ADJUSTED MACROECONOMIC INDICATORS REPORT

2021 EDITION

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Ministry of Finance, Planning and Economic Development

SUMMARY

This is the third edition of Uganda's Adjusted Macroeconomic Indicators Report, produced by the Macroeconomic Policy Department of the Ministry of Finance, Planning and Economic Development (MoFPED), following the publication of the first edition in 2019 and the second in 2020. Appreciation goes to the World Bank and the Global Program on Sustainability for assistance in their production.

The report provides 2020 values and long-term trends for Adjusted Net National Income (ANNI) and Adjusted Net Savings (ANS). While the methodology for deriving these measures is similar to that used by the World Bank, there has been an attempt to use Uganda-sourced data where possible. For example, as in the previous edition, we have continued to use domestic prices for forest products. These are lower than the global markets prices in the World Bank dataset, which has significantly reduced the monetary value of forest loss and net depletion.

As in the previous two reports, the results indicate that Uganda had positive ANS in 2020. A notable contribution was increased government expenditure in the education sector and the inclusion of non-government education spending in the analysis. This significantly increased the recorded investment in the human capital component of ANS.

To maintain positive ANS there is need to increase the quality of the environment, ensure that there is a net positive gain in vegetation (especially tree cover), reduce pollution and prioritise investment in human capital through education. A very high rate of produced capital depletion (5 percent) significantly affected both the ANS and ANNI. It is therefore also important to invest in long-term resilient infrastructure, while at the same time ensuring the maintenance and operation of existing assets, including natural capital.

The Government of Uganda should adopt a 'sustainable budgeting rule' to ensure that future fiscal revenues from natural capital (such as forests, minerals and energy) are spent on capital investments (including education). This will become especially important as commercial oil production comes onstream and depletes non-renewable natural capital.

In addition, and aligning with the previous Macroeconomic Indicators Reports, it is recommended that the country emphasises investment in:

- increasing vegetation cover by planting trees and protecting existing natural forests;
- investing in human capital through appropriate health, skilling and education measures;
- reducing the rate of depletion of produced capital and ensuring operation and maintenance is provided for in the budget; and
- reducing pollution and poor waste disposal through awareness raising, law enforcement and provision of suitable infrastructure.

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LIST OF ABBREVIATIONS

ANNI	Adjusted Net National Income
ANS	Adjusted Net Savings
BOP	Balance of Payments
CFC	Consumption of Fixed Capital
CO_2	Carbon dioxide
CWON	Changing Wealth of Nations
DAS	Depletion Adjusted Savings
ESA	Education Satellite Accounts
FAO	Food and Agriculture Organisation of the United Nations
FRA	Forest Resources Assessment
FY	Financial Year
GDP	Gross Domestic Product
GFS	Government Finance Statistics
GNI	Gross National Income
GNS	Gross National Savings
GOU	Government of Uganda
MDA	Ministries, Departments and Agencies
MoFPED	Ministry of Finance, Planning and Economic Development
NFA	National Forestry Authority
NNI	Net National Income
SBI	Sustainable Budget Index
SEEA	System of Economic Environmental Accounts
UBOS	Uganda Bureau of Statistics
UGX	Ugandan Shillings
US$	United States Dollars
WAVES	Wealth Accounting and Valuation of Ecosystem Services

1 INTRODUCTION

1.1 Overview

Uganda's Natural Capital Accounting framework reflects a global trend towards broadening the measurement of macroeconomic indicators and countries' national wealth. Conventional accounting frameworks and measures, such as Gross Domestic Product (GDP), fail to measure a country's wealth comprehensively, nor do they consider the impacts on wealth of activities that lead to the over-consumption of natural resources, pollution and environmental degradation. A country's financial status and sustainability should be assessed more holistically, to ascertain whether income is being generated sustainably or by depleting natural assets.

To address these shortcomings, the System of Economic-Environmental Accounts (SEEA) was developed under the auspices of the United Nations Statistical Division. The SEEA follows the principles of the System of National Accounts that underpins the calculation of GDP and other measures of economic activity, but it incorporates a broader range of costs and benefits in the calculation of the following macroeconomic indicators:

1) Adjusted Net National Income (ANNI), and
2) Adjusted Net Savings (ANS).

While the SEAA was under development, the Changing Wealth of Nations (CWON) project was developed by the World Bank to present measures of comprehensive wealth and a form of national balance sheet to accompany the (adjusted) income accounts. The CWON adjusts macroeconomic indicators for depletion of natural resources, like the SEEA, but expands the wealth estimates to include human capital in order to track levels of national wealth and sustainable national income generation.[1]

Following these methodological developments, Uganda undertook a Natural Capital Accounting exercise[2] that covered a range of accounts, including land, forests and wetlands, as well as the macroeconomic and overall wealth accounts, using data from both domestic sources and the World Bank's CWON database.

This report presents adjusted Uganda's macroeconomic indicators for 2020 and highlights relevant policy issues for planning and budgeting. This is a continuous exercise that requires annual updates and new sources of data so that changing components of national wealth (like oil and gas resources) are appropriately identified and incorporated in the natural capital accounts to guide annual budgets and medium- and long-term planning frameworks.

[1] For the adjusted macroeconomic indicators tools see: datacatalog.worldbank.org/dataset/adjusted-net-savings For the Comprehensive wealth tool see: datacatalog.worldbank.org/dataset/wealth-accounting

[2] The exercise was facilitated by the World Bank-led Wealth Accounting and Valuation of Ecosystem Services (WAVES) project. See: www.wavespartnership.org

1.2 Macroeconomic Indicators

The main macroeconomic and wealth indicators developed under the CWON project are as follows:

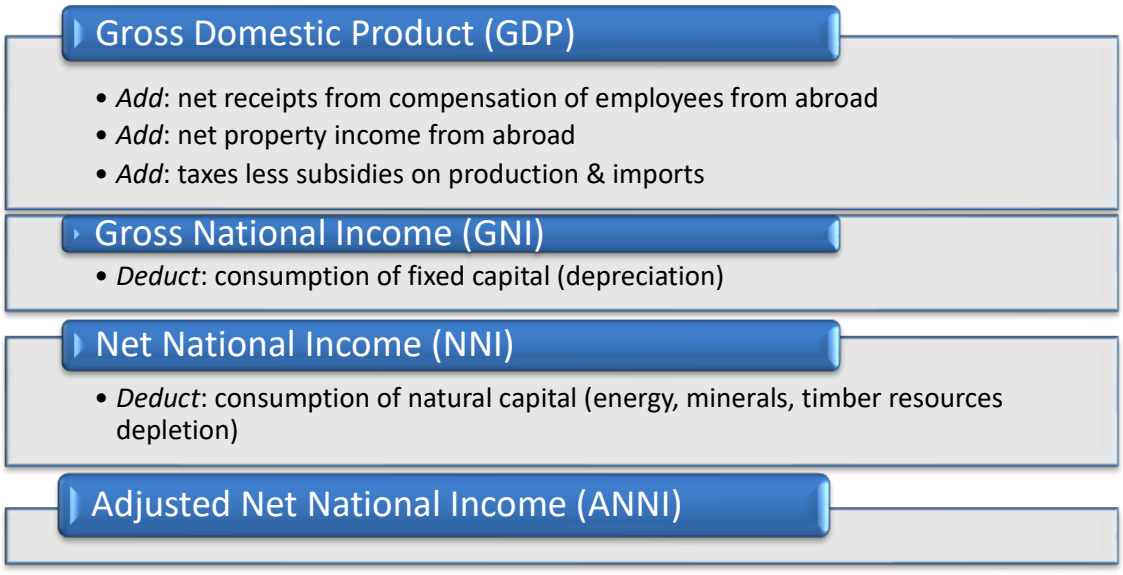
1. Adjusted macroeconomic indicators:
   - Adjusted Net National Income
   - Adjusted Net Savings
2. Comprehensive wealth components:[3]
   - Produced capital
   - Financial capital
   - Natural capital
   - Human capital (this indicator is not included in the SEAA)

The principles for calculating each of these indicators are described below.

1.2.1 Adjusted macroeconomic measures

Adjusted Net National Income (ANNI) is derived from the conventional measure of Gross National Income (GNI) by deducting the value of depleted assets, including produced capital (consumption of fixed capital) and natural capital (both renewable and non-renewable) (Figure 1). This gives a more accurate measure of sustainable income than GDP or GNI, which record gross income regardless of whether it comes partly from the depletion of assets.

Figure 1: Calculation of Adjusted Net National Income from GDP



[3] Note that Produced Capital and Net Financial Assets form part of the conventional national accounts, while Natural Capital and Human Capital are new additions.

Adjusted Net Savings (ANS) is derived from the conventional measure of Gross National Savings (GNS) by adding the value of investment in human capital and deducting the value of depleted assets (as above) and pollution damage. Human capital is thus treated as part of the comprehensive wealth base of the economy. It is proxied by the value of spending on education by the government and, if possible, by the private sector.[4] The depletion of non-renewable natural capital (such as minerals and energy resources) is measured directly by the depletion component of production (extraction). For renewable natural capital (such as forests and fisheries), depletion is measured by the excess of production over the natural rate of regrowth. In principle, the consumption of renewable natural capital is sustainable if it does not exceed the rate at which the resource regenerates. Finally, damages from air pollution are deducted. The value for pollution damage in the ANS calculation has two components: (i) the value of carbon dioxide (CO_2) emissions and (ii) the value of particulate ($PM^{2.5}$) emissions.[5]

ANS is a particularly useful macroeconomic indicator as it is directly linked to the components of comprehensive wealth, a negative figure indicating that the pattern of economic activity is not sustainable and that wealth is being depleted.

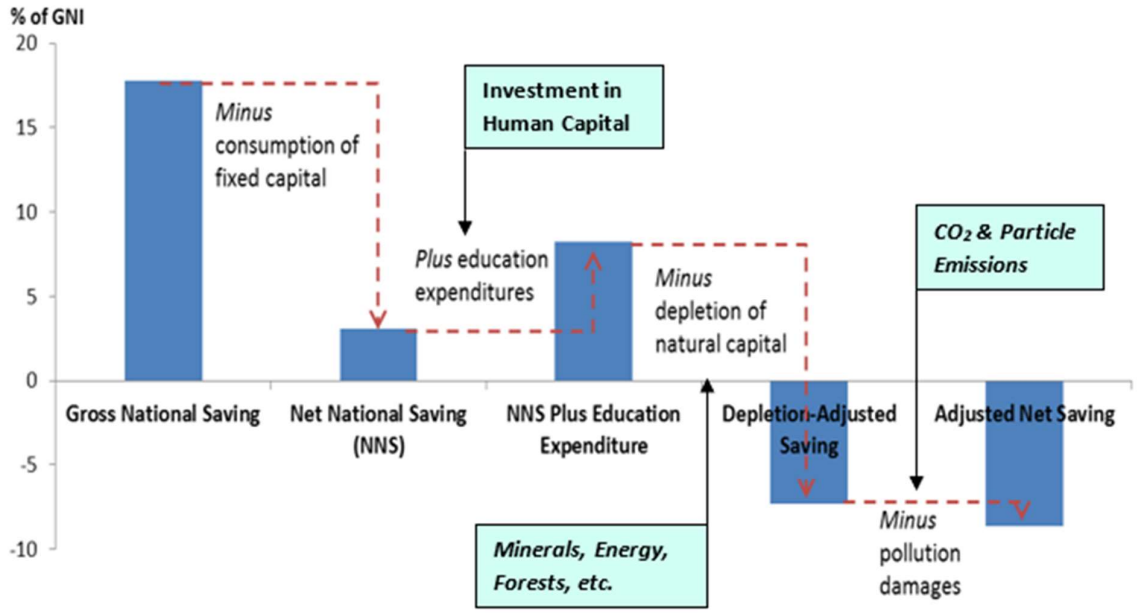
Figure 2 illustrates the method for calculating GNS and Figure 3 shows how this is then used to calculate ANS.

Figure 2: Calculation of Gross National Savings from GDP

[4] Only recurrent spending is included in the ANS calculation, as the investment component is already included in the measure of produced capital stock.

[5] Full details of the methodology can be found in: World Bank (2022). *Estimating the World Bank's Adjusted Net Saving: Methods and Data*. See: datacatalog.worldbank.org/dataset/adjusted-net-savings

Figure 3: Adjusted Net Saving visualisation from GNS



ANNI and ANS figures are published annually by the World Bank in the World Development Indicators database, along with the various components used in their calculation. It is useful to derive these indicators using local data, however, as this is often more representative.

1.2.2 Comprehensive Wealth components

The analysis incorporates four measures that contribute to the calculation of Comprehensive Wealth:[6]

a) **Produced capital.** Also referred to as capital stock, this value is generated alongside the national accounts by deducting consumption of fixed capital (CFC) from gross fixed capital formation (GFCF).

b) **Net financial assets.** Defined as the balance between financial assets and liabilities with the rest of the world, conventionally generated as part of the Balance of Payments (BOP) accounts and also referred to as the International Investment Position.

c) **Natural capital.** This includes:

- **Sub-soil resources.** Includes energy resources and minerals below the ground, which are non-renewable. Energy resources include coal, oil and gas, while minerals include the ten major mined commodities globally: copper, nickel, tin, gold, bauxite, iron ore, phosphate, lead, silver and zinc.

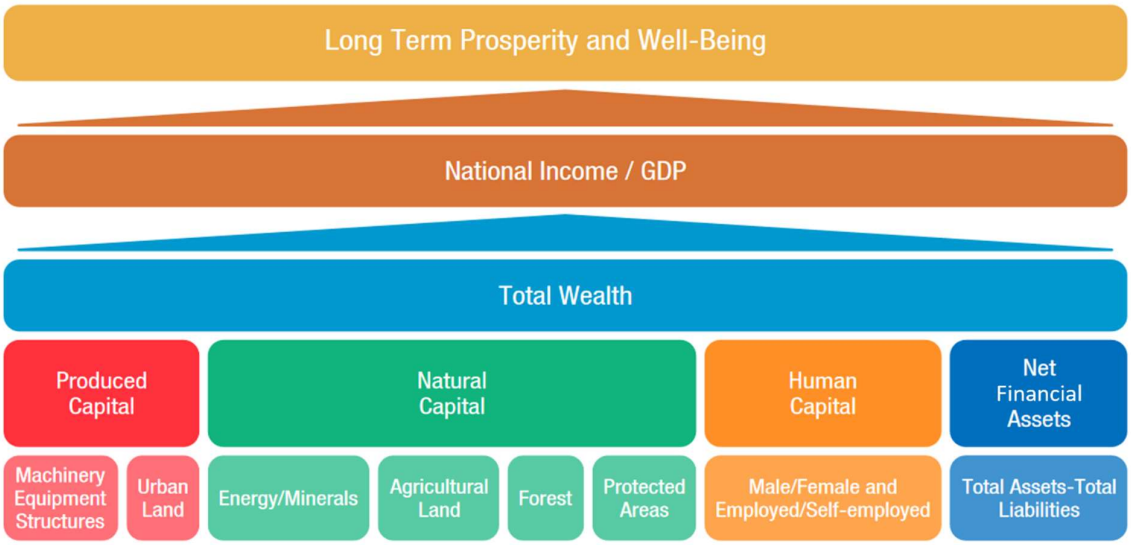
[6] Comprehensive Wealth is also known as Total Wealth.

- **Above-ground resources.** Divided into several sub-categories, including agricultural land, forests and protected areas. Agricultural land is further sub-divided into crop land and pasture land, while forest land is sub-divided into timber and non-timber ecosystems.

d) **Human capital.** The value embodied in the education, training and skills of the population, which is as important an input to the production of economic value as the produced capital stock conventionally measured.

The collective contribution of these four measures to GDP and prosperity is illustrated in Figure 4.

Figure 4: Schematic representation of the elements contributing to Total Wealth and its relationship to GDP and prosperity

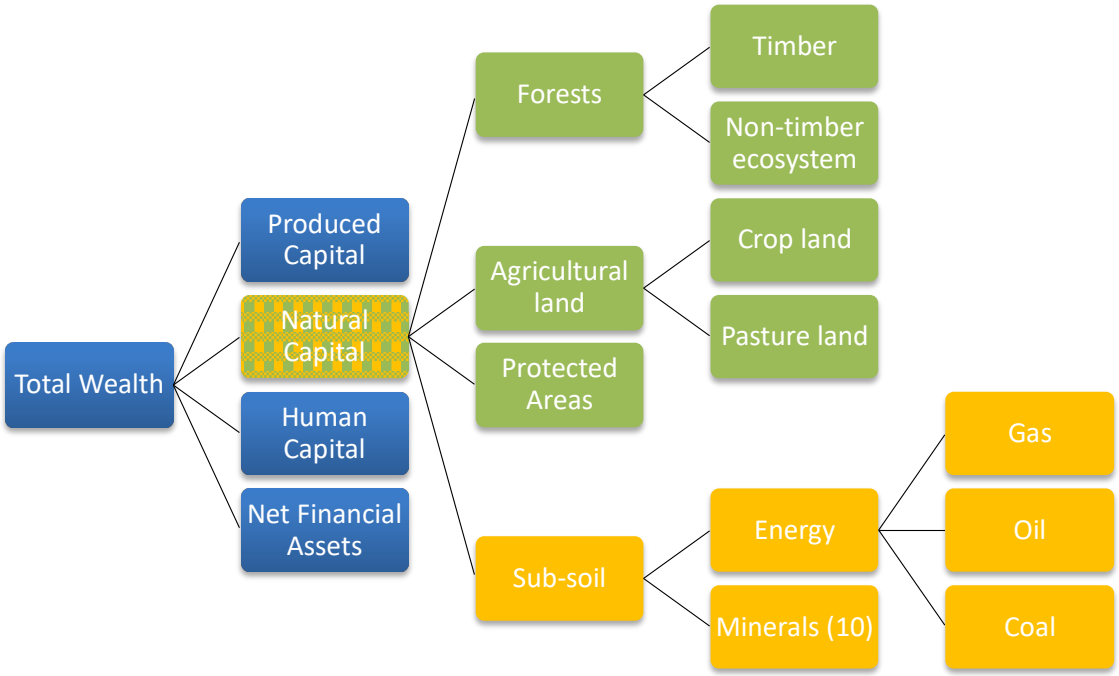


Source: SEEA Ecosystem Accounting: seea.un.org/content/seea-e-learning-resources

Different methods are used to value the different forms of capital. Produced Capital figures can be generated by the Perpetual Inventory Method, whereby the capital stock at the end of each year is simply the previous year's value plus additions (GFCF) and minus depletions (CFC) during the year. Net Foreign Assets are measured directly by the Central Bank as part of the BOP statistics. For natural resources, all types of capital are valued as the Net Present Value of future flows of value generated, based on calculated or estimated rental rates.[7] The contributory elements of Natural Capital are illustrated in Figure 5.

[7] datacatalog.worldbank.org/dataset/wealth-accounting

Figure 5: Breakdown of constituents of Natural Capital



The Comprehensive Wealth value can be used in several ways. For example, it can be used to track whether a country is maintaining, building or depleting wealth as it develops. Wealth can be measured as a percentage of GNI or per capita income (in real terms). If real per capita wealth is being depleted over time, then the pattern of development may not be sustainable. The composition of Comprehensive (or Total) Wealth can also be tracked. So, for instance, if some categories of natural capital are depleted over time, perhaps through mining or excessive consumption of energy resources, then they need to be matched by building up produced capital, human resources or financial assets to compensate.

1.3 Methodology

This section summarises the calculations that were carried out, the main issues encountered and potential methodological improvements.

1.3.1 Data sources

The data sources for calculation of ANS and ANNI are summarised in Table 1 below. While the World Bank is the source for most of the data, local data has been substituted where an acceptable alternative exists. For example, a relatively high proportion of Uganda's education expenditure comes from non-government sources, which are not captured in the World Bank methodology. In addition, the World Bank uses the global market price for valuation of timber products, but this poorly reflects Uganda's internal market. Using local data will also make it easier to calculate bespoke statistics in the future, as more inputs are developed.

Table 1: Data sources

Variable	*Source*
Gross National Income	World Bank
Gross National Savings	World Bank
Capital stock	Uganda Bureau of Statistics (UBOS)
Capital depreciation rate	MoFPED
GDP deflators	UBOS
Exchange rate (UGX/US$)	Bank of Uganda
Education expenditure	UBOS and MoFPED
Timber production by type	UBOS
Charcoal and fuelwood prices	Uganda National Charcoal Survey, 2015[8]
Poles and sawn timber prices	UBOS
Productive forest area	UBOS, Wood Asset and Forest Accounts
Energy depletion	World Bank
Mineral depletion	World Bank
Rental rate	World Bank
Annual commercial increment	World Bank
Baseline CO_2 damage	World Bank
Total forest area	World Bank[9]
CO_2 emissions per ha of deforestation	Uganda's Forest Reference Emission Level report
Air pollution damage	World Bank

1.3.2 Net National Savings

Net National Savings (NNS) is Gross National Savings (GNS) less Consumption of Fixed Capital (CFC). The logic is that depreciation of assets is equivalent to dis-saving. CFC numbers come from the MoFPED's macroeconomic modelling team and are based on a depreciation rate of 5 percent (%) of the year's capital stock.

As the World Bank data on which most of this modelling depends (and with which comparisons will be made) is provided in current US$ by calendar year, the modelling of NNS adopts the same units. CFC numbers are in real Ugandan Shillings (UGX) per financial year, so they were first converted into nominal terms, then into US$ and finally to calendar years.

[8] Ministry of Energy and Mineral Development, 2015. *National Charcoal Survey for Uganda*.

[9] The data reported by the World Bank on total forest area is derived from the FAO Forest Resources Assessment (FRA), which is published every five years (most recently in 2015). The source of the Uganda's FRA data is the NFA.

1.3.3 NNS + education expenditures

One of the steps in computing ANS (as shown in Figure 3), is to add recurrent education expenditure to NNS. The logic here is that any expenditure on education is an investment in human capital, an asset of the country, and should thus be counted positively. Only recurrent education expenditure is added, as expenditure on fixed assets (such as building schools) is already reflected in the GNS calculation. Education expenditure includes spending by the public sector (government, including its donors) and the private sector (households). This methodological adjustment was considered important for Uganda, where a large proportion of education spending comes from the private sector and is not captured in World Bank data.

Education spending data comes from two sources, the **Education Satellite Accounts** (ESA) compiled by UBOS and the **Government Finance Statistics**.

The ESA provide total education expenditure from all sources, including government, household and development partners. They also distinguish recurrent spending from development spending. As these accounts were only compiled for the period 2008/09 to 2013/14, they were used to determine the proportion of total education spending that came from the government over that period, which was 31.4%, and the proportion of total education spending that was recurrent, which was 83.5%. Using a log-log regression with a linear trend, we also calculated the elasticity of private spending to government spending over the recorded period. The derived value of -0.1 suggests that a decrease in government education spending is partly compensated for by an increase in private spending, the amount compensated being up to 30% of the reduction.

The data from the Government Finance Statistics on government education expenditure runs from 1997/98 to 2020/21. This was used as the basis for estimating total expenditure, by applying the ratios and elasticity value derived from the ESA, using the following methodology:

1) Assuming away temporal trends in service provision shares in the Ugandan education sector (which were not visible in the ESA), the estimated government spending share of 31.4% was inverted to a 318.7% uplift (with private spending being 218.7% of government spending) in order to estimate long-term total spending from government spending.

2) To reflect the long-term nature of this assumption, the uplift was not applied to current period government spending, but to a three-year moving average of government spending covering the current, previous and following financial years.

3) In addition, the short-term responsiveness of private spending to changes in government spending was modelled by adjusting the

estimated long-term private spending to changes in government spending from the previous period with an elasticity of -0.1.

Estimated total education spending in the current period is thus the sum of three components:

1) Government education spending in the current period;
2) Private education spending, computed as a 218.7% mark-up over the three-year moving average of government spending; and
3) The short-term private spending response to changes in government spending, calculated as the response of the level of private spending (from Step 2) to the percentage change in government spending from the previous period (Step 1), using the estimated elasticity of -0.1.

Table 2 provides a numerical example.

Table 2: Example of education spending calculation (UGX trillion)

Step	*Time*	*t-1*	*t*	*t+1*
(1)	Current Government annual education spending	3.4	**4.2**	5.6
	3-Year moving average [(3.4 + 4.2 + 5.6) / 3]	…	4.4	…
(2)	Estimated private spending (218.7% uplift) [-4.4 * 2.187]	…	**9.62**	…
	Log-difference of Government spending from t-1 to t [ln (4.2 / 3.4)]	…	0.21	…
(3)	Estimated short-term private response [9.62 * 0.21 * - 0.1]	…	**-0.20**	…
	Estimated total spending = (1) + (2) + (3) *[4.2 + 9.62 – 0.20]*	…	***13.62***	…

The estimate of total education spending was then converted to calendar years and added to NNS to give NNS + education expenditure.

1.3.4 Depletion-Adjusted Savings

Depletion-Adjusted Savings (DAS) are NNS + education expenditure, less net natural capital depletion. The logic is that you include net saving in natural and human capital in the same way as net saving of produced capital (NNS). Both renewable resources (forests) and non-renewable resources (energy and minerals) are included in the methodology, i.e.,

$$DAS = NNS + education\ expenditure - net\ natural\ capital\ depletion$$

Net natural capital depletion is the sum of Net Forest Depletion, energy depletion and mineral depletion:

$$Net\ natural\ capital\ depletion = \begin{matrix} Net\ forest\ depletion \\ + \\ Energy\ depletion \\ + \\ Mineral\ depletion \end{matrix}$$

Net Forest Depletion. The valuation of forest timber resources is an important component of natural capital accounting in Uganda, and incorporated as follows in the calculation of macroeconomic indicators and comprehensive wealth:

a) In the calculation of ANS, NNS are adjusted to account for, *inter alia*, the depletion of renewable and non-renewable natural capital, including forest timber resources.

b) In the calculation of comprehensive wealth, natural capital includes the valuation of forest timber (as well as non-timber) capital.

The World Bank's global ANS and CWON databases include the valuation of forest timber depletion and forest timber assets for Uganda. Many of the inputs used for these valuations are derived from global datasets and regional values, for reasons of consistency of data sourcing, definitions and measurement across countries. However, it is often preferable to use domestic sources for greater accuracy. Here we describe the process for producing domestic valuations for forest timber depletion in Uganda.

Net Forest Depletion (NFD) is calculated as:

$$NFD = (Q - N)\pi$$

where:

- Q is the volume of timber harvested in cubic metres (m^3), also referred to as production
- N is the annual volume of natural growth in production-oriented forest
- (Q – N) therefore represents overharvest
- π is the unit rent per m^3, calculated using locally generated export unit values and a constant regional rental rate.

In the World Bank approach, timber is divided into three categories;

1) Woodfuel
2) Industrial roundwood (coniferous)
3) Industrial roundwood (non-coniferous)

Production figures would normally be obtained from the FAO Global Forest Resources Assessment (FRA), which are in turn supplied by the National Forestry Authority (NFA). These data do not include the use of timber for producing charcoal. Production and rental values are usually derived from export unit values for each of the three categories. However, the use of export unit values may not be appropriate for Uganda, where most timber resources are sold domestically and are not exported or competing with imports.

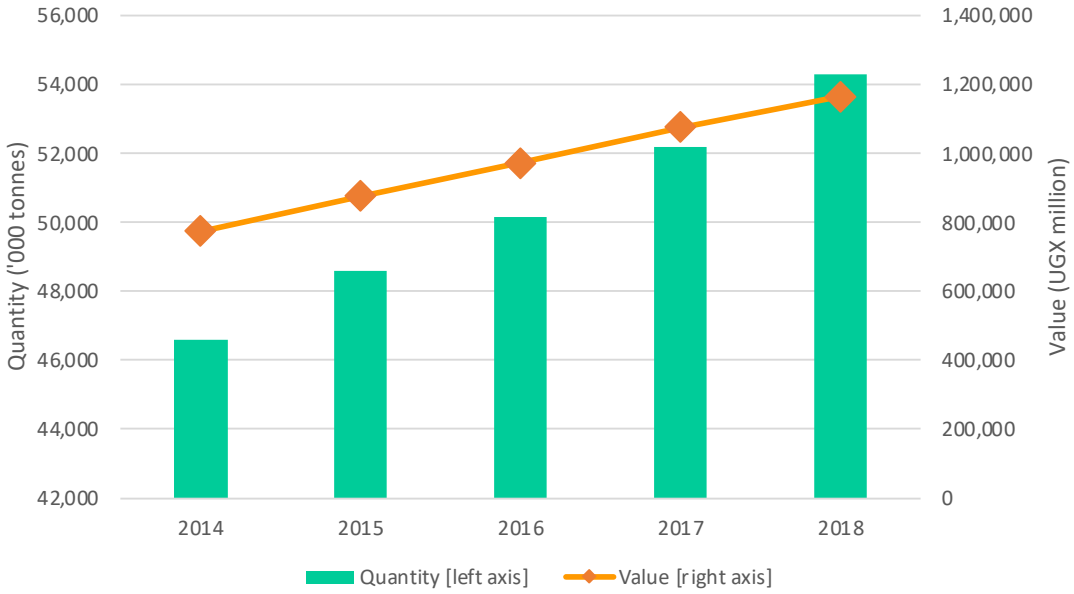
Alternative data sources for timber production and valuation are available in Uganda. The starting point is Tables 1.2.1 to 1.2.3 in the UBOS Annual Statistical Abstract 2020, which provides data on timber production (in '000

tonnes of roundwood[10]) and valuation (in UGX million) for the following forest categories:

- Broadleaved plantations
- Conifer plantations
- Tropical High Forest, well-stocked
- Tropical High Forest, low-stocked
- Woodland

Annual timber production and value from NFA data is presented in Figure 6.

Figure 6: Production and value of roundwood in Uganda, 2014-2018



Source: *National Forest Authority, in UBOS Annual Statistical Abstract*

The FAO and World Bank data is presented in cubic metres rather than tonnes. But by making an assumption of average wood density (with a default value of 720 kg/m^3), the volume of timber production can be derived from the NFA data and compared with the FAO and World Bank numbers.

There are, however, some concerns about the reliability of the FAO data on timber production, which could be too high. The largest component of production is non-monetary domestic woodfuel consumption, for which data is subject to considerable uncertainty. The recorded production (extraction) levels are extremely high relative to estimates of the standing stock of timber. For instance, FAO's 2015 FRA records total growing stock of 92 million m^3 of timber stock in forest land and 21 million m^3 in other woodland, making a

[10] Roundwood is wood in its natural state as felled, or otherwise harvested, round, split, roughly squared or in other forms (roots, stumps, burls, etc.), with or without bark (www.fao.org/forestry/34572-0902b3c041384fd87f2451da2bb9237.pdf).

total of 114 million m^3. With annual production estimated at 48,000 t in 2016, or approximately 69,600 million m^3, the country's entire timber stock would be depleted in less than two years. This is not possible and suggests that the growing stock is underestimated, the rate of production (extraction) is overestimated, annual growth adds significantly to the standing stock and/or there is significant wood stocking outside areas defined as forests. The only other available data source on domestic woodfuel consumption, the 2016 National Charcoal Survey, has a consumption estimate that is less than half that of the UBOS data. This may in part because it considers only wood demand for the production of charcoal, and not for direct use as firewood.

Valuation of wood products. Unit valuations of timber can also be obtained from the UBOS data, based on density assumptions and prevailing UGX/US$ exchange rates. The resulting valuations are shown in Table 3, together with those from the FAO/WB data.

Table 3: Timber valuations (US$/$m^3$), 2012-2016

		2012	2013	2014	2015	2016
UBOS	Charcoal wood	3.31	3.20	3.08	2.38	2.18
	Fuelwood	3.41	3.28	3.21	2.52	2.36
	Poles	62.22	71.90	76.03	65.02	59.00
	Sawn timber	51.14	70.95	86.67	85.86	94.43
World Bank / FAO	Woodfuel	134.71	138.89	141.08	161.92	178.23
	Industrial roundwood (C)	69.28	74.88	75.35	71.29	51.35
	Industrial roundwood (Non-C)	391.09	384.82	391.18	389.70	350.30

Source: *UBOS; FAOSTAT*

The valuations based on the UBOS data are much lower than those from FAO/WB, particularly for fuelwood and wood for charcoal. There is also a marked downward trend in the UBOS US$ values of fuelwood and wood for charcoal since 2012. The FAO/WB data was used.

Both sets of data show that the use of timber for fuelwood and charcoal is by far the main usage in Uganda. As a result, changes in the valuation of wood for these purposes are likely to have a dramatic impact on the valuations of Net Forest Depletion and forest timber asset value.

An alternative valuation of wood for charcoal can be derived from information in the 2015 Uganda National Charcoal Survey and other sources (see Table 4).

Table 4: Calculation of implied value of wood used for charcoal production

Unit	*Value*	*Source*
Average weight of charcoal bag	61 kg	National Charcoal Survey, Table 4-11
Average farm-gate price for charcoal	UGX 18,500/bag (UGX 303,279/t)	Ditto, paragraph 13.1.2
Wood proportion of charcoal production costs	34%	Ditto, Table 5-7
Wood input value	UGX 102,698/t	Calculated
Conversion factor (kiln efficiency)	18%	TZ charcoal kiln study
Weight of wood input per tonne of charcoal	5.56 t	Calculated
Wood density	0.72 t/m^3	Forest Research UK
Volume of wood input per tonne of charcoal	7.72 m^3	Calculated. N.B. PROFOR 2014 uses a conversion factor of 6
Wood input cost	UGX 13,310/m^3	Calculated
Exchange rate (Jan 2022)	3,420 UGX/US$	Bank of Uganda
Wood input cost	3.89 US$/m^3	Calculated

Using these alternative data sources as shown in the table, the calculated value of wood inputs to the charcoal value chain is US$ 3.89/m^3, which is around 80% higher than the 2016 value derived from UBOS data.

Energy and mineral depletion. World Bank data was used to assign a value to energy and mineral depletion, which was added to the calculation of Net Forest Depletion to give Net Natural Capital Depletion.

1.3.5 Adjusted Net Savings

Adjusted Net Savings (ANS) is Depletion-Adjusted Savings less pollution damages, as these negative externalities constitute negative savings that should be accounted for.

$$ANS = DAS - pollution\ damages$$

The pollution externalities can be either global (as with greenhouse gas emissions, where citizens of every country bear the cost) or local (as with air pollution, where the health of local citizens is negatively affected).

Pollution damages, under the World Bank methodology, are the combination of baseline CO_2 emissions and air pollution damage. Baseline CO_2 emissions are those from fossil fuel use and cement production, to which we have also added an estimate for CO_2 damages from deforestation, as it was clear from the Net Forest Depletion calculations that deforestation is a significant factor in Uganda.[11]

[11] Deforestation-linked CO_2 emissions result from the burning of forest, which is not replaced. Although the burning of charcoal and fuelwood also releases CO_2, if this is replanted or regenerates (resulting in no net

$$Pollution\ damages = \begin{matrix} Baseline\ CO_2\ damage \\ + \\ Deforestation\ CO_2\ damage \\ + \\ Air\ pollution\ damage \end{matrix}$$

World Bank numbers were used for baseline CO_2 damage and air pollution damage, whereas we used our own method to determine CO_2 damages from deforestation.

The Forest Reference Emission Level report for Uganda[12] gives an estimate for average annual CO_2 emissions from deforestation over the period 2000 to 2015. By comparing this with the change in total forest area reported by the World Bank over the same period, we were able to estimate average CO_2 emissions of 73.7 tCO_2e per ha per year. We applied this emissions factor to the total forest area lost by year, calculated from the same World Bank numbers, to give CO_2 emissions per year. We then multiplied this by an estimated carbon price to derive a monetary value.

The carbon price was inferred from World Bank data. The annual CO_2 damage value (in US$) in the ANS dataset was divided by the CO_2 emissions estimates provided by World Bank Open Data to give an implied annual damage cost of carbon emissions. This price increases over time. The estimates of CO_2 damage and air pollution damage were combined to give total pollution damage. This was deducted from DAS to give ANS.

1.3.6 Adjusted Net National Income

Adjusted Net National Income (ANNI) was calculated from the starting point of GNI, as calculated by the World Bank. MoFPED's estimation of CFC was deducted from this figure to yield Net National Income (NNI). The value for natural capital depletion used for DAS was then deducted to give ANNI.

1.3.7 Comprehensive Wealth

No adjustments were made to the World Bank methodology or data for calculating Comprehensive Wealth, although localised improvements could be considered in the future as Uganda's natural capital accounts are developed further. The World Bank estimates human capital wealth based on an income method. Uganda's high proportion of non-government expenditure on education is not problematic here, as income measures of human capital capture all education, however obtained. An attempt was made to recalculate human capital for Uganda using an expenditure methodology, as part of the preparations for this paper. But the expenditure method delivered a very low

forest loss), then net CO_2 emissions from this source are zero as the growing stock absorbs CO_2. There may, however, be an increase in the overall warming effect due to emissions arising from carbonisation (to make charcoal) and the fact that the emissions at the point of final use have constituents such as methane and black carbon that have a higher forcing factor than CO_2.

[12] Ministry of Water and Environment (2018). *Proposed Forest Reference Emission Level for Uganda.* Available here: www.mwe.go.ug/sites/default/files/library/Final%20-%20Uganda%20Forest%20Reference%20Emission%20Level%20Document%20-February%202018.pdf

number and was not considered usable. This could imply that there is a lot of informal education of value in Uganda (such as learning on the job, which is a high productivity uplift), that there is a lot of education and training completed abroad, that education expenditure is very good value for money in Uganda, or a combination of these factors.

2 RESULTS

The latest compilation of adjusted macroeconomic measures provides insights into Uganda's adjusted net wealth status and its evolution since the previous year.

Key Results

- Uganda's Adjusted Net Savings as a share of GNI was 15.7% in 2020, down from 17.2% in 2019.
- The biggest negative impact on ANS in 2020 came from an increase in Consumption of Fixed Capital, followed by a decline in Gross National Savings and education spending as a percentage of GNI, and increased pollution damages.
- Consumption of Fixed Capital increased by 12.4% from UGX 10,242 billion in 2019 to UGX 11,517 billion in 2020.
- ANNI decreased slightly as a share of GNI, from 91% in 2019 to 90.7% in 2020, because of the increased Consumption of Fixed Capital.
- Education expenditure declined from a peak of 8.2% of GNI in 2016 to 5.5% of GNI in 2020.
- Net Forest Depletion has increased significantly since 2012. As a share of GNI, net forest depletion is 7.3%.
- Pollution damage decreased by 0.2% in 2020 but remains stable as a share of GNI. This implies that the increase in Uganda's national income is not a result of additional pollution damages.

2.1 Adjusted Macroeconomic Indicators

2.1.1 Adjusted Net Savings

Uganda demonstrated a positive ANS in 2020. This is because education expenditure continued to increase in real terms (though reduced as a share of GNI) due to higher non-government spending, while the monetary value of Net Forest Depletion decreased. The biggest negative impact came from the consumption of fixed capital.

As presented above, Uganda's ANS in 2020 was 15.7% of GNI, down from 17.2% in 2019. This translates to an absolute 1.2% decline (from UGX 21,812 billion to UGX 21,540 billion), while nominal GNI growth over the same period was 8.2%. See Figure 7 and Figure 8.

Figure 7: ANS visualization (current UGX billion), 2020

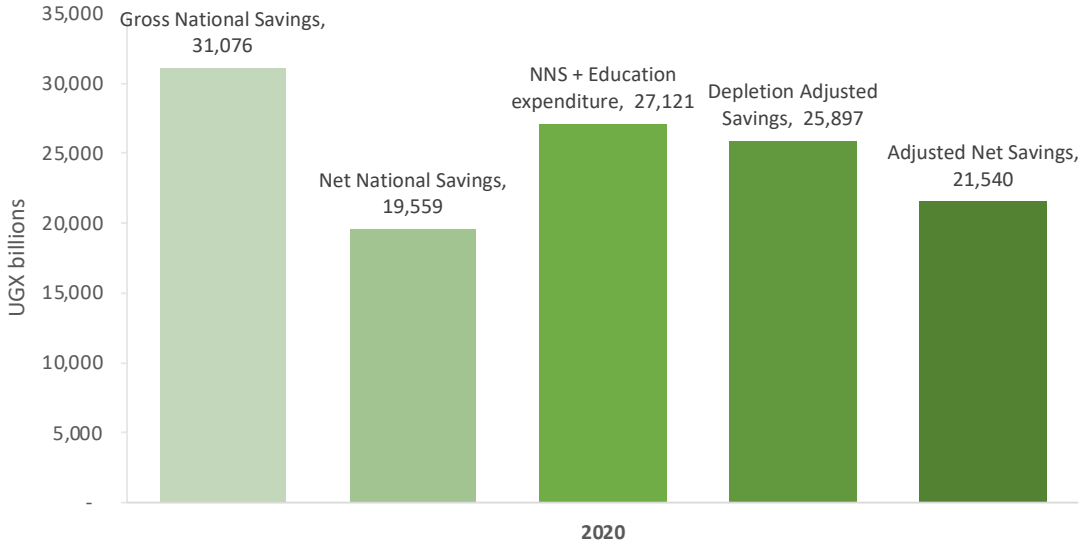
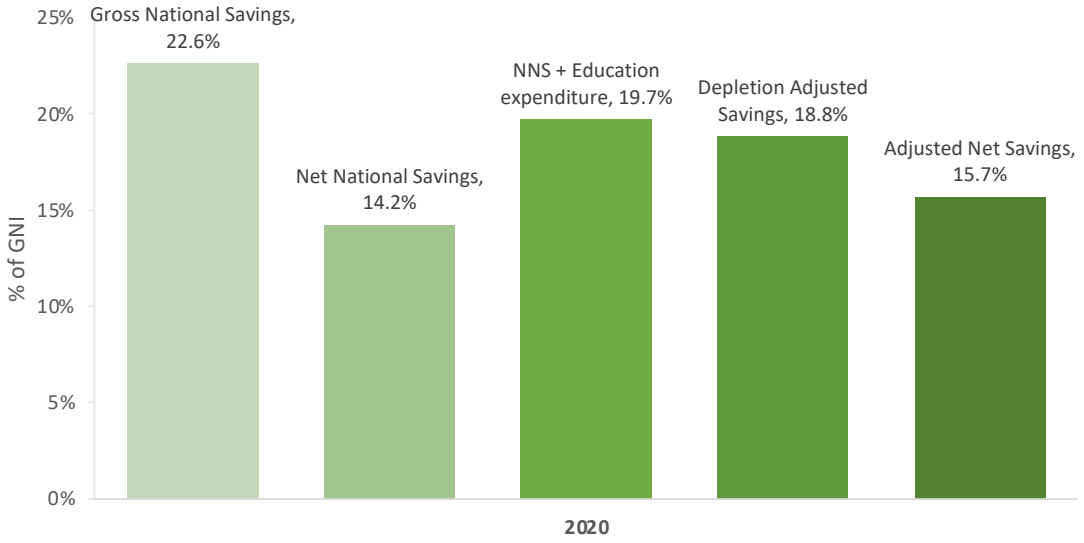


Figure 8: ANS visualization as a percentage of GNI, 2020



A breakdown of ANS as a share of GNI from 2015 to 2020 is shown in Figure 9. The corresponding percentage change breakdown is shown in Figure 10.

Figure 9: Breakdown of ANS as a share of GNI, 2015 - 2020

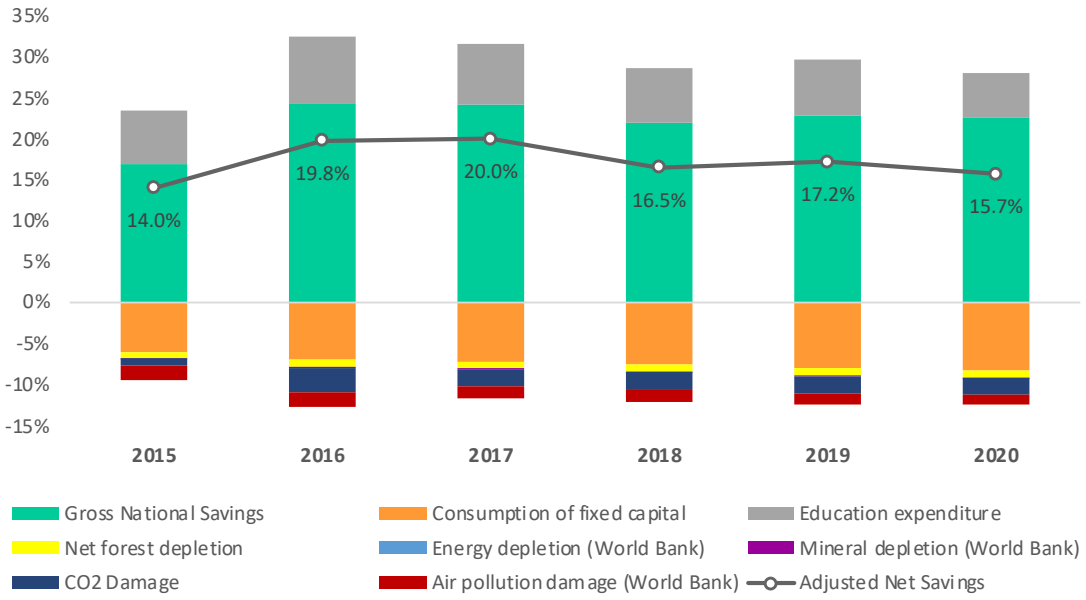
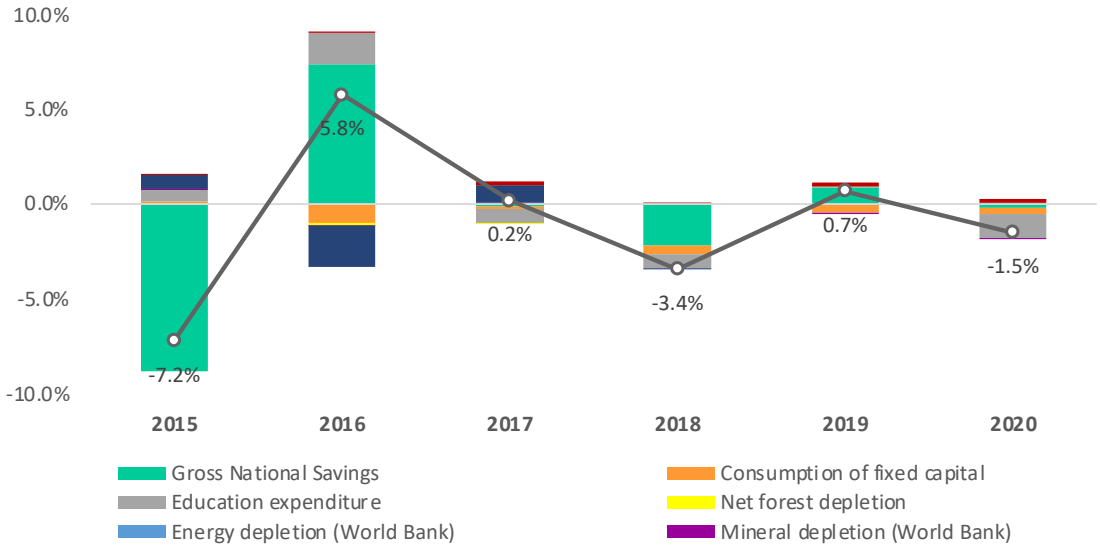
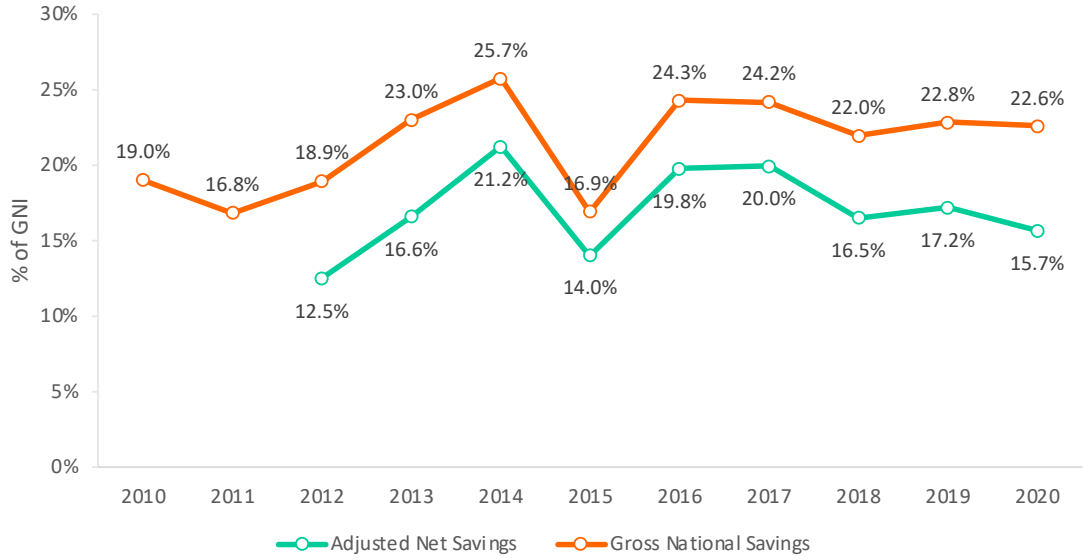


Figure 10: Breakdown of the change in the share of ANS in GNI, 2015-2020



As a percentage of GNI, the decline in ANS between 2019 and 2020 was greater than the decline in Gross National Savings (which only fell from 22.8% to 22.6%), confirming that the recorded economic growth is unsustainable because it is depleting resources, especially in the most recent years. See Figure 11 for the longer-term trend in ANS and GNS as a percentage of GNI.

Figure 11: ANS and GNS as a percentage of GNI, 2010-2020



As illustrated, GNS has remained fairly steady as a proportion of GNI, despite targets to increase it. In absolute terms, GNS recorded an increase of 7.3%, from UGX 28,957 billion in 2019 to UGX 31,076 million in 2020.

2.1.2 Adjusted Net National Income

Uganda's ANNI is also relatively high because of low net natural capital depletion. Again, this is because timber products have such a low monetary value in Uganda and because consumption of fixed capital may be an underestimate (according to the World Bank results).

Although there was an absolute increase in ANNI by 8%, from UGX 115,483 million in 2019 to UGX 124,759 million in 2020, ANNI decreased by 0.3% as a share of GNI. ANNI barely differs from GNI, due to the small values for net natural capital depletion. See Figure 12 and Figure 13. It has remained quite stable at approximately 92% of GNI.

Figure 12: ANNI (current UGX), 2020

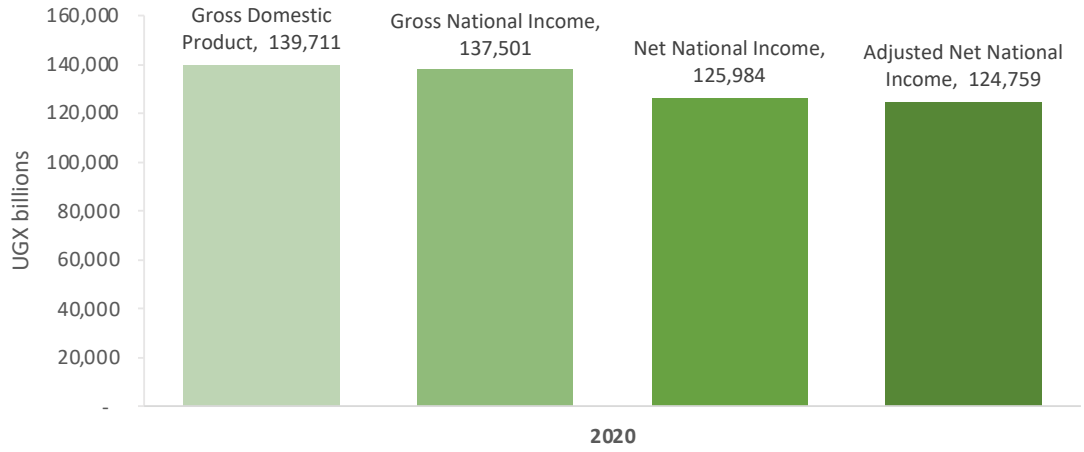
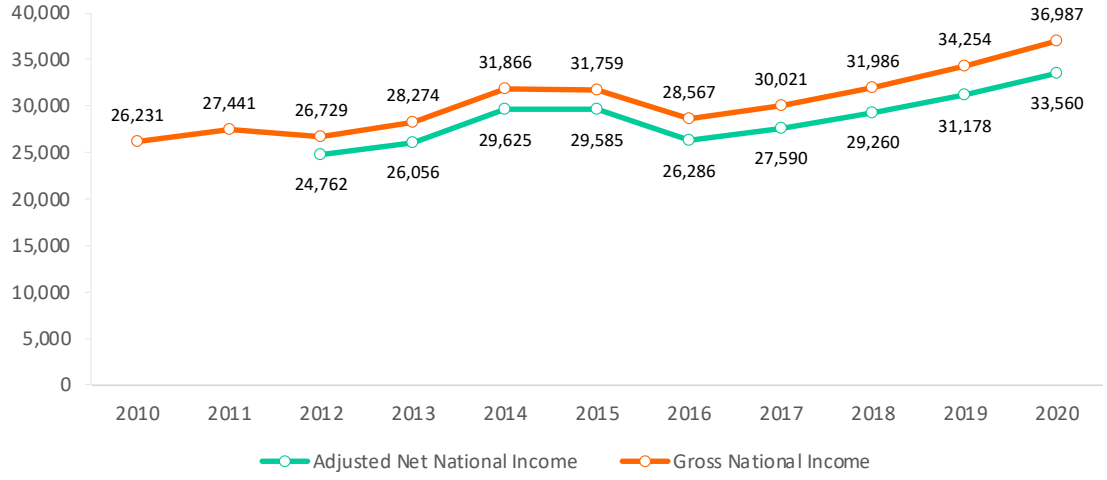


Figure 13: ANNI compared to GNI (current UGX), 2010-2020



A breakdown of ANNI in current US$ from 2015 to 2020 is shown in Figure 14. The corresponding percentage change breakdown is shown in Figure 15.

Figure 14: ANNI breakdown (current US$ million), 2015 - 2020

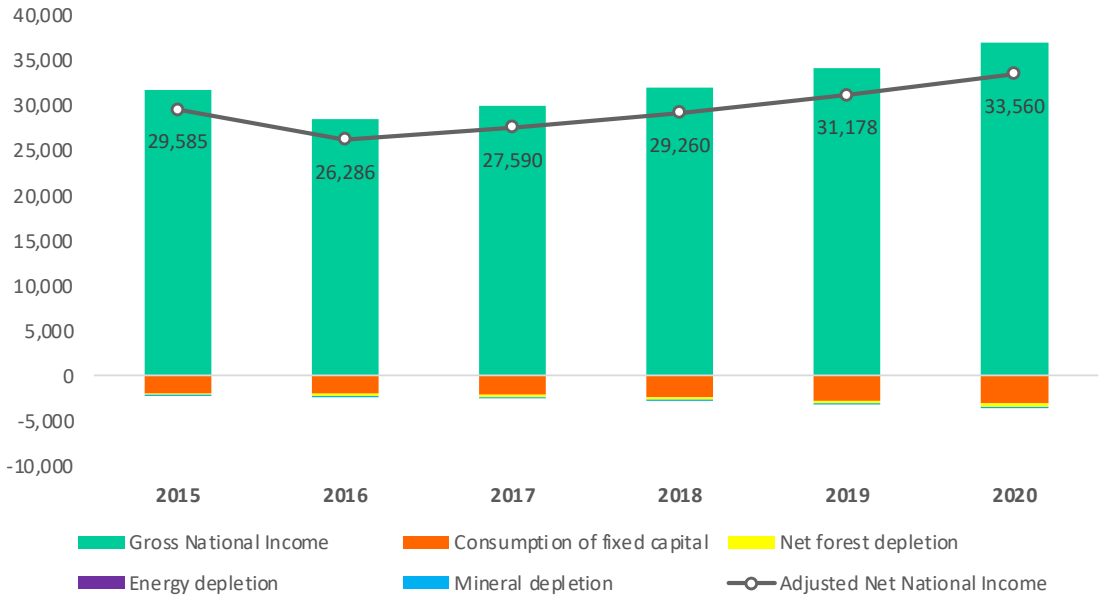
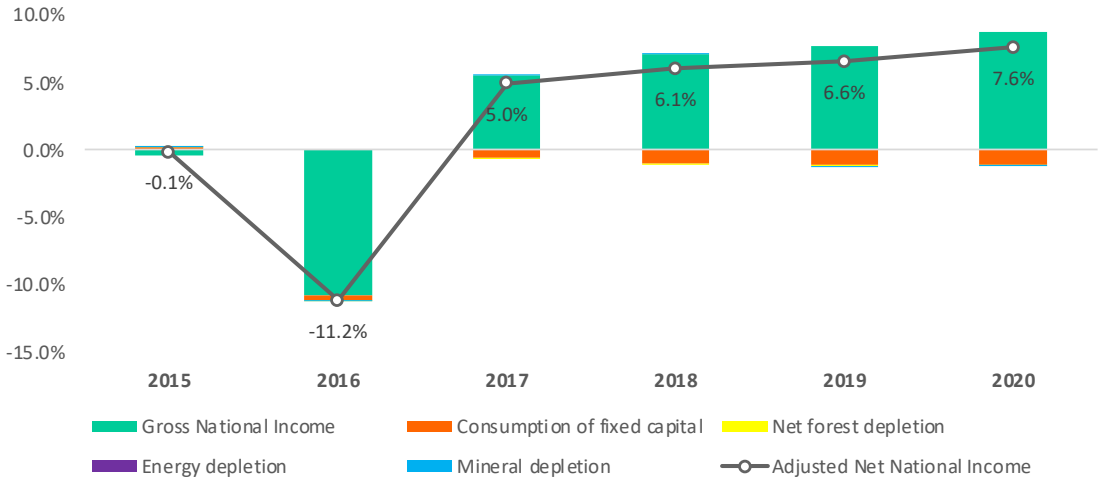


Figure 15: ANNI trend (percentage change and breakdown), 2015 - 2020



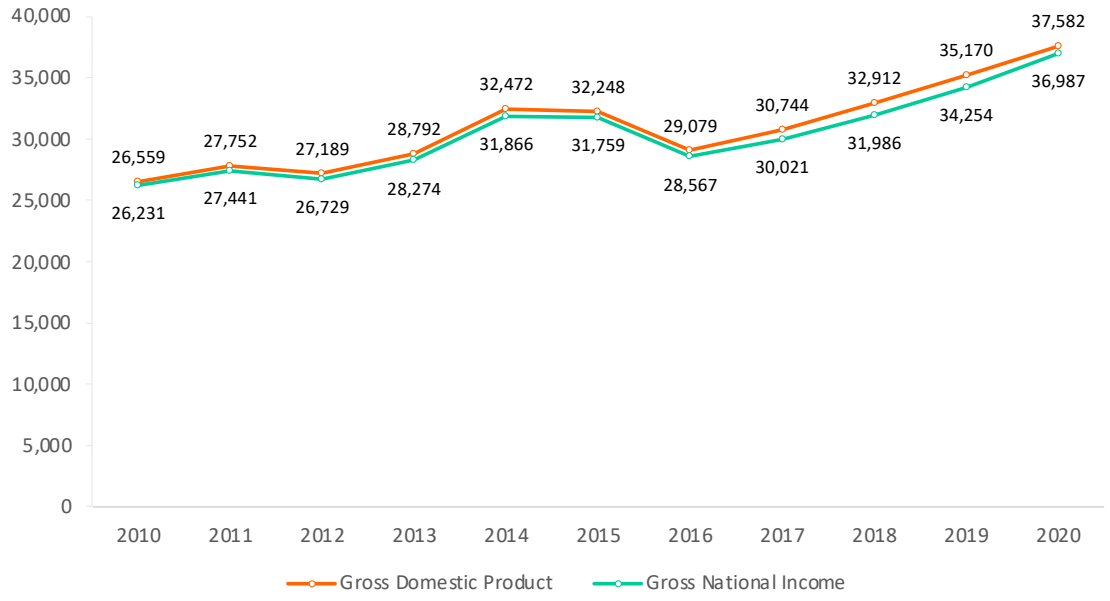
From the absolute 7.6% increase of ANNI between 2019 and 2020, 8.8% is accounted for by the nominal GNI growth. Out of this, a further 1.1% is subtracted because of a higher CFC, and a small share of 0.06% is also subtracted to account for increased depletion of natural capital. It is again evident that the biggest negative impact in 2020 comes from the increased CFC, accompanied by a slight deterioration in mineral depletion.

2.2 Components of ANS and ANNI

2.2.1 GDP and GNI

Uganda's GDP and GNI have been rising steadily since 2010 (see Figure 16). A rebasing exercise led to an upward revision of numbers in 2010 and 2014. The recorded dip in 2016 is partly attributed to a prolonged drought that affected agriculture yields.

Figure 16: GDP and GNI (current US$ million), 2010 - 2020



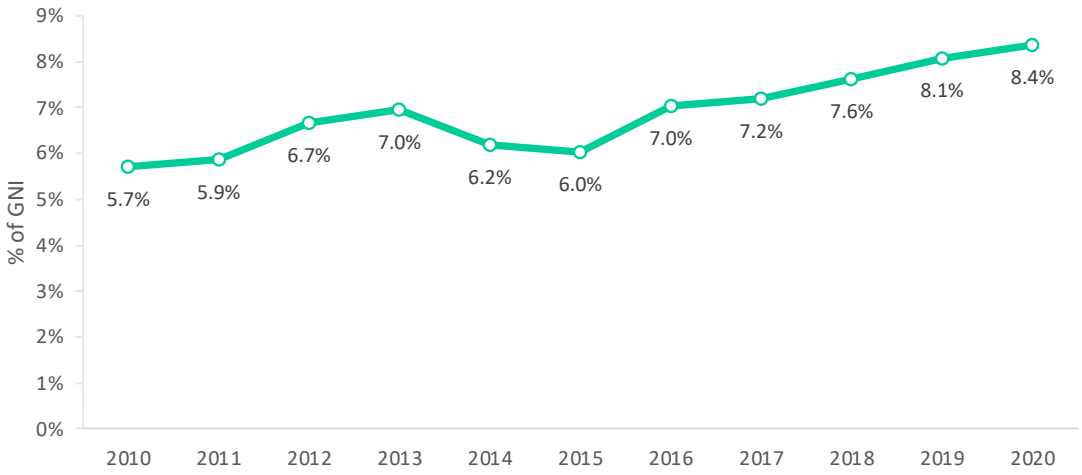
2.2.2 Consumption of Fixed Capital

Consumption of Fixed Capital (CFC) increased by 12.4% in 2020, from a value of UGX 10,242 billion in 2019, which also represents a 0.3% increase relative to GNI. In 2020, the MOFPED data provides a CFC estimate of UGX 11,517 billion (8.4% of GNI) (Figure 17). This is lower than the World Bank's estimate due to an applied 5% depreciation rate.[13]

The increase in CFC as a percentage of GNI indicates that the increase in national income is at the expense of over-utilising the country's fixed assets, without creating the corresponding fixed capital for future generations.

[13] The divergence with the World Bank CFC series most likely reflects the difference in capital stock estimation (the World Bank figures use the estimates contained in the Penn World Tables). As a rule, it would be expected that the ratio of CFC to GNI would rise over time in a country experiencing a high level of investment (and hence an increasing ratio of capital stock to GNI).

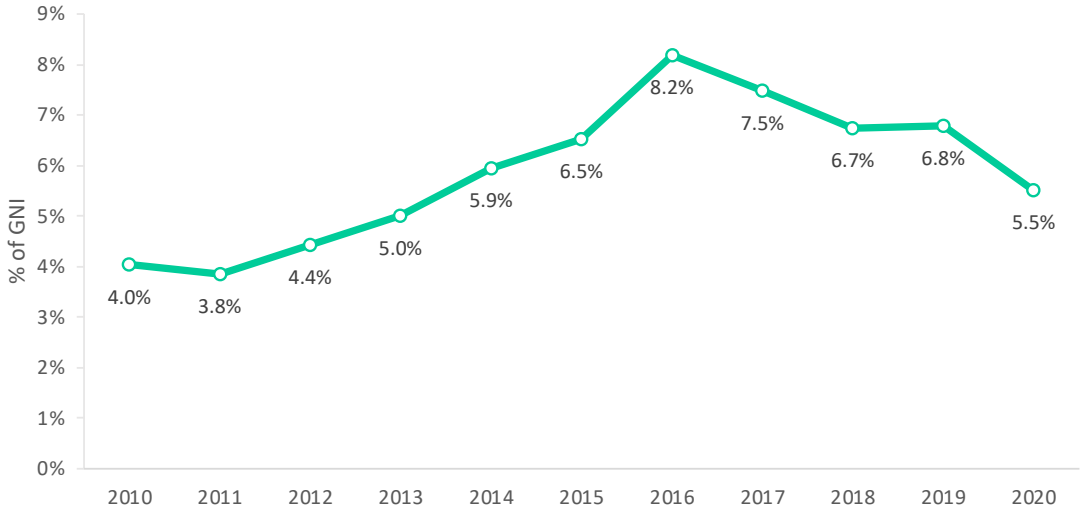
Figure 17: Consumption of Fixed Capital as a percentage of GNI, 2010 - 2020



2.2.3 Education expenditure

Education expenditure has been declining as a share of GNI since 2016 and reached 5.5% of GNI in 2020, down from 6.8% in 2019 (Figure 18). There has been an absolute 12.2% decline in education expenditure (from UGX 8,611 billion in 2019 to UGX 7,563 billion in 2020), while there was 8% growth in nominal GNI. The outbreak of COVID-19 in led to the closure of all learning institution in 2020, which accounts for the recorded decline in recurrent education spending for that year, although this only continued the existing downwards trend.

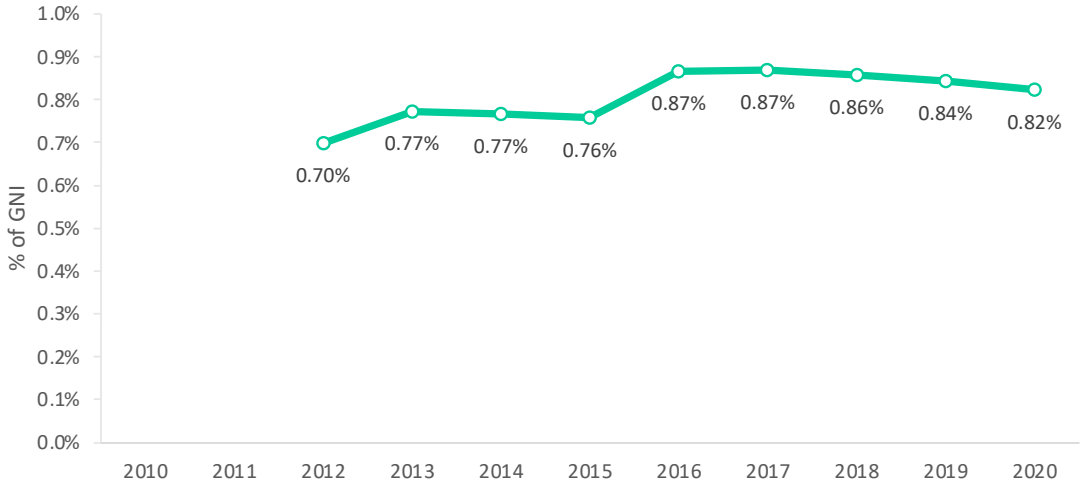
Figure 18: Education expenditure as a percentage of GNI, 2010-2020



2.2.4 Net Forest Depletion

Net Forest Depletion (NFD) has been increasing since 2012, rising from UGX 467 billion to reach UGX 1,131 billion in 2020. Despite this rise, NFD has been decreasing as a percentage of GNI in recent years, reducing from 0.87% of GNI in 2017 to 0.82% in 2020, as shown in Figure 19 below.

Figure 19: Net Forest Depletion as a percentage of GNI, 2012-2020



2.2.5 Energy and Mineral Depletion

Depletion of energy assets is currently at zero, as Uganda currently produces no oil, gas or coal.[14] But as oil and gas extraction may commence in 2025,[15] it will be important that future estimates of ANS incorporate energy depletion. Mineral depletion in Uganda is negligible – less than 0.02% of GNI in most years and never more than 0.1% of GNI.

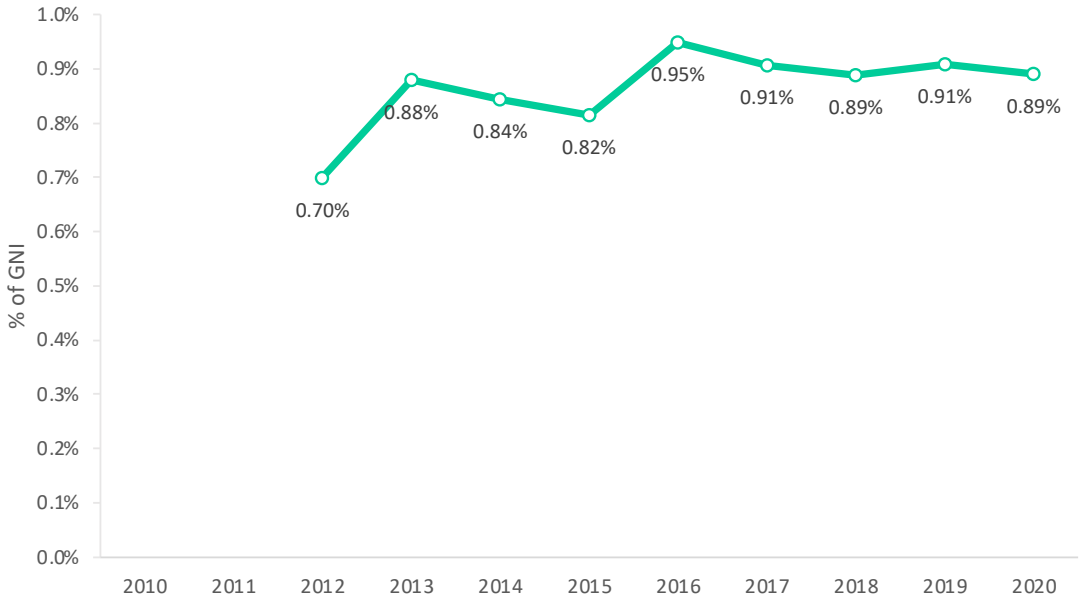
2.2.6 Total Natural Capital Depletion

Given the negligible contribution of energy and mineral depletion, total natural capital depletion mirrors NFD almost exactly (see Figure 20).

[14] The World Bank also reports zero depletion of energy assets for Uganda

[15] See: www.observer.ug/businessnews/64631-uganda-underlines-intention-to-become-a-major-oil-and-gas-player and www.ugmirror.com/index.php/2022/02/01/done-deal-totalenergies-cnooc-make-final-decision-to-invest-10bn-in-uganda-tanzania-oil-project/

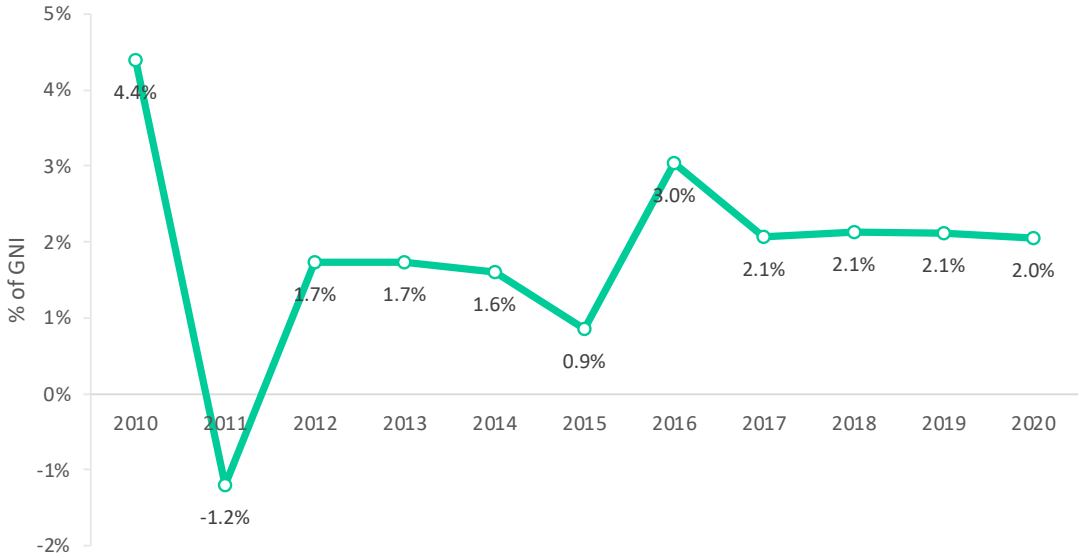
Figure 20: Total Natural Capital Depletion as a percentage of GNI, 2012-2020



2.2.7 CO_2 damage[16]

CO_2 damage remained stable relative to GNI between 2017 and 2020, at 2.0-2.1% (Figure 21). In absolute terms it increased by 25.3% over the same period, however, from UGX 2,245 billion to UGX 2,813 billion.

Figure 21: CO_2 damage as a percentage of GNI, 2010 - 2020

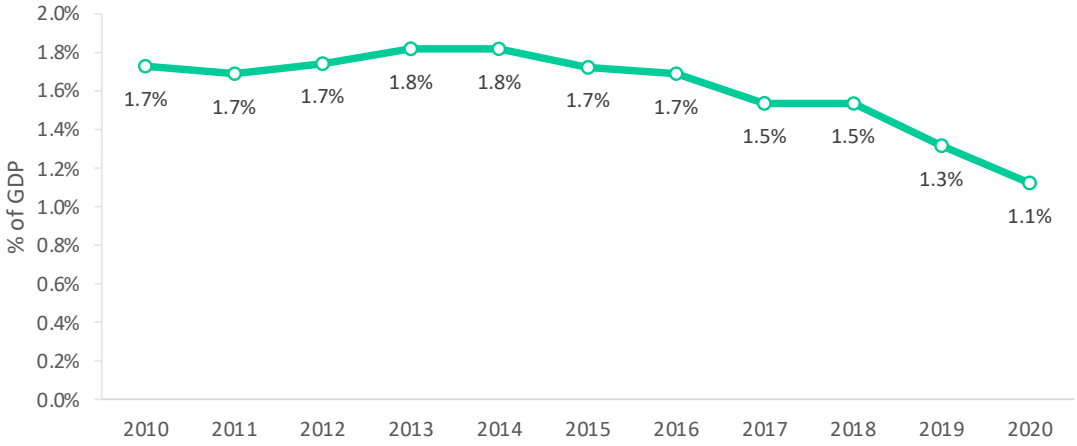


[16] CO_2 damage is roughly twice as high under our estimates than those of the World Bank, due to the inclusion of emissions from deforestation.

2.2.8 Air pollution damage

Whilst rising in absolute values, air pollution damage has continued to fall as a percentage of GNI. It reached 1.1% of GNI in 2020, which is slightly lower than CO_2 damage.

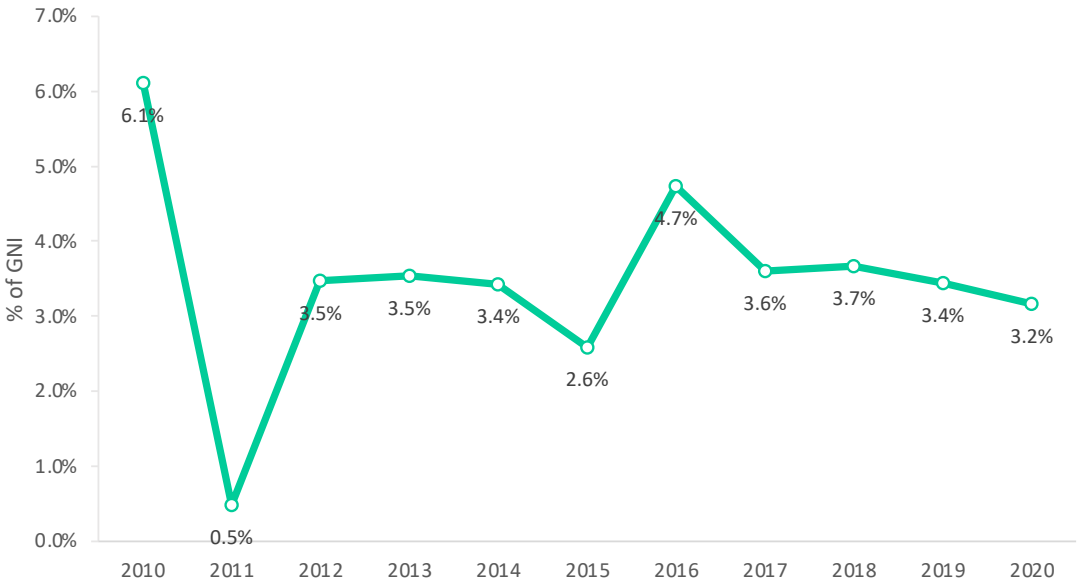
Figure 22: Air pollution damage as a percentage of GNI, 2010 - 2020



2.2.9 Total pollution damage

Total pollution damage has been relatively stable as a share of GNI since 2012 and was an estimated 3.2% of GNI in 2020 (Figure 23). However, in absolute terms, it has increased by 87.4% over the same period to a 2020 value of UGX 4,356 billion.

Figure 23: Total pollution damage as a percentage of GNI, 2010-2020



ANNEX 1: Economic indicators and data sources

Calendar year (% of GNI)	*2015*	*2016*	*2017*	*2018*	*2019*	*2020*
Gross National Savings	16.9%	24.3%	24.2%	22.0%	22.8%	22.6%
Consumption of fixed capital	6.0%	7.0%	7.2%	7.6%	8.1%	8.4%
Net National Savings	10.9%	17.3%	17.0%	14.3%	14.8%	14.2%
Fully adjusted education expenditure	6.5%	8.2%	7.5%	6.7%	6.8%	5.5%
NNS + Education expenditure	17.4%	25.4%	24.5%	21.1%	21.5%	19.7%
Net Forest Depletion	0.8%	0.9%	0.9%	0.9%	0.8%	0.8%
Energy depletion (World Bank)	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Mineral depletion (World Bank)	0.1%	0.1%	0.0%	0.0%	0.1%	0.1%
Total natural capital depletion	0.8%	0.9%	0.9%	0.9%	0.9%	0.9%
Depletion Adjusted Savings	16.6%	24.5%	23.6%	20.2%	20.6%	18.8%
CO_2 damage	0.9%	3.0%	2.1%	2.1%	2.1%	2.0%
Air pollution damage (World Bank)	1.7%	1.7%	1.5%	1.5%	1.3%	1.1%
Pollution damage	2.6%	4.7%	3.6%	3.7%	3.4%	3.2%
Adjusted Net Savings	14.0%	19.8%	20.0%	16.5%	17.2%	15.7%
Net National Income	94.0%	93.0%	92.8%	92.4%	91.9%	91.6%
Adjusted Net National Income	93.2%	92.0%	91.9%	91.5%	91.0%	90.7%

Calendar year (current US$, million)	*2015*	*2016*	*2017*	*2018*	*2019*	*2020*
Gross Domestic Product	32,248	29,079	30,744	32,912	35,170	37,582
Gross National Income	31,759	28,567	30,021	31,986	34,254	36,987
Gross National Savings	5,370	6,940	7,257	7,027	7,818	8,359
Consumption of fixed capital	1,915	2,009	2,159	2,442	2,765	3,098
Net National Savings	3,454	4,931	5,098	4,586	5,053	5,261
Fully adjusted education expenditure	2,074	2,337	2,247	2,151	2,325	2,034
NNS + Education expenditure	5,528	7,268	7,345	6,737	7,377	7,296
Net Forest Depletion	240	248	261	274	289	304
Energy depletion (World Bank)	0	0	0	0	0	0
Mineral depletion (World Bank)	18	24	12	10	22	25
Total natural capital depletion	259	271	272	284	311	329
Depletion Adjusted Savings	5,269	6,997	7,073	6,452	7,067	6,966
CO_2 damage	273	868	622	681	726	757
Air pollution damage (World Bank)	546	483	462	492	452	415
Pollution damage	819	1,351	1,084	1,173	1,178	1,172
Adjusted Net Savings	4,450	5,646	5,989	5,280	5,889	5,794
Net National Income	29,844	26,557	27,862	29,544	31,489	33,889
Adjusted Net National Income	29,585	26,286	27,590	29,260	31,178	33,560

Financial year (current US$, million)	***2014/15***	***2015/16***	***2016/17***	***2017/18***	***2018/19***	***2019/20***
Gross Domestic Product	32,360	30,663	29,912	31,828	34,041	36,376
Gross National Income	31,812	30,163	29,294	31,004	33,120	35,621
Gross National Savings	6,784	6,155	7,099	7,142	7,423	8,088
Consumption of fixed capital	1,944	1,962	2,084	2,301	2,603	2,932
Net National Savings	4,841	4,193	5,015	4,842	4,819	5,157
Fully adjusted education expenditure	1,985	2,205	2,292	2,199	2,238	2,180
NNS + Education expenditure	6,825	6,398	7,307	7,041	7,057	7,336
Net Forest Depletion	242	244	254	268	282	297
Energy depletion (World Bank)	0	0	0	0	0	0
Mineral depletion (World Bank)	22	21	18	11	16	24
Total natural capital depletion	264	265	272	278	298	320
Depletion Adjusted Savings	6,561	6,133	7,035	6,763	6,759	7,016
CO_2 damage	392	570	745	651	703	741
Air pollution damage (World Bank)	563	515	473	477	472	434
Pollution damage	955	1,085	1,217	1,128	1,175	1,175
Adjusted Net Savings	5,606	5,048	5,818	5,634	5,584	5,842
Net National Income	29,869	28,201	27,210	28,703	30,517	32,689
Adjusted Net National Income	29,605	27,936	26,938	28,425	30,219	32,369

Financial year (current UGX, billion)	***2014/15***	***2015/16***	***2016/17***	***2017/18***	***2018/19***	***2019/20***
Gross Domestic Product	94,551	102,062	105,246	116,860	126,480	134,990
Gross National Income	92,968	100,393	103,064	113,827	123,057	132,189
Gross National Savings	19,373	20,583	24,974	26,203	27,577	30,016
Consumption of fixed capital	5,672	6,544	7,335	8,450	9,672	10,880
Net National Savings	13,701	14,039	17,639	17,753	17,905	19,137
Fully adjusted education expenditure	5,830	7,362	8,054	8,067	8,315	8,087
NNS + Education expenditure	19,531	21,401	25,694	25,820	26,219	27,224
Net Forest Depletion	708	814	894	982	1,047	1,101
Energy depletion (World Bank)	0	0	0	0	0	0
Mineral depletion (World Bank)	62	70	61	39	59	87
Total natural capital depletion	770	884	955	1,022	1,106	1,188
Depletion Adjusted Savings	18,762	20,517	24,738	24,798	25,114	26,036
CO_2 damage	1,108	1,927	2,607	2,391	2,613	2,751
Air pollution damage (World Bank)	1,640	1,713	1,660	1,751	1,754	1,609
Pollution damage	2,748	3,639	4,267	4,142	4,367	4,359
Adjusted Net Savings	16,014	16,878	20,471	20,655	20,746	21,676
Net National Income	87,296	93,849	95,729	105,377	113,384	121,309
Adjusted Net National Income	86,527	92,965	94,773	104,355	112,279	120,121