NILE BASIN
WATER RESOURCES ATLAS

NILE BASIN INITIATIVE
INITIATIVE DU BASSIN DU NIL

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The Nile Basin Initiative (NBI) is an intergovernmental partnership of ten Nile riparian countries that is seeking to manage and develop the common Nile water resources in a cooperative manner and promote regional peace and security.

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FOREWORD

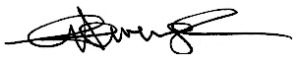
Esteemed Reader,

The Nile Basin is one of the few basins of the world that has given birth to early human civilization. The Basin is as relevant to humanity today as it was in the past millennia. This said though, the Basin is facing huge challenges. While economies of most of its countries are growing, the Basin is faced with a rising population, which increases degradation of natural resources and puts pressure on economic infrastructure including water. It also increases food security concerns and leads to rural urban migration with the attendant problems of rapid urbanization.

These and more developments are one way or the other predicated on continued availability of Nile waters. But the Nile is, as it were, a very finite and fragile resource, marked by alteration of extreme events of either prolonged droughts or floods of biblical proportions. In the midst of this, the Nile is going to face growing pressure in the coming decades due to continued steady rise in the demand for water. All this requires: more - and not less - basin wide cooperation; smarter, forward looking, knowledge based and prudent basin-wide water resources management and development policies, which ultimately should result in enhanced water use efficiency and productivity across economic sectors and countries.

The Nile Basin Water Resources Atlas is one such knowledge tool developed by NBI. The Atlas makes the data and information accessible in a format that is easy, succinct and visually attractive. By providing a bird's eye view of the potentials, problems and trends in the Basin, I hope this Atlas contributes to advancing our mission of encouraging thoughtful deliberation among basin policy makers, citizens and all concerned for the future of this great River of ours - the Nile!

With best wishes,



Hon. Eng Gerson Lwenge (MP)
Chairperson, Nile Council of Water Ministers
& Minister of Water and Irrigation,
United Republic of Tanzania

STATEMENT BY EXECUTIVE DIRECTOR, NILE BASIN INITIATIVE

Dear Esteemed Reader,

I am most delighted to welcome you to the first Nile Basin Water Resources Atlas.

Water resources development is vitally important for enabling the Nile Basin countries to meet their development objectives. However, interventions that are not founded on a sound understanding of the water resources potential are unsustainable.

The complexity of the large number of countries sharing the Nile Basin, combined with the uneven distribution of the water resources among these countries, population pressure and urbanisation pose significant challenges for sustainable management and development of the shared resource. Coupled with these is the complex hydrology of the Nile system as well as climate change.

In order to develop the Nile Basin resources to address urgent social and economic needs of the basin communities while ensuring equitable utilisation and benefit from the common resource, decision makers need well synthesized and factual information to enable them make evidence based decisions.
As part of the Water Resources Management function of the Nile Basin Initiative, and in line with its overarching goal of fostering evidence-based water resources management and development, NBI has prepared a Water Resources Atlas for the Nile Basin. The Atlas presents well synthesized and interpreted information with a special focus on spatial and temporal distribution of the resources within the Basin. Together with the State of Basin Report, the Atlas will also be used as a basin monitoring tool.

The 200-page document is delivered in seven chapters presenting the physiography of the Basin, socio economic profiles of Nile Basin countries, water availability in terms of climate and hydrology as well as water demand and use infrastructure.

The Atlas is expected to enlighten ongoing deliberations on Nile issues among policy makers, senior government officials, water resources officers, academia and the general public on broad basin issues.

The Nile Basin Water Resources Atlas is part of NBI's sustained efforts to build trust and confidence among Member States and to nurture a conducive environment for cooperative management and

development of the shared water and related resources, through provision of factual and impartial knowledge and information. It is therefore my hope that you will find it a very useful document.

I take this opportunity to thank the staff of NBI as well as members of the Regional Working Group who have tremendously contributed towards the successful preparation of this key knowledge product.

Finally, I extend my gratitude to Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) for their immeasurable technical and financial support towards the preparation of this inaugural Water Resources Atlas for the Nile Basin.

I wish you an enjoyable reading.

John Rao Nyaoro, HSC (PhD)
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ACRONYMS

BCM	Billion Cubic Meters
CRU	Climate Research Unit
DRC	Democratic Republic of Congo
EAC	East African Community
ENSAP	Eastern Nile Subsidiary Action Program
ENTRO	Eastern Nile Technical Regional Office
ESA	European Space Agency
ET	Evapotranspiration
FAO	Food and Agriculture Organisation
FAOSTAT	Food and Agriculture Organisation Statistical Databases
FDFC	Flood Diagnostics and Forecasting Center, Kenya
GCM	Global circulation Model
GDP	Gross Domestic Product
GIS	Geographic Information System
GNI	Gross National Income
GW	Gigawatt
GWh	Gigawatt Hour
Ha	Hectare
HDI	Human Development Index
HDR	Human Development Report
HYDROMET	Hydro-meteorological survey of the Equatorial Lakes
IGAD	Intergovernmental Authority on Development
IGAD-HYCOS	IGAD- Hydrological Cycle Observation System
IGEBU	Institut Géographique du Burundi
IGRAC	International Groundwater Resources Assessment Center
ITCZ	Intertropical Convergence Zone
IWRM	Integrated Water Resources Management
Km	Kilometers
Km2	Square Kilometers
KV	Kilovolts
KWh	Kilowatt hour
L	Litres
LVBC	Lake Victoria Basin Commision
LVEMP	Lake Victoria Environmental Management Program
M	Meters
METTELSAT	Agence Nationale de Meteorologgie et de Teledetection par Satellite
MERIS	Medium Resolution Imaging Spectrometer
NBI	Nile Basin Initiative
NELSAP	Nile Equatorial Lakes Subsidiary Action Program
Nile-COM	Nile Council of Water Ministers
Nile-SEC	Nile Basin Initiative Secretariat
Nile-TAC	Nile Technical Advisory Committee
NTEAP	Nile Transboundary Environmental Action Program
PET	Potential Evapotranspiration
PPP	Purchasing Power Parity
SADC	Southern Africa Development Community
TECCONILE	Technical Cooperation for the Promotion of the Development and Environmental Protection of the Nile Basin
TRMM	Tropical Rainfall Measuring Mission
UNDP	United Nations Development Program

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EXECUTIVE SUMMARY

The Nile Basin Water Resources Atlas has been prepared to support stakeholder dialogues and inform decision-making by the Nile Basin riparian states in order to achieve the shared vision of "sustainable socio-economic development through the equitable utilization and, benefit from, the common Nile Basin water resources".

The basin is home to more than 257 million people or around 20% of the population of the African continent. The water resources of the Nile Basin are of paramount importance for the socio-economy and sectors such as agriculture, power, navigation, fisheries and water supply, sanitation and health and the environment.

The upper parts of the Nile Basin is characterized by mountain ranges and steep slopes. In the middle reaches there are large plateau regions, while the lower parts have wide flood plains and ultimately the huge Nile Delta. The population's settlement patterns are heavily influenced by the availability of water and the infrastructure. In the downstream countries, population is concentrated along the course of the River Nile and in the Delta. The highest population densities in the upstream countries are found in the Ethiopian Highlands and in the Nile Equatorial Lakes Region. The rural population of the basin countries increased between 1.5% and 3.0% (2005 – 2015) while the urban population increased between 4.4% and 7.0% in the same period. Poverty is widespread and by income, around 40% of the population of the basin countries live below a poverty line of USD 1.25 per day.

The high dependence on shared basin water resources, which in large areas are scarce, makes a fact-based management essential. Monitoring of water resources is therefore done by all countries and there exist close to 1,000 rainfall stations and close to 450 streamflow gauging stations across the basin countries. Technical and financial resources are needed to operate the stations and get reliable data. In many countries the number of stations decreases and the quality of the data is variable. The need for improvements have been recognized by the Nile Basin Initiative, which has completed a design of a Nile Basin Regional Hydromet System based on upgrading of existing stations adding water quality monitoring and laboratory strengthening. Groundwater monitoring is generally very sparse.

Climatically, the Nile Basin has large variations ranging from the tropical climate in the equatorial region to the Mediterranean climate of the delta. The variations reflect the latitude range, 4° S to 32° N and the altitude range; from sea level to more than 3,000 m. The equatorial lakes region and southwestern Ethiopia have well distributed rainfall with an average annual rainfall of more than 1000 mm while Sudan and Egypt have negligible rainfall, with an average annual rainfall below 50 mm. Combined with temperature ranges of 10 – 45°C, very little surface runoff is generated here. Global warming is bringing about changes in climate around the world. Trends and statistics have to be reviewed as even small changes in temperature averages or extremes can have serious consequences for water resources and supplies, agriculture, power and transportation systems, the natural environment, and even health and safety.

The Nile Basin streamflow patterns are influenced by the variations in climate and topography/altitude. The Blue Nile is highly seasonal with most of its flow occurring between July and September, while the White Nile flow is stable over the year. On the average, the Blue Nile contributes almost twice the volume of water (roughly 1600 m^3/s) of the White Nile. Groundwater is another, though small part of the water resources of the basin. The most significant aquifer is the Nubian Sandstone. Sediment production takes place in upland areas with the Ethiopian Highlands as the main source compared to other parts of the basin. Water quality is generally influenced by human activities and urban areas and industrial activities are the main influencing factors.

The water resources in the basin are essential for sustaining life, the economy and a healthy environment. Water is used off-stream (withdrawn e.g. for agriculture or domestic use), in-stream (e.g. hydropower, fisheries, environment) or on-stream (e.g. transport, tourism). By far, the largest consumptive use is for irrigation (roughly 2600 m^3/s) with Egypt and Sudan as the largest users. Water demand for municipal and industrial use is rapidly increasing from the present estimates of roughly 400 m^3/s. Water demands for all sectors is expected to increase substantially and there is a risk that the aggregate water demand basin-wide can surpass available water will become unable to meet the water demand. A high degree of trust, collaboration and sharing of water and benefits between the Nile riparian nations becomes imperative and the Nile Basin Initiative has a strategic mission to facilitate the cooperation.

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