						
Cassava	-	-	-	32,790						
Sweet potatoes	-	-	-	4,778						
Irish potato	-	-	-	-						
Cattle	-	-	-	636,576						
Goats	-	-	-	77,262						
Sheep	-	-	-	40,282						
Total	-	-	-	973,310						
Monetary Use SNA Goods and Services (UGX million, 2018)										
Maize					-	20,893	49,676	-	-	70,568
Finger millet					-	4,476	1,419	-	-	5,895
Sorghum					-	68,405	2,629	-	-	71,034
Rice					-	-	-	-	-	-
Beans					-	11,713	3,022	-	-	14,735
Field peas					-	-	-	-	-	-
Cowpeas					-	-	-	-	-	-
Pigeon peas					-	-	-	-	-	-
G.nuts					-	11,642	7,369	-	-	19,011
Sim sim					-	-	-	-	-	-
Soybean					-	-	-	-	-	-
All bananas					-	352	26	-	-	378
Cassava					-	30,131	2,659	-	-	32,790
Sweet potatoes					-	4,268	510	-	-	4,778
Irish potato					-	-	-	-	-	-
Cattle					-	579,284	57,292	-	-	636,576
Goats					-	76,490	773	-	-	77,262
Sheep					-	39,879	403	-	-	40,282
Total					-	847,533	125,777	-	-	973,310

Ngetta zone MSUT Economic Units and Ecosystem types 2009

	Economic Unit				Ecosystem types		
	Gov.	Businesses	Households	Total	Cropland	Grassland	Total
Monetary Supply Food Provisioning Ecosystem Services (UGX million, 2009)							
Maize					37,736	-	37,736
Finger millet					22,863	-	22,863
Sorghum					20,500	-	20,500
Rice					33,130	-	33,130
Beans					89,951	-	89,951
Field peas					4,405	-	4,405
Cowpeas					246	-	246
Pigeon peas					5,069	-	5,069
G.nuts					30,798	-	30,798
Sim sim					47,591	-	47,591
Soybean					6,836	-	6,836
All bananas					286	-	286
Cassava					149,876	-	149,876
Sweet potatoes					20,458	-	20,458
Irish potato					23	-	23
Cattle					-	71,569	71,569
Goats					-	8,648	8,648
Sheep					-	128	128
Total					469,770	80,345	550,115
Monetary Use Food Provisioning Ecosystem Services (UGX million, 2009)							
Maize	-	-	-	37,736			
Finger millet	-	-	-	22,863			
Sorghum	-	-	-	20,500			
Rice	-	-	-	33,130			
Beans	-	-	-	89,951			
Field peas	-	-	-	4,405			
Cowpeas	-	-	-	246			
Pigeon peas	-	-	-	5,069			
G.nuts	-	-	-	30,798			
Sim sim	-	-	-	47,591			
Soybean	-	-	-	6,836			
All bananas	-	-	-	286			
Cassava	-	-	-	149,876			
Sweet potatoes	-	-	-	20,458			
Irish potato	-	-	-	23			
Cattle	-	-	-	71,569			
Goats	-	-	-	8,648			
Sheep	-	-	-	128			
Total	-	-	-	550,115			

Ngetta zone MSUT producers and consumers 2009

	Producer				Consumer					
	Gov.	Business	Hholds	Total	Govt.	Hhold	Business	Change in Inventory	Export	Total
Monetary Supply SNA Goods and Services (UGX million, 2009)										
Maize	-	-	-	37,736						
Finger millet	-	-	-	22,863						
Sorghum	-	-	-	20,500						
Rice	-	-	-	33,130						
Beans	-	-	-	89,951						
Field peas	-	-	-	4,405						
Cowpeas	-	-	-	246						
Pigeon peas	-	-	-	5,069						
G.nuts	-	-	-	30,798						
Sim sim	-	-	-	47,591						
Soybean	-	-	-	6,836						
All bananas	-	-	-	286						
Cassava	-	-	-	149,876						
Sweet potatoes	-	-	-	20,458						
Irish potato	-	-	-	23						
Cattle	-	-	-	71,569						
Goats	-	-	-	8,648						
Sheep	-	-	-	128						
Total	-	-	-	550,115						
Monetary Use SNA Goods and Services (UGX million, 2009)										
Maize					-	11,172	26,564	-	-	37,736
Finger millet					-	17,360	5,503	-	-	22,863
Sorghum					-	19,741	759	-	-	20,500
Rice					-	1,787	31,342	-	-	33,130
Beans					-	71,504	18,447	-	-	89,951
Field peas					-	4,405	-	-	-	4,405
Cowpeas					-	246	-	-	-	246
Pigeon peas					-	5,069	-	-	-	5,069
G.nuts					-	18,861	11,938	-	-	30,798
Sim sim					-	46,860	731	-	-	47,591
Soybean					-	6,836	-	-	-	6,836
All bananas					-	267	20	-	-	286
Cassava					-	137,721	12,155	-	-	149,876
Sweet potatoes					-	18,276	2,182	-	-	20,458
Irish potato					-	15	8	-	-	23
Cattle					-	65,128	6,441	-	-	71,569
Goats					-	8,561	86	-	-	8,648
Sheep					-	127	1	-	-	128
Total					-	433,937	116,178	-	-	550,115

Ngetta zone MSUT Economic Units and Ecosystem types 2018

	Economic Unit				Ecosystem types		
	Gov.	Businesses	Households	Total	Cropland	Grassland	Total
Monetary Supply Food Provisioning Ecosystem Services (UGX million, 2018)							
Maize					172,050	-	172,050
Finger millet					30,852	-	30,852
Sorghum					18,489	-	18,489
Rice					72,777	-	72,777
Beans					48,312	-	48,312
Field peas					-	-	-
Cowpeas					-	-	-
Pigeon peas					-	-	-
G.nuts					38,289	-	38,289
Sim sim					39,705	-	39,705
Soybean					87,074	-	87,074
All bananas					11,823	-	11,823
Cassava					747,382	-	747,382
Sweet potatoes					38,723	-	38,723
Irish potato					-	-	-
Cattle					-	191,500	191,500
Goats					-	22,074	22,074
Sheep					-	3,056	3,056
Total					1,305,475	216,630	1,522,105
Monetary Use Food Provisioning Ecosystem Services (UGX million, 2018)							
Maize	-	-	-	172,050			
Finger millet	-	-	-	30,852			
Sorghum	-	-	-	18,489			
Rice	-	-	-	72,777			
Beans	-	-	-	48,312			
Field peas	-	-	-	-			
Cowpeas	-	-	-	-			
Pigeon peas	-	-	-	-			
G.nuts	-	-	-	38,289			
Sim sim	-	-	-	39,705			
Soybean	-	-	-	87,074			
All bananas	-	-	-	11,823			
Cassava	-	-	-	747,382			
Sweet potatoes	-	-	-	38,723			
Irish potato	-	-	-	-			
Cattle	-	-	-	191,500			
Goats	-	-	-	22,074			
Sheep	-	-	-	3,056			
Total	-	-	-	1,522,105			

Ngetta zone MSUT producers and consumers 2018

	Producer				Consumer					
	Gov.	Business	Hholds	Total	Govt.	Hhold	Business	Change in Inventory	Export	Total
Monetary Supply SNA Goods and Services UGX million, 2018)										
Maize	-	-	-	172,050						
Finger millet	-	-	-	30,852						
Sorghum	-	-	-	18,489						
Rice	-	-	-	72,777						
Beans	-	-	-	48,312						
Field peas	-	-	-	-						
Cowpeas	-	-	-	-						
Pigeon peas	-	-	-	-						
G.nuts	-	-	-	38,289						
Sim sim	-	-	-	39,705						
Soybean	-	-	-	87,074						
All bananas	-	-	-	11,823						
Cassava	-	-	-	747,382						
Sweet potatoes	-	-	-	38,723						
Irish potato	-	-	-	-						
Cattle	-	-	-	191,500						
Goats	-	-	-	22,074						
Sheep	-	-	-	3,056						
Total	-	-	-	1,522,105						
Monetary Use SNA Goods and Services (UGX million, 2018)										
Maize					-	50,938	121,112	-	-	172,050
Finger millet					-	23,425	7,426	-	-	30,852
Sorghum					-	17,805	684	-	-	18,489
Rice					-	3,926	68,850	-	-	72,777
Beans					-	38,404	9,908	-	-	48,312
Field peas					-	-	-	-	-	-
Cowpeas					-	-	-	-	-	-
Pigeon peas					-	-	-	-	-	-
G.nuts					-	23,448	14,841	-	-	38,289
Sim sim					-	39,095	610	-	-	39,705
Soybean					-	87,074	-	-	-	87,074
All bananas					-	11,010	812	-	-	11,823
Cassava					-	686,771	60,611	-	-	747,382
Sweet potatoes					-	34,592	4,131	-	-	38,723
Irish potato					-	-	-	-	-	-
Cattle					-	174,265	17,235	-	-	191,500
Goats					-	21,854	221	-	-	22,074
Sheep					-	3,025	31	-	-	3,056
Total					-	1,215,632	306,473	-	-	1,522,105

Rwebitaba zone MSUT Economic Units and Ecosystem types 2009

	Economic Unit				Ecosystem types		
	Gov.	Business	Households	Total	Cropland	Grassland	Total
Monetary Supply Food Provisioning Ecosystem Services (UGX million, 2009)							
Maize					48,293	-	48,293
Finger millet					8,220	-	8,220
Sorghum					1,075	-	1,075
Rice					833	-	833
Beans					45,157	-	45,157
Field peas					177	-	177
Cowpeas					39	-	39
Pigeon peas					-	-	-
G.nuts					7,994	-	7,994
Sim sim					-	-	-
Soybean					591	-	591
All bananas					103,847	-	103,847
Cassava					54,844	-	54,844
Sweet potatoes					16,448	-	16,448
Irish potato					17,641	-	17,641
Cattle					-	55,847	55,847
Goats					-	7,986	7,986
Sheep					-	94	94
Total					305,157	63,926	369,083
Monetary Use Food Provisioning Ecosystem Services (UGX million, 2009)							
Maize	-	-	-	48,293			
Finger millet	-	-	-	8,220			
Sorghum	-	-	-	1,075			
Rice	-	-	-	833			
Beans	-	-	-	45,157			
Field peas	-	-	-	177			
Cowpeas	-	-	-	39			
Pigeon peas	-	-	-	-			
G.nuts	-	-	-	7,994			
Sim sim	-	-	-	-			
Soybean	-	-	-	591			
All bananas	-	-	-	103,847			
Cassava	-	-	-	54,844			
Sweet potatoes	-	-	-	16,448			
Irish potato	-	-	-	17,641			
Cattle	-	-	-	55,847			
Goats	-	-	-	7,986			
Sheep	-	-	-	94			
Total	-	-	-	369,083			

Rwebitaba zone MSUT producers and consumers 2009

	Producer				Consumer					
	Gov.	Business	Hholds	Total	Govt.	Hhold	Business	Change in Inventory	Export	Total
Monetary Supply SNA Goods and Services (UGX million, 2009)										
Maize	-	-	-	48,293						
Finger millet	-	-	-	8,220						
Sorghum	-	-	-	1,075						
Rice	-	-	-	833						
Beans	-	-	-	45,157						
Field peas	-	-	-	177						
Cowpeas	-	-	-	39						
Pigeon peas	-	-	-	-						
G.nuts	-	-	-	7,994						
Sim sim	-	-	-	-						
Soybean	-	-	-	591						
All bananas	-	-	-	103,847						
Cassava	-	-	-	54,844						
Sweet potatoes	-	-	-	16,448						
Irish potato	-	-	-	17,641						
Cattle	-	-	-	55,847						
Goats	-	-	-	7,986						
Sheep	-	-	-	94						
Total	-	-	-	369,083						
Monetary Use SNA Goods and Services (UGX million, 2009)										
Maize					-	14,298	33,995	-	-	48,293
Finger millet					-	6,241	1,979	-	-	8,220
Sorghum					-	1,035	40	-	-	1,075
Rice					-	45	788	-	-	833
Beans					-	35,896	9,261	-	-	45,157
Field peas					-	177	-	-	-	177
Cowpeas					-	39	-	-	-	39
Pigeon peas					-	-	-	-	-	-
G.nuts					-	4,895	3,098	-	-	7,994
Sim sim					-	-	-	-	-	-
Soybean					-	591	-	-	-	591
All bananas					-	96,711	7,136	-	-	103,847
Cassava					-	50,396	4,448	-	-	54,844
Sweet potatoes					-	14,694	1,755	-	-	16,448
Irish potato					-	11,495	6,146	-	-	17,641
Cattle					-	50,820	5,026	-	-	55,847
Goats					-	7,906	80	-	-	7,986
Sheep					-	93	1	-	-	94
Total					-	295,331	73,752	-	-	369,083

Rwebitaba zone MSUT Economic Units and Ecosystem types 2018

	Economic Unit				Ecosystem types		
	Gov.	Businesses	Hholds	Total	Cropland	Grassland	Total
Monetary Supply Food Provisioning Ecosystem Services (UGX million, 2018)							
Maize					150,604	-	150,604
Finger millet					3,782	-	3,782
Sorghum					4,087	-	4,087
Rice					9,089	-	9,089
Beans					69,877	-	69,877
Field peas					-	-	-
Cowpeas					-	-	-
Pigeon peas					-	-	-
G.nuts					33,851	-	33,851
Sim sim					604	-	604
Soybean					1,563	-	1,563
All bananas					361,259	-	361,259
Cassava					93,404	-	93,404
Sweet potatoes					17,641	-	17,641
Irish potato					75,147	-	75,147
Cattle					-	192,041	192,041
Goats					-	21,517	21,517
Sheep					-	2,673	2,673
Total					820,907	216,230	1,037,138
Monetary Use Food Provisioning Ecosystem Services (UGX million, 2018)							
Maize	-	-	-	150,604			
Finger millet	-	-	-	3,782			
Sorghum	-	-	-	4,087			
Rice	-	-	-	9,089			
Beans	-	-	-	69,877			
Field peas	-	-	-	-			
Cowpeas	-	-	-	-			
Pigeon peas	-	-	-	-			
G.nuts	-	-	-	33,851			
Sim sim	-	-	-	604			
Soybean	-	-	-	1,563			
All bananas	-	-	-	361,259			
Cassava	-	-	-	93,404			
Sweet potatoes	-	-	-	17,641			
Irish potato	-	-	-	75,147			
Cattle	-	-	-	192,041			
Goats	-	-	-	21,517			
Sheep	-	-	-	2,673			
Total	-	-	-	1,037,138			

Rwebitaba zone MSUT producers and consumers 2018

	Producer				Consumer					
	Gov.	Business	Hholds	Total	Govt.	Hhold	Business	Change in Inventory	Export	Total
Monetary Supply SNA Goods and Services (UGX million, 2018)										
Maize	-	-	-	150,604						
Finger millet	-	-	-	3,782						
Sorghum	-	-	-	4,087						
Rice	-	-	-	9,089						
Beans	-	-	-	69,877						
Field peas	-	-	-	-						
Cowpeas	-	-	-	-						
Pigeon peas	-	-	-	-						
G.nuts	-	-	-	33,851						
Sim sim	-	-	-	604						
Soybean	-	-	-	1,563						
All bananas	-	-	-	361,259						
Cassava	-	-	-	93,404						
Sweet potatoes	-	-	-	17,641						
Irish potato	-	-	-	75,147						
Cattle	-	-	-	192,041						
Goats	-	-	-	21,517						
Sheep	-	-	-	2,673						
Total	-	-	-	1,037,138						
Monetary Use SNA Goods and Services (UGX million, 2018)										
Maize					-	44,588	106,016	-	-	150,604
Finger millet					-	2,871	910	-	-	3,782
Sorghum					-	3,936	151	-	-	4,087
Rice					-	490	8,599	-	-	9,089
Beans					-	55,547	14,331	-	-	69,877
Field peas					-	-	-	-	-	-
Cowpeas					-	-	-	-	-	-
Pigeon peas					-	-	-	-	-	-
G.nuts					-	20,730	13,121	-	-	33,851
Sim sim					-	594	9	-	-	604
Soybean					-	1,563	-	-	-	1,563
All bananas					-	336,434	24,826	-	-	361,259
Cassava					-	85,829	7,575	-	-	93,404
Sweet potatoes					-	15,759	1,882	-	-	17,641
Irish potato					-	48,965	26,181	-	-	75,147
Cattle					-	174,757	17,284	-	-	192,041
Goats					-	21,301	215	-	-	21,517
Sheep					-	2,646	27	-	-	2,673
Total					-	816,012	221,126	-	-	1,037,138

Serere zone MSUT Economic Units and Ecosystem types 2009

	Economic Unit				Ecosystem types		
	Gov.	Businesses	Households	Total	Cropland	Grassland	Total
Monetary Supply Food Provisioning Ecosystem Services (UGX million, 2009)							
Maize					43,369	-	43,369
Finger millet					16,513	-	16,513
Sorghum					21,405	-	21,405
Rice					22,366	-	22,366
Beans					8,527	-	8,527
Field peas					609	-	609
Cowpeas					3,215	-	3,215
Pigeon peas					50	-	50
G.nuts					24,953	-	24,953
Sim sim					3,652	-	3,652
Soybean					145	-	145
All bananas					92	-	92
Cassava					86,616	-	86,616
Sweet potatoes					30,080	-	30,080
Irish potato					-	-	-
Cattle					-	84,802	84,802
Goats					-	6,708	6,708
Sheep					-	151	151
Total					261,592	91,660	353,252
Monetary Use Food Provisioning Ecosystem Services (UGX million, 2009)							
Maize	-	-	-	43,369			
Finger millet	-	-	-	16,513			
Sorghum	-	-	-	21,405			
Rice	-	-	-	22,366			
Beans	-	-	-	8,527			
Field peas	-	-	-	609			
Cowpeas	-	-	-	3,215			
Pigeon peas	-	-	-	50			
G.nuts	-	-	-	24,953			
Sim sim	-	-	-	3,652			
Soybean	-	-	-	145			
All bananas	-	-	-	92			
Cassava	-	-	-	86,616			
Sweet potatoes	-	-	-	30,080			
Irish potato	-	-	-	-			
Cattle	-	-	-	84,802			
Goats	-	-	-	6,708			
Sheep	-	-	-	151			
Total	-	-	-	353,252			

Serere zone MSUT producers and consumers 2009

	Producer				Consumer					
	Gov.	Business	Hholds	Total	Govt.	Hold	Business	Change in Inventory	Export	Total
Monetary Supply SNA Goods and Services (UGX million, 2009)										
Maize	-	-	-	43,369						
Finger millet	-	-	-	16,513						
Sorghum	-	-	-	21,405						
Rice	-	-	-	22,366						
Beans	-	-	-	8,527						
Field peas	-	-	-	609						
Cowpeas	-	-	-	3,215						
Pigeon peas	-	-	-	50						
G.nuts	-	-	-	24,953						
Sim sim	-	-	-	3,652						
Soybean	-	-	-	145						
All bananas	-	-	-	92						
Cassava	-	-	-	86,616						
Sweet potatoes	-	-	-	30,080						
Irish potato	-	-	-	-						
Cattle	-	-	-	84,802						
Goats	-	-	-	6,708						
Sheep	-	-	-	151						
Total	-	-	-	353,252						
Monetary Use SNA Goods and Services (UGX million, 2009)										
Maize					-	12,840	30,529	-	-	43,369
Finger millet					-	12,538	3,975	-	-	16,513
Sorghum					-	20,613	792	-	-	21,405
Rice					-	1,207	21,159	-	-	22,366
Beans					-	6,778	1,749	-	-	8,527
Field peas					-	609	-	-	-	609
Cowpeas					-	3,215	-	-	-	3,215
Pigeon peas					-	50	-	-	-	50
G.nuts					-	15,281	9,672	-	-	24,953
Sim sim					-	3,596	56	-	-	3,652
Soybean					-	145	-	-	-	145
All bananas					-	86	6	-	-	92
Cassava					-	79,592	7,024	-	-	86,616
Sweet potatoes					-	26,871	3,209	-	-	30,080
Irish potato					-	-	-	-	-	-
Cattle					-	77,170	7,632	-	-	84,802
Goats					-	6,641	67	-	-	6,708
Sheep					-	149	2	-	-	151
Total					-	267,380	85,873	-	-	353,252

Serere zone MSUT Economic Units and Ecosystem types 2018

	Economic Unit				Ecosystem types		
	Gov.	Businesses	Households	Total	Cropland	Grassland	Total
Monetary Supply Food Provisioning Ecosystem Services (UGX million, 2018)							
Maize					37,746	-	37,746
Finger millet					14,736	-	14,736
Sorghum					18,815	-	18,815
Rice					17,758	-	17,758
Beans					2,682	-	2,682
Field peas					-	-	-
Cowpeas					-	-	-
Pigeon peas					-	-	-
G.nuts					29,607	-	29,607
Sim sim					4,228	-	4,228
Soybean					3,242	-	3,242
All bananas					1,266	-	1,266
Cassava					249,784	-	249,784
Sweet potatoes					17,702	-	17,702
Irish potato					121	-	121
Cattle					-	43,024	43,024
Goats					-	12,571	12,571
Sheep					-	736	736
Total					397,685	56,331	454,017
Monetary Use Food Provisioning Ecosystem Services (UGX million, 2018)							
Maize	-	-	-	37,746			
Finger millet	-	-	-	14,736			
Sorghum	-	-	-	18,815			
Rice	-	-	-	17,758			
Beans	-	-	-	2,682			
Field peas	-	-	-	-			
Cowpeas	-	-	-	-			
Pigeon peas	-	-	-	-			
G.nuts	-	-	-	29,607			
Sim sim	-	-	-	4,228			
Soybean	-	-	-	3,242			
All bananas	-	-	-	1,266			
Cassava	-	-	-	249,784			
Sweet potatoes	-	-	-	17,702			
Irish potato	-	-	-	121			
Cattle	-	-	-	43,024			
Goats	-	-	-	12,571			
Sheep	-	-	-	736			
Total	-	-	-	454,017			

Serere zone MSUT producers and consumers 2018

	Producer				Consumer					
	Gov.	Business	Hholds	Total	Govt.	Hhold	Business	Change in Inventory	Export	Total
Monetary Supply SNA Goods and Services (UGX million, 2018)										
Maize	-	-	-	37,746						
Finger millet	-	-	-	14,736						
Sorghum	-	-	-	18,815						
Rice	-	-	-	17,758						
Beans	-	-	-	2,682						
Field peas	-	-	-	-						
Cowpeas	-	-	-	-						
Pigeon peas	-	-	-	-						
G.nuts	-	-	-	29,607						
Sim sim	-	-	-	4,228						
Soybean	-	-	-	3,242						
All bananas	-	-	-	1,266						
Cassava	-	-	-	249,784						
Sweet potatoes	-	-	-	17,702						
Irish potato	-	-	-	121						
Cattle	-	-	-	43,024						
Goats	-	-	-	12,571						
Sheep	-	-	-	736						
Total	-	-	-	454,017						
Monetary Use SNA Goods and Services (UGX million, 2018)										
Maize					-	11,175	26,571	-	-	37,746
Finger millet					-	11,189	3,547	-	-	14,736
Sorghum					-	18,118	696	-	-	18,815
Rice					-	958	16,800	-	-	17,758
Beans					-	2,132	550	-	-	2,682
Field peas					-	-	-	-	-	-
Cowpeas					-	-	-	-	-	-
Pigeon peas					-	-	-	-	-	-
G.nuts					-	18,131	11,476	-	-	29,607
Sim sim					-	4,163	65	-	-	4,228
Soybean					-	3,242	-	-	-	3,242
All bananas					-	1,179	87	-	-	1,266
Cassava					-	229,527	20,257	-	-	249,784
Sweet potatoes					-	15,813	1,888	-	-	17,702
Irish potato					-	79	42	-	-	121
Cattle					-	39,152	3,872	-	-	43,024
Goats					-	12,445	126	-	-	12,571
Sheep					-	729	7	-	-	736
Total					-	368,032	85,985	-	-	454,017

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