



ECONOMICS OF KIGALI CITY WETLAND ECOSYSTEM SERVICES

Evaluation of Policy Options

POLICY BRIEF

EXECUTIVE SUMMARY

Wetlands are highly productive ecosystems with a number of ecological functions that yields dozens of ecosystem services such as surface water detention which yields flood protection; stream flow maintenance that yields water supply, nutrient transformation that yields water quality; sediment and other particulate retention which is also associated with water quality service; provision of habitat for fish which is associated with subsistence and commercial fishing; provision of habitat for wildlife which is associated with recreation and tourism, and biodiversity protection and conservation; carbon storage and sequestration which is associated with climate stability among others. There are about 37 interconnected wetlands (forming complex) in Kigali City with a total area of about 9, 160 hectares or about 12.5% of the cities land mass, and over 73% of the wetland is has been reclaimed for crop farming.



The main objective of this study was to carry out a total economic valuation of ecosystem services in the selected wetlands in Kigali City. In conducting the study, a modified Troy & Wilson method was adopted to develop the research methods which entailed; delineation of study area (boundaries & limits of the spatial rear of the wetland), typology development (land use and land cover types), data collection strategy, mapping, and data analysis (estimation of current economic values, scenario analysis for two scenarios i.e., the business-as-usual scenario and the implementation of Kigali City wetland master plan). The baseline (2021) economic value of four provisioning (crop farming, papyrus products, grass harvesting, and bricks making) is US\$ 22 million, while that for regulating services (climate change mitigation, habitat for biodiversity, sediment control, and water quality improvement) is valued at slightly more than US\$ 51 million. If the status quo (business as usual scenario) is maintained, then the Kigali City wetland complex will accumulate net present value loss in terms of ecosystem services worth over \$US 1.8 billion by 2050. While implementation of the Kigali City wetland master plan would outperform the status quo by generating a net present value benefit of more than \$US 1.9 billion by 2050. The wetland master plan would generate around an extra \$US 155 million annually more than the status quo.

1. INTRODUCTION

Wetlands are highly productive ecosystems with a number of ecological functions that yields dozens of ecosystem services such as surface water detention which yields flood protection; stream flow maintenance that yields water supply, nutrient transformation that yields water quality; sediment and other particulate retention which is also associated with water quality service; provision of habitat for fish which is associated with subsistence and commercial fishing; provision of habitat for wildlife which is associated with recreation and tourism, and biodiversity protection and conservation; carbon storage and sequestration which is associated with climate stability among others¹.

Despite wetlands having the ability to offer close to two dozen of ecosystem services, they are also one of the ecosystems that are being subjected to the greatest degradation globally². There was a decline of about 35% of global wetlands between 1970 and 2015³. The average annual rate of natural wetland loss estimated by the WET Index is -0.78% a year which is over three times faster than the average annual rate of loss of natural forests (-0.24% a year) between 1990 and 2015⁴. There are about 37 interconnected wetlands (forming a complex) in the City of Kigali, Rwanda, with a total area of about 9, 160 hectares. This is about 12.5% of the city's land mass, and over 73% of the wetland complex has been reclaimed for crop farming⁵.

The direct drivers or immediate causes of wetland loss and degradation include; infrastructure development, over-use, land conversion, pollution, water withdrawal, climate change, eutrophication, pollution, invasive alien species⁶, while the underlying causes of the direct drivers (the indirect drivers) include price distortions, income distribution inequalities, absence of full cost accounting, policy failures, market failures (missing prices), lack of property rights, population growth and the consequent and increasing economic development⁷. The main reason for the continued loss and degradation of wetlands throughout the world is because they (wetlands) have been traditionally considered to be of little or no value, or even at times to be of negative value⁸. This study therefore seeks to establish the exchange and utilitarian value of the City of Kigali wetlands complex so as to make them visible thereby making them comparable to other land uses.

The main objective of this study was to carry out a total economic valuation of ecosystem services in the selected wetlands in Kigali City. The specific objectives included: Development of a replicable methodology for ecosystem services assessment and total economic valuation; collection, organization and analysis of spatially explicit data to identify, assess and evaluate the key/priority ecosystem services in Kigali City complexes; provision of key and actionable recommendations for ecosystem mainstreaming in various sectors of development.

In conducting the study, a modified Troy & Wilson⁹ method was adopted to develop the research methods which entailed; delineation of study area (boundaries & limits of the spatial rear of the wetland), typology development (land use and land cover types), data collection strategy, mapping, and data analysis (estimation of current economic values, scenario analysis for two scenarios i.e., the business as usual and the implementation of Kigali City wetland master plan).

2. THE STUDY FINDINGS

2.1. Land Use Land Cover Types of Kigali City Wetlands Complex

The land use land cover for Kigali City wetland complex is majorly comprising of; cropland (7,273.1ha), Built up areas of commercial buildings, public facilities and residences (1,050ha), green spaces of parks and rivers (388.8ha), and papyrus and phragmites vegetation (408.1ha).

2.2. The Major Ecosystem Services of the Kigali City Wetlands Complex

There are around four important provisioning ecosystem services that support local city dwellers with income and livelihoods, they include; crop farming, papyrus and papyrus products, grass harvesting, and bricks making. Other ecosystem services of importance include; Flood control, sediment control, water purification, habitat for biodiversity, tourism and recreation, and carbon storage & sequestration. Table 1 shows various ecosystem services and the associated land uses.

Table 1: Important ecosystem services and associated land uses

Ecosystem service	Papyrus & Phragmites	Cropland	Grassland	Green spaces	Built-up areas
Crop farming	-	√	-	-	-
Papyrus products	√	-	-	-	-
Grass harvesting	-	-	√	√	√
Bricks making	-	-	√	-	√
Biodiversity	√	-	√	√	-
Flood control	√	-	√	-	-
Water purification	√	-	√	-	-
Sediment control	√	-	√	-	-
Carbon storage	√	√	√	√	√
Tourism & recreation	-	-	-	√	-

2.3. The Current Economic (2021) Values of the Ecosystem Services

Various valuation techniques (market price, replacement cost, and damage cost avoided) coupled with value transfer functions were employed to estimate the baseline or also known as current (2021) economic values as shown in table 2.

Table 2: The Current (2021) Economic Values of the Wetlands Ecosystem Services

Ecosystem services	Associated Wetlands Area (ha)	Economic Value (USD)
Crop farming	7,273.1	20,357,035
Papyrus products	408.1	129,776
Bricks making	5	1,500,000
Grass harvesting	40	176,640
Flood control	408.1	1,490,789
Sediment control	648.1	1,182,881
Water purification	836.9	1,709,378
Habitat for biodiversity	836.9	2,868,056
Tourism and recreation	388.8	83,333
Carbon storage & sequestration	7,894.6	44,735,380
Total	9,160	74,233,268

2.4. The Net Present Values of Maintaining the Current Land Use Practices in the Wetland

The economic performance of two wetlands management options were evaluated over a 30-year period, using a social discount rate of 10% per annum, and Net Present Values as the cost benefit analysis indicator. The first management option is the current wetlands land use practice also called the business as usual or status quo scenario in which the spatial dimensions of the wetlands land use and land cover are assumed to remain constant for the next 30 years. The cumulative economic benefits of the ecosystem services over the next 30 years are valued at slightly above US\$ 2 billion while the cumulative costs are valued at slightly above US\$ 8.6 billion. If the status quo (business as usual) is maintained, then the Kigali City wetlands complex will accumulate a net present value loss in terms of ecosystem services, worth over \$US 1.8 billion by 2050.

2.5. The Net Present Values of Implementing the proposed Wetland Master Plan

The second management option is the Kigali City wetland master plan. Under the Kigali City Wetland Master Plan, there are three broad objectives of allocation of some wetland area (3,888 ha) for conservation, some other 3,851 ha of wetlands for sustainable use, and the remaining 1,421 hectares of wetlands for tourism and recreation. The net present value of the economic benefit of the wetland master plan over the next 30 years is slightly above US\$ 1.9 billion.

2.6. The Annualized Incremental Benefits of the Wetland Master Plan over the Current Use

The additional benefit or cost of the recently formulated wetland master plan over or against the current practice also known as the business as usual or status quo scenario was also conducted through the annualized net present values, i.e., the annual net benefit expressed in each period as an even flow of the undiscounted net benefits and it is the same in each period as shown in table 4 below.

Table 4: The annualized incremental benefits and costs of the wetland master and the BAU

Ecosystem services	NPV of the BAU	NPV of the wetland master plan	Incremental benefit of the wetland master plan	Annualized net NPV
Papyrus products	1,004,099	3,156,725	2,152,626	228,349
Crop farming	146,926,767	49,123,888	-97,802,879	-10,374,856
Grass harvesting	350,063	350,063	0	0
Bricks making	5,656,149	5,656,149	0	0
Biodiversity value	27,036,921	186,627,128	159,590,207	16,929,209
Flood control	13,995,836	178,725,562	164,729,726	17,474,405
Water purification	16,118,013	100,367,323	84,249,310	8,937,103
Sediment control	11,150,918	88,586,568	77,435,650	8,214,316
Tourism & recreation	9,749,390	17,373,083	7,623,693	808,716
Carbon storage & sequestration	421,716,601	1,490,385,881	1,068,669,280	113,363,634
Total	653,704,757	2,120,352,370	1,466,647,613	155,580,876

RECOMMENDATIONS

- Investments in regular data collection is recommended to help in keeping track of the flow of the ecosystem services provision.
- The Kigali City wetland master plan should be implemented over the status quo since it will generate more than \$US 155 million annually over the business-as-usual scenario.
- Mitigation measures for the losses and damages (specially to crop farmers who are the likely losers) in case the wetland master plan is implemented should be considered.
- Investing on the wetland as a carbon sink for climate change mitigation is also recommended.
- The more primary studies can still be conducted since the study relied considerably on value transfer functions.

POLICY IMPLICATIONS

- Retaining the business-as-usual scenario will result into an improvement in agricultural outcome for Kigali City and the larger Rwanda since it will generate an annualized benefit of over \$US 10 million over the implementation of the Kigali City wetland master plan and potentially keep 14 thousand households in employment.
- However, implementation of the Kigali City wetland master plan will have policy implications on the stakeholders and economic value of wetland ecosystem services as follows;
- Crop farming would lead to economic losses to a cross-section of the over 14 thousand city dwellers who depend on the Kigali wetlands complex for crop farming if the wetland master plan is implemented .
- Products from Papyrus & other related grasses will result into an annual incremental benefit worth \$US 228 thousand above the current levels.
- Water purification function for use by downstream community would offer an annual incremental economic benefit valued at \$US 8.9 million over and above the current Kigali wetlands complex management and utilization.
- Sediment control would result into an improvement and offer annual incremental net benefit of \$ US 8 million over and above the current use of the Kigali wetlands complex.
- Flood control for disaster mitigation would result into an annual incremental value of \$US 17 million over the current Kigali wetlands complex management and use.
- Carbon storage and sequestration for climate change mitigation would have an annual incremental benefit over the current management worth \$US 113 million.
- Habitat for biodiversity conservation value will have an incremental benefit over the current practice worth \$US 16.9 million annually.
- Tourism and recreation would result into an annual net benefit of over \$US 800 thousand over the current business as usual scenario.

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Founded in 1995, ARCOS is a regional conservation organization with the mission to enhance biodiversity conservation and sustainable management of natural resources, in the Albertine Rift region, African Great Lakes region and in Africa mountains ecosystems, through the promotion of collaborative action for nature and people.

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