NILE BASIN INITIATIVE
INITIATIVE DU BASSIN DU NIL

Application of a Multi-Criteria Decision Analysis (MCDA) f ranking identified Water Quality Hotspots in the Nile Basi

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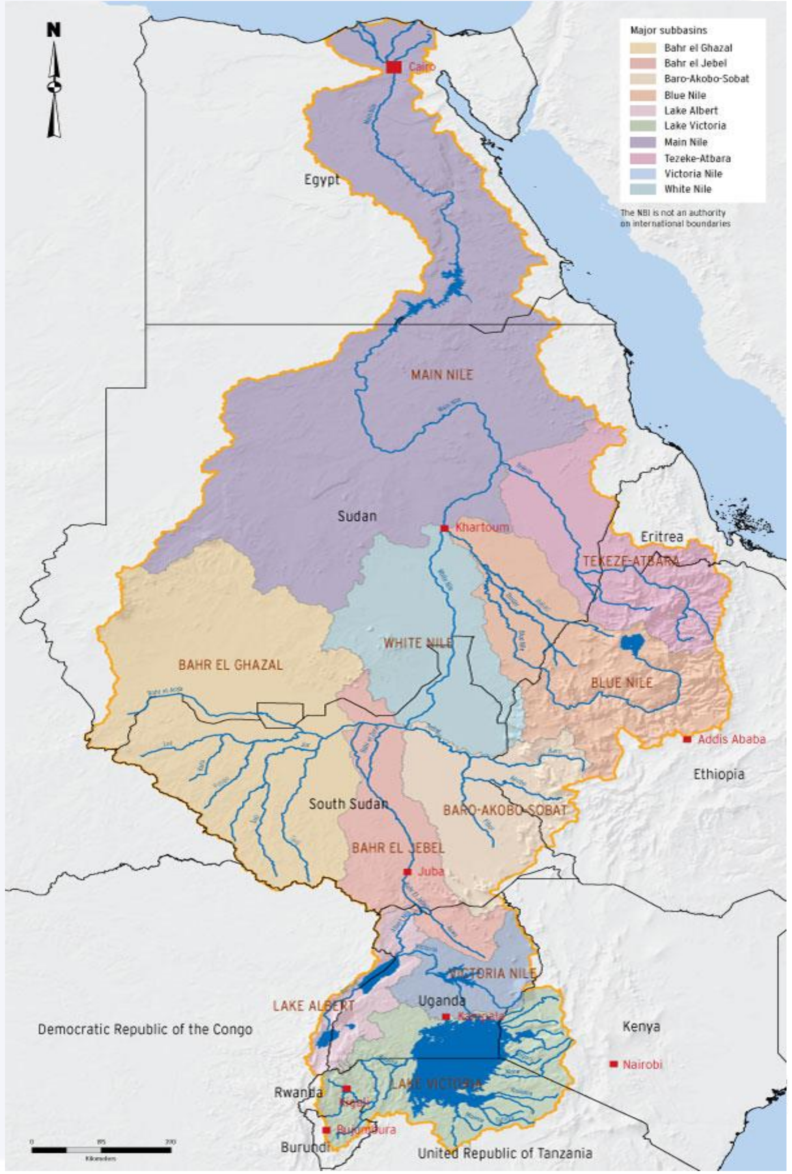


Introduction to NBI

Shared Vision Objective:

'To achieve sustainable socio-economic development through the equitable utilization of, and benefit from, the common Nile Basin water resources'

Core functions:

- Facilitating basin cooperation
- Water resources management
- Water resources development

Offices:

- Nile-SEC: Entebbe, Uganda
- ENTRO: Addis Ababa, Ethiopia
- NELSAP-CU: Kigali, Rwanda

Website: https://www.nilebasin.org/

NBI strategy 2017-2027 – Key areas

Water security — Goal 1: Water Security: Water Security – Meeting Rising Water Demand

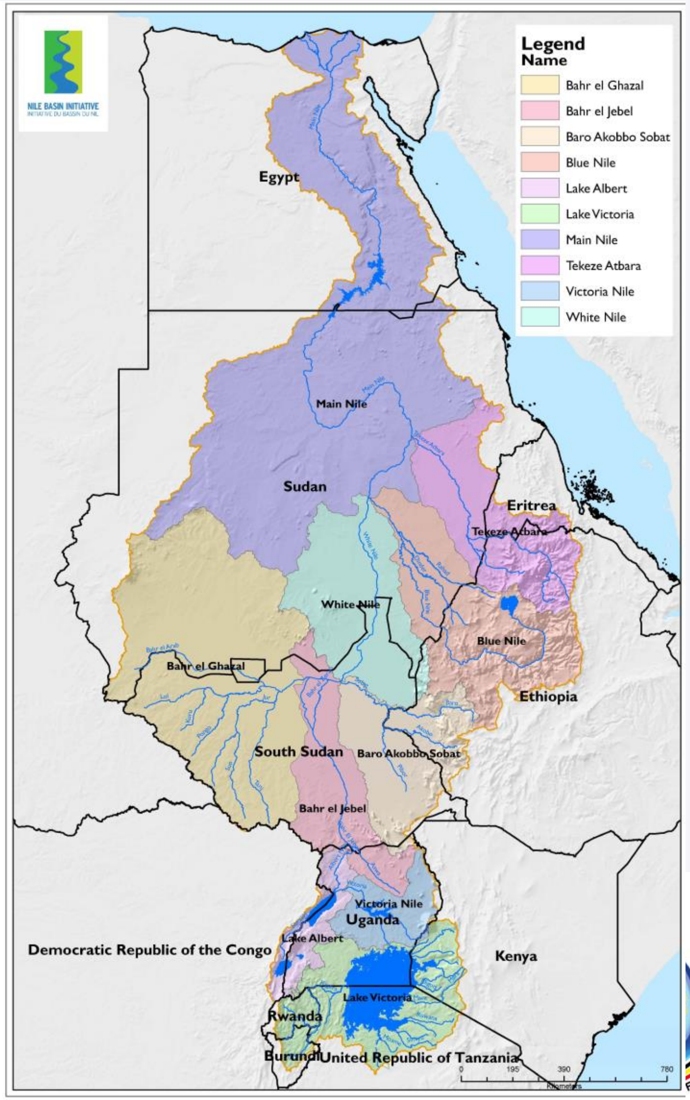
Environment sustainability — Goal 4: Environmental Sustainability- Protecting And Restoring Degraded Ecosystems

Energy security — Goal 2: Energy Security- Unlocking And Optimising Hydropower Potential

Climate change adaptation — Goal 5: Climate Change Adaptation – Preparing For Climate Change Impacts

Food security — Goal 3: Food Security - Increasing Agricultural Productivity

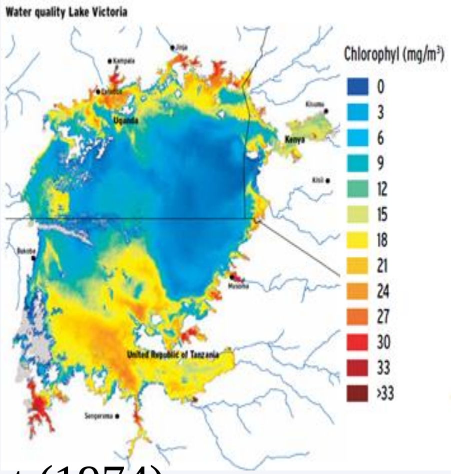
Transboundary water governance — Goal 6: Strengthen Transboundary Water Governance



Background

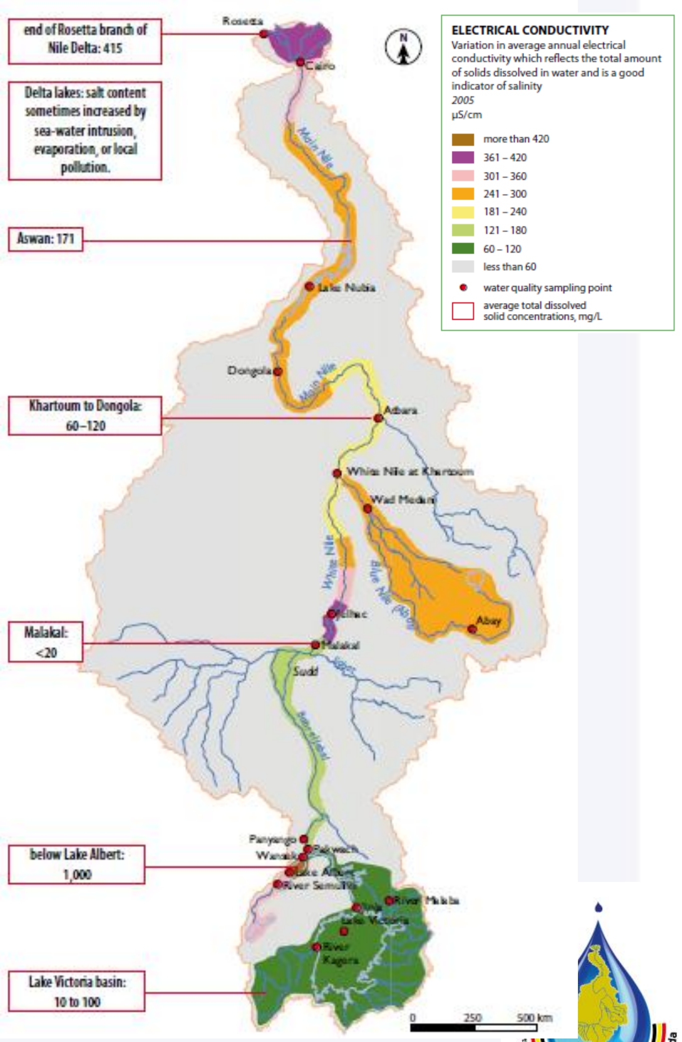
<u>Main Water Quality management issues in the Nile Basin:</u>

- Lack of Data and Monitoring
- Water Quality Modelling
- Lack of harmonized Water Quality Policies and Institutional Framework
- Level of Awareness



<u>Several Water Quality monitoring efforts at regional level:</u>

- Sediment monitoring conducted under the HYDROMET Project (1974);
- Lake Victoria Environment Management Program Phase I (LVEMP I) 1997 to 2004 and phase II (2009 to 2017);
- Nile Transboundary Environmental Action Project (NTEAP) (2009)
- Eastern Nile Watershed management Cooperative Regional Assessment Project (2002-2008)
- Engaging Private sector for Green Growth in Lake Victoria Basin (EPSGG-LVB) and LVB-IWRMP
- The Nile Cooperation for Climate Resilience **(NCCR)** Project (2021 – 2025)



Multi-Criteria Analysis

- Multi-Criteria Analysis (MCA) is a general term for a wide variety of techniques that can be used when faced with several competing options.
- Allows wide variety of factors to be compared: cost; policy priorities; stakeholder preferences; environmental impact

- Advantages of MCA:
  - ➢ Structured sequence of steps; systematic thought-process
  - ➢ Decision-making process open and accountable
  - ➢ Audit trail for decision, including any revisions

- Disadvantages of MCA:
  - ➢ Some subjectivity, expert opinion & personal preferences
  - ➢ Not suitable for analyzing a problem from scratch

Steps of conducting the WQ-MCA

1. Establish the WQ-TWG
2. Literature Review and Identification of WQ Hotspots
3. Develop and Adopt the MCA
4. Appy the MCA to the List of WQ Hotspots
5. Select the highest ranked Hotspot

NCCR WATER QUALITY TECHNICAL WORKING GROUP (WQ-TWG) MEMBERS

		Storage management, NELTAC		
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Steps of conducting the WQ-MCA

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2) **Stage 2: Compile long list of Hotspots (options)**
- Literature review- NTEAP, LVMEP,
- A list of 44 WQ Hotspots were identified through literature review

No.	Country	No. of HS
1	Burundi	4
2	D.R.Congo	3
3	Ethiopia	4
4	Kenya	4
5	Rwanda	3
6	South Sudan	7
7	Sudan	6
8	Tanzania	6
9	Uganda	7
	TOTAL	**44**

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Steps of conducting the WQ-MCA

Establish the WQ-TWG

Literature Review and Identification of WQ Hotspots

Stage 3: Development of the MCA:

- A criteria of 8 sub-criteria was developed and agreed by the WQ-TWG members during the 1st Regional Workshop

No	Criteria	Rank	Weight
1	Contaminant loading on receiving waters	1	20%
2	Nature/Location of Hotspot	2	15%
3	Country preference	3	13%
4	Livelihoods impacts	4	13%
5	Health impacts	5	12%
6	Environmental impacts	6	12%
7	Economic impacts	7	10%
8	Source of pollution (Point versus diffuse)	8	5%
Total			100%

Rank of indicator	Criteria / Indicator	Weight
Criteria 1: Contaminant loading on receiving waters: What effect does the discharge (whether from a point-source or a diffuse-source) have on the receiving waters, in terms of contaminant loading and deterioration of receiving water quality, judged against water-quality classes in national or international standards? This will be decided in a qualitative manner (High, Medium, Low) This will be led by/broken down according to the WQ parameters, the pollutant, the indicators and the drivers/causes		20%
Parameters of water quality deterioration: sediment loadings in tonnes per year, amount of BOD loading in mg/l, amount of COD loading in mg/l, amount of heavy metals entering the water systems, amount of pesticides polluting the water course and lakes, Total Suspended Solids (TSS) in the waterways, Total Dissolved Solids (TDS), conductivity and nutrients especially Nitrogen (N) and Phosphates (P) that are limiting the water weeds		
3	1. High contamination	20
2	1. Medium Contamination	13.3
1	1. Low Contamination	6.7
Criteria 2: Nature of the hotspot Site		15%
4	1. Trans-boundary sites (location) i.e., water bodies such as lakes, wetlands, river reaches along borders or crossing borders, or tributary rivers that feed the shared lakes and wetlands;	15.0
3	1. Sites wholly located within one country but having trans-boundary significance/impact, for example sites with high pollution loads or where any pollution has the capacity to significantly impact locations downstream country(ies), such as from mining, major urban centres (even if they are not close to national borders), agriculture, etc.	11.25
2	1. Sites that are sources of water for key communities (major cities, cross-border communities, etc.) for water supply, irrigation, industrial use, etc.	7.5
1	1. Sites that are home to critical and/or endangered species;	3.75
Criteria 3: Country preferences: If the country has ranked their Hotspots according to their priority (Yes, No)		13%
2	If Yes, Then the rank will apply	
1	If No, then all Hotspots will be treated as equal (Each given 10% out of 13%)	
Criteria 4: Impacts on livelihoods: Taking into account the impacts on local livelihoods and human development indices.		13%
3	1. Direct impact on livelihood	13%
2	1. Indirect impact on livelihood	8.7
1	1. Induced impact on livelihood	4.3

Steps of conducting the WQ-MCA

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Stage 5: Run the MCA: Assign weights, Score, then Rank the Options (EN Region)

Hotspot Location	Country	Criteria 1: Contaminant loading on receiving waters (20%)	Criteria 2: Nature/Location of Hotspot (15%)	Criteria 3: Country preference (13%)	Criteria 4: Livelihoods impacts (13%)	Criteria 5: Health impacts (12%)	Criteria 6: Economic impacts (12%)	Criteria 7: Economic Impacts (12%)	Criteria 8: Source of pollution (Point versus diffuse) (5%)	Total	Ranking
Lake Tana sub basin (Ethiopia) – GilgelAbay	Ethiopia	20.0	11.3	13	13.0	12.0	12.0	10.0	5.0	**96.3**	**1**
Blue Nile (Ethiopia)	Ethiopia	20.0	11.3	10	13.0	6.0	8.0	10.0	5.0	[illegible]	[illegible]
Baro-Akobo-Sobat (Ethiopia & South Sudan)	Ethiopia	13.3	15.0	13	13.0	9.0	10.0	6.7	1.7	81.7	9
Tekeze-Setit-Atbra (Ethiopia and Sudan)	Ethiopia	13.3	15.0	13	13.0	9.0	10.0	6.7	1.7	81.7	9
Bahr El Jebel at Juba	South Sudan	13.3	7.5	10	13.0	9.0	6.0	10.0	5.0	73.8	12
White Nile at Melut	South Sudan	20.0	15.0	10	13.0	9.0	10.0	10.0	3.3	90.3	5
Naam River at Bentiu	South Sudan	20.0	7.5	10	13.0	9.0	12.0	6.7	1.7	79.9	10
Sud wetland	South Sudan	13.3	11.3	10	13.0	6.0	10.0	6.7	1.7	71.9	14
Mashar Marches wetland	South Sudan	13.3	11.3	10	8.7	6.0	10.0	6.7	5.0	70.9	15
Baro - Akobo – Sobat at Akobo	South Sudan	13.3	11.3	13	8.7	9.0	10.0	6.7	1.7	73.6	13
Bhar el Jebel at Nimule	South Sudan	20.0	15.0	10	8.7	9.0	6.0	6.7	1.7	77.1	11
Blue Nile, especially in Khartoum	Sudan	20.0	11.3	13	13.0	9.0	10.0	10.0	5.0	91.2	4
Meeting point of the White and Blue Niles	Sudan	20.0	11.3	10	8.7	9.0	10.0	10.0	5.0	83.9	7
White Nile start from the border of South Sudan and Sudan	Sudan / South Sudan	20.0	15.0	10	13.0	9.0	10.0	10.0	5.0	**92.0**	**3**
White Nile at Khartoum from (Dobasin bridge to the confluence with Blue Nile (Mogran))-	Sudan	20.0	11.3		13.0	9.0	10.0	10.0	5.0	78.3	8
Blue Nile (Sennar/North Khartoum)-	Sudan	20.0	11.3	10	13.0	12.0	12.0	10.0	5.0	**93.3**	**2**
Main Nile, start form Khartoum -	Sudan	20.0	11.3	10	13.0	9.0	10.0	10.0	5.0	88.3	6

Steps of conducting the WQ-MCA

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Stage 5: Run the MCDA: Assign weights, Score, then Rank the Options (NEL Region)

Hotspot Location	Country	C1	C2	C3	C4	C5	C6	C7	C8	Total	Ranking
River Ruvuvu	Burundi	13.3	11.25	13	13.0	9.0	6.0	6.7	1.7	73.95	20
Ruvyironza river (Burundi) which flows into the Ruvuvu	Burundi	6.7	11.3	10	8.7	6.0	6.0	6.7	1.7	57.05	25
Akagera river (transbandoury Burundi and Rwanda)	Burundi	20.0	15.0	13	8.7	6.0	10.0	6.7	1.7	81.10	11
Lake Cohoha(transboundary Burundi and Rwanda)	Burundi	6.7	15.0	10	4.3	3.0	6.0	3.3	1.7	50.00	26
Lake Albert	D.R.Congo	13.3	15.0	13	8.7	9.0	8.0	6.7	5.0	78.70	15
Semliki River,	D.R.Congo	13.3	15.0	13	13.0	9.0	8.0	3.3	5.0	79.60	12
Lake Edwards	D.R.Congo	6.7	15.0	10	13.0	9.0	8.0	3.3	5.0	70.00	
Throughout the country	D.R.Congo	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Lake Victoria	Kenya	20.0	15.0	13	13.0	9.0	10.0	10.0	5.0	95.00	3
Sio-MalabaMalakisi basins	Kenya	13.3	15.0	10	8.7	9.0	8.0	6.7	5.0	75.70	18
Mara River	Kenya	13.3	15.0	10	8.7	6.0	8.0	6.7	1.7	69.40	23
Gucha-Migori, Isiukhu, Middle Nzoia, Nyando, SonduMiriu	Kenya	20.0	11.3	13	8.7	9.0	10.0	6.7	5.0	83.65	9
Nyabarongo River at Ruliba (Rwanda)	Rwanda	20.0	11.3	13	13.0	3.0	10.0	10.0	5.0	85.25	8
Muhazi Lake	Rwanda	13.3	11.3	6.7	8.7	3.0	10.0	10.0	5.0	67.95	24
Akagera River at Rusumo Border	Rwanda	20.0	15.0	13	13.0	9.0	12.0	10.0	5.0	97.00	2
Lake Victoria	Tanzania	20.0	15.0	13	13.0	12.0	12.0	10.0	5.0	[illegible]	1
Mara River	Tanzania	20.0	15.0	10	8.7	9.0	12.0	13.0	5.0	92.70	5
Simiyu River	Tanzania	13.3	11.3	10	8.7	9.0	10.0	6.7	1.7	70.65	24
Kagera River	Tanzania	13.3	15.0	10	8.7	9.0	12.0	10.0	5.0	83.00	10
Urban Streams	Tanzania	20.0	11.3	10	8.7	9.0	6.0	3.3	5.0	73.25	21
Small scale mining sites	Tanzania	20.0	11.3	10	13.0	9.0	4.0	10.0	1.7	78.95	14
Lake Victoria -Bays of lake Victoria examples: Sango, Inner Murchison, Entebbe, Namanve, Wanyange, Napoleon etc.	Uganda	20.0	11.3	13	8.7	12.0	10.0	10.0	5.0	89.95	6
Lake Victoria-Main Lake (Open water)	Uganda	13.3	15.0	10	13.0	3.0	12.0	10.0	1.7	78.00	16
R Kagera at discharge into L-victoria at Kasensero	Uganda	20.0	15.0	10	13.0	3.0	12.0	10.0	5.0	88.00	7
Lake Kyoga/ Kwania	Uganda	13.3	11.25	10	13.0	9.0	10.0	6.7	1.7	74.95	19
Albertine Grabben Belt – Lake Albert, Lake George, Lake Edward, R. Semliki and Kazinga Channel	Uganda	20.0	15.0	10	13.0	9.0	12.0	10.0	5.0	94.00	4
R. Nile system (Victoria Nile, Kyoga Nile, Albert Nile)	Uganda	13.3	11.3	10	8.7	9.0	12.0	6.7	5.0	75.95	17
R. Sio Malaba	Uganda	13.3	15.0	10	8.7	9.0	8.0	10.0	5.0	79.00	13

Steps of conducting the WQ-MCA

1. Establish the WQ-TWG
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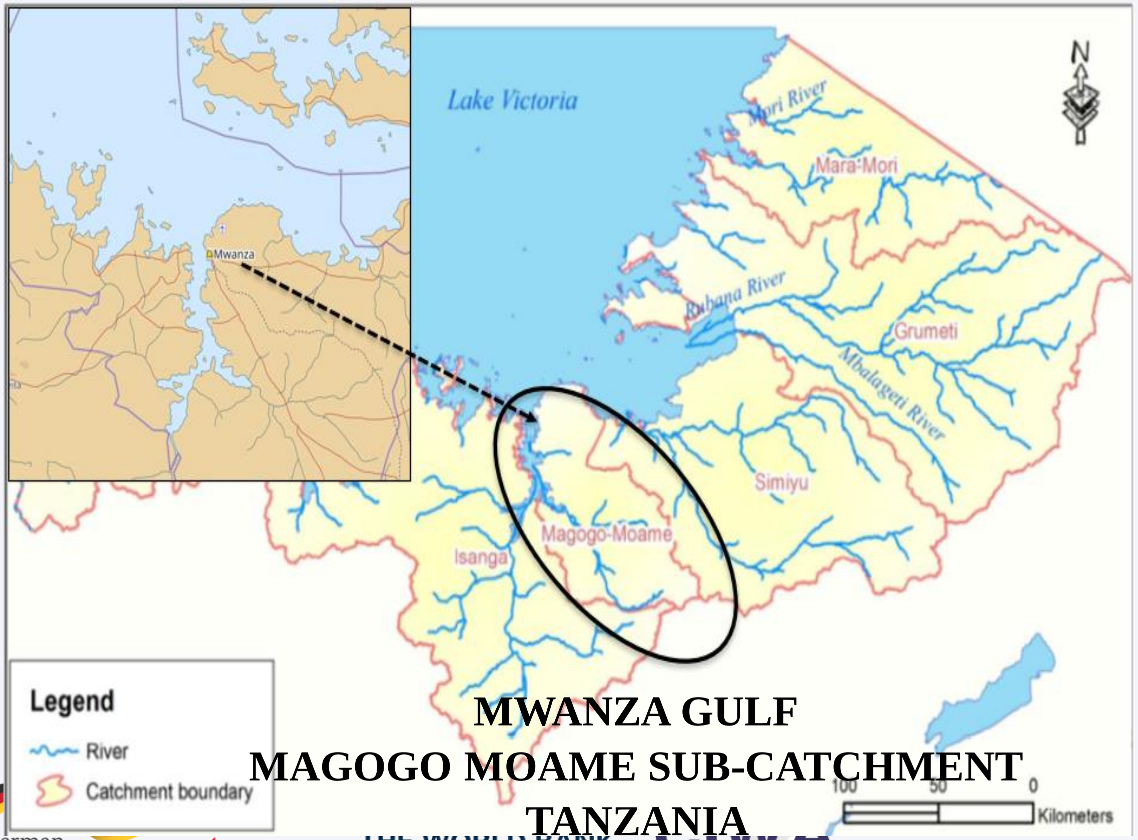
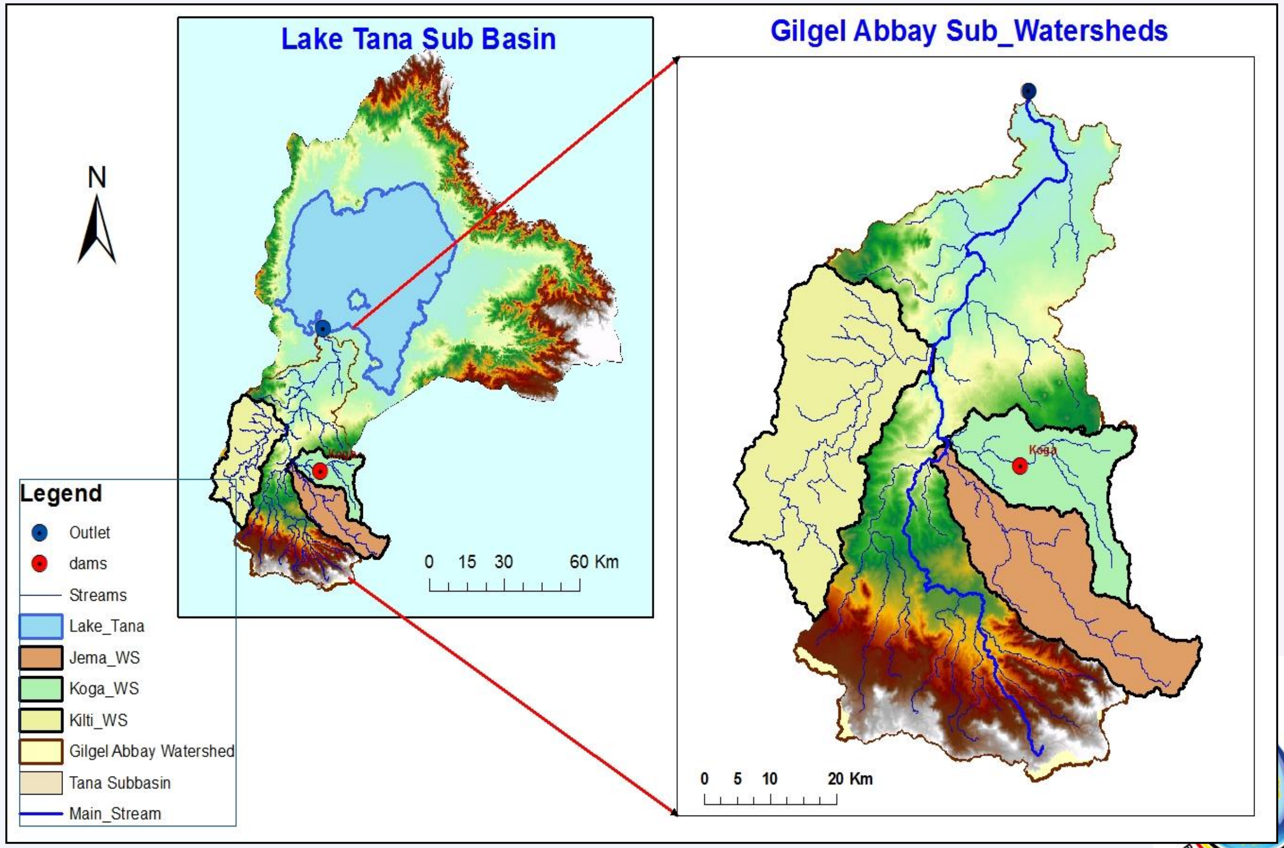
Stage 6: Selection of the 2 Water Quality Hotspots (1 in NEL & 1 in EN)



MWANZA GULF
MAGOGO MOAME SUB-CATCHMENT
TANZANIA



Conclusion

1. This paper highlights the processes undertaken by the Nile Equatorial Lakes Subsidiary Action Program (NELSAP) and the Water Quality Technical Working Group (WQ-TWG) to develop and apply a Multi-criteria Analysis (MCA) methodology for ranking identified water quality hotspots.
2. By conducting a literature review, a long list of forty-four (44) water quality hotspots were identified.
3. Subsequently, a set of Water Quality Hotspot Screening Criteria consisting of eight sub-criteria were devised to facilitate the MCA.
4. The MCA was then implemented to assess and prioritize the 44 identified hotspots, resulting in a ranked list of hotspots.
5. Two WQ Hotspots (1 in NEL and 1 in EN) were selected for further studies and identification of interventions (Structural and non-structural) with focus on Nature-Based Solutions.

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