Key findings on the contribution of Water Resources Development and Environmental Management to Uganda's Economy

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Background to the Study

- The MWE recognized the need to have an analytical report to provide increased understanding of the contribution of water resources development and environmental management to economic growth and development in Uganda.
- Key among the reasons for the above was the need to use the information to bid for increased funding from the Treasury.
- Through the Sector Working Group – funding for the study was secured from the World Bank (project).
- International Consultants (Industrial Economics, Incorporated) were hired.

Methodology of the Study

- The consultant teamed up with local consultants to execute the assignment.
- Counterpart staff were drawn from the Ministry departments and agencies and attached, as focal point persons, to the consultants.
- Data requirements and the analytical tools were presented to the client before and during the study.
- Draft reports were prepared and discussed with the client as provided in the ToRs.

Methodology Cont'd

- Because the study required to look at comparisons, a national macro-model – the Computable General Equilibrium (CGE), was used.

- Since the direct contribution and distributional effects of water and environmental management interventions enter the economy through land, labour and capital productivity, a number of key pathways (channels of economic impact) were identified for analysis.

- As such 10 pathways viz: (i) Crop Production; (ii) Livestock Production; (iii) Water for Industry and Services; (iv) Water Supply and Sanitation; (v) Hydropower Generation; (vi) Flood Damages to Infrastructure; (vii) Timber Production; (viii) Fuelwood; (ix) Water Quality; and (x) Ecosystem Protection.

- Translation of the sector's raw natural goods and services to intermediate goods that impact on productivity in the economy was traced, in the CGE, through simultaneous equations for production and consumption.

Methodology Cont'd

- The study adopted a set of sector development indicators and targets set out in the national development planning frameworks viz: NDPII, sector SIP 2030; and Vision 2040.
- The CGE model runs were made to depict scenarios within the agreed upon study time horizon of 2015 – 2040 assuming three investment scenarios (BAU, MI and HI)
- The analysis was sub-divided into regional level – based on the old administrative regions.
- Data from UBOS (SUTs), MWE (SPRs) and other secondary sources.

Key Findings from the study

General findings

- Water is inexpensive and generally plentiful in Uganda – the question is how it is managed to ensure that it is available in time, quantity and quality to support economic growth and social transformation.

- Investment requirements in the sector (approx. US$8.4 billion) require “front-loading” and thereafter smoothen out to comparable portions with other sectors (esp. under HI scenario) – over the period to 2040.

- There are multiple benefits across “impact channels” and thus all sectors of the economy - e.g. water storage facilities – provide water for crops, animals, municipal, industrial and ecosystem services.

Key Findings (cont'd)

- Agriculture is the main (biggest) user of water in the economy. – "green water" path (most water intensive sector) – "direct non-energy water use"
- Manufacturing, which is linked to agriculture and is the target priority sector in the NDP, produces the most water intensive products – "blue water" path i.e. water embodied in final product - "embodied non-energy water use"
- Manufacturing depends on electricity inputs more than any other sector in the economy and electricity is primarily through hydropower generation – "embodied energy water use" – approx. 16BCM p.a. (x20 of other uses combined)
- Achieving social goals of improved public health rely heavily on water for feacal and sludge management – "grey water" path

Key Findings (Cont'd)

share of water use and national GDP by sector

Sector	%GDP contrib.	% Water use (% facilitation by category of water use)		
		Direct Non-Energy water use	Embodied Non-Energy water use	Embodied Energy water Use
Services Sector	59	5	9	51
Agriculture Sector	21	50	20	6
Manufacturing Sector	11	16	41	34
Transport & Comm'ctn	5	-	-	3
Water	2	29	29	5
Electricity/Energy	1	-	-	-
Mining	0.3	1	-	-
other	0.7	-	1	1
Total	**100**	**100**	**100**	**100**

Key findings (cont'd)

- **Crop Production**
- Increases in irrigated crop areas, as a result of MWE investments, translate to higher overall agricultural yields as irrigated crops have both higher yields and lower variability in yields compared to rainfed fields.
- largest increases accrue to rice, vegetables and sugarcane followed by flowers and maize (across all regions).

- Hydropower Generation
- Will benefit/see an increase of over 1000 GWH per year due to enhanced water resources management

Key findings (cont'd)

- **Livestock Production**
- **Due to expanded water supply for livestock production increases are as follows: BAU – Moderate Investment (1.5%) and BAU – High Investment (5%)**

- **Water for Industry & Services**
- **Under BAU-MI (4.6 fold increase)**
- **BAU – HI (5.1 fold increase)**

Key findings (cont'd)

- Flood damages to Infrastructure
- Measured in this study in terms of depreciation rates, if we continued on BAU – the rates rise from the current 5% to 8.5% in 2030-2040
- But moving from BAU – HI reduces the rates to 3% by 2030-2040

Key findings (Cont'd)

Water Supply and Sanitation (WASH) – nexus and role of each element (water, sanitation and hygiene) towards economic growth through 4 panels viz:

- Less time spent collecting water means more time for labour (production to the economy),
- Reduction in ill-health caused by water related diseases means a more productive working population,
- Fewer occurrences of water related diseases means savings on health care by HHs and at national level, and
- Availability of water facilities improves skilling of population (labour) through saving time to attend school (children)

Key Findings (Cont'd)

Cumulative Health Cost Savings (2015 – 2040) – US$ millions

Investment Scenario	Central	Eastern	Northern	Western	Total
Moderate - BAU	$193.6	$235.7	$285.1	$154.4	$868.8
High - BAU	$224.6	$271.0	$340.2	$177.6	$1,013.4

Key Findings (Cont'd)

- Impact on the increase in labour hours endowment (relative 2015) by region – due to provision of water.

Investment Scenario	Time Period	Central	Eastern	Northern	Western
Moderate - BAU	2015-2020	0.4%	0.5%	0.5%	0.5%
	2025-2030	2.0%	2.3%	3.4%	1.8%
	2035-2040	2.5%	3.1%	4.1%	2.4%
High-BAU	2015-2020	1.0%	1.2%	1.4%	1.0%
	2025-2030	2.3%	2.7%	3.8%	2.2%
	2035-2040	3.0%	3.7%	4.7%	3.0%

Key Findings (Cont'd)

- Impact on the change in skilled labour endowment (relative 2015) by region – due to provision of water.

Investment Scenario	Time Period	Central	Eastern	Northern	Western
Moderate - BAU	2015-2020	0.1%	0.1%	0.1%	0.1%
	2025-2030	1.3%	1.4%	2.1%	1.1%
	2035-2040	2.3%	2.7%	3.4%	2.3%
High-BAU	2015-2020	0.2%	0.2%	0.2%	0.1%
	2025-2030	1.0%	1.2%	1.4%	1.1%
	2035-2040	2.2%	2.8%	3.0%	2.6%

Key Findings (Cont'd)

- Timber Production (forest yields)

Forest yields are influenced by both environmental conditions and by efforts to expand production through afforestation and shifting away from fuelwood use.

If all suitable land as per the NDP goals were converted to forest in each region under the different scenarios, the yield would increase by 2040 (relative to current - 2015 yields) as follows:

BAU – increase 10%

MI – increase 32%

HI – increase 72%

Key Findings (Cont'd)

- Health benefits – include reduction in exposure to airborne particulates that cause respiratory complications and increase premature mortality.
- When these are fed into the CGE, the avoided health care costs are estimated as cumulative benefits US$ millions (2015 – 2040) as follows:

Investment Scenario	Central	Eastern	Northern	Western	Total
Moderate - BAU	$2,814.1	$1,918.0	$1,661.5	$2,190.5	$8,584.1
High-BAU	$2,938.9	$2,015.9	$1,745.5	$2,297.9	$8,998.2

Key Findings (Cont'd)

- Water Quality – benefits were assessed using the relationship between fish catch and Dissolved Oxygen (DO) concentration through the biophysical effects from catchment management, afforestation, wetland management, and other land management actions. The results are generated by shocks in the CGE as follows:

At present reduction in DO results in reduced fish catch rates in all the four regions.

But with MWE actions (afforestation, wetland management, catchment management/IWRM) under the two scenarios (MI & HI), relative improvements accrue and over time to realize increased fish catch rates (results table next page)

Water Quality Vs Fish catch - results

Investment Scenario	Time Period	Central	Eastern	Northern	Western
Moderate - BAU	2015-2020	3.2%	1.8%	7.0%	9.5%
	2025-2030	13.5%	12.6%	23.1%	26.4%
	2035-2040	23.1%	24.6%	35.4%	36.1%
High-BAU	2015-2020	28.1%	35.2%	41.3%	45.9%
	2025-2030	49.5%	58.6%	77.6%	85.3%
	2035-2040	40.7%	42.7%	70.9%	76.6%

Key Findings (Cont'd) – Ecosystem services

- Ecosystem benefits are generally not acknowledged in the Uganda CGE model (non-market ecological service flow values).
- Indeed globally studies have been scanty – South Africa (2010) and New Zealand (2013) had the following generalizations:

	Service/function category	US$/Hectare
1	Provisioning services	84 – 17,000
2	Regulating services/functions	17,000 – 45,000
3	Habitat services/functions	1,000 – 3,500
4	Cultural services	4,000 – 8,400
5	Tourism services/values	160 – 40,000

- Additional benefits such as grazing; herbal and traditional medicines; flood attenuation; provision of fishery nurseries; micro-climate regulation and others – are not captured in the market values.

Key Findings (Cont'd) - Uganda case studies

Wetland Service	Value (2016 $/ha)		Wetland Service	Value (2016 $/ha)
Yams cultivation	$135.65		Sand harvesting	$0.01
Grass harvesting for roof thatching	$21.55		Sugarcane revenues	$0.62
Raw papyrus	$24.43		Rice growing	$57.58
Papyrus mats	$0.26		Rice milling	$43.57
Palm mats	$0.04		Soil fertility maintenance	$5.39
Fish value	$6.85		Water recharge	$25.79
Water transport	$1.96		Water treatment	$7.25
Wetland trees	$96.85		Water irrigation	$117.45
Pottery	$10.87			
Total economic value of wetlands – Karanja et al. 2001				$556.14
Wetland Service	Value (2016 $/ha)		Wetland Service	Value (2016 $/ha)
Flood control	$69.00		Habitat	$48.00
Groundwater recharge	$55.00		Recreation	$245.00
Water quality management	$66.00		Amenity	$1.00
Total economic value of wetlands – Woodward and Wui 2001				$484

Key Findings (Cont'd)

- Based on the above and other studies, projections into the future figures are provided below:

Investment Scenario	Year	% wetland coverage	Total Economic Value (TEV) – Wetland
Moderate Investment	2015	10.9%	600 million
	2020	10%	970 million
	2040	10%	1.110 billion
High Investment	2015	10.9%	600 million
	2020	13%	1.26 billion
	2040	**13%**	**1.44 billion**

conclusion - summary

- It is worthwhile investing in MWE interventions as these yield significant economy-wide impacts (2040).
- The benefits to GDP directly exceed the investment costs (about 8 times) – when undiscounted.
- Investing US$5.3 billion to the sector (26 years) under the Moderate Investment scenario will realize a cumulative GDP gain of US$38.1 billion.
- But investing US$8.4 billion to the sector (26 years) under the High Investment Scenario will realize a cumulative GDP gain of US$ 67.2 billion.
- Consider more specifically regional allocation of investments in the sector
- Reconcile MWE investment Plans (updated) with other MDAs