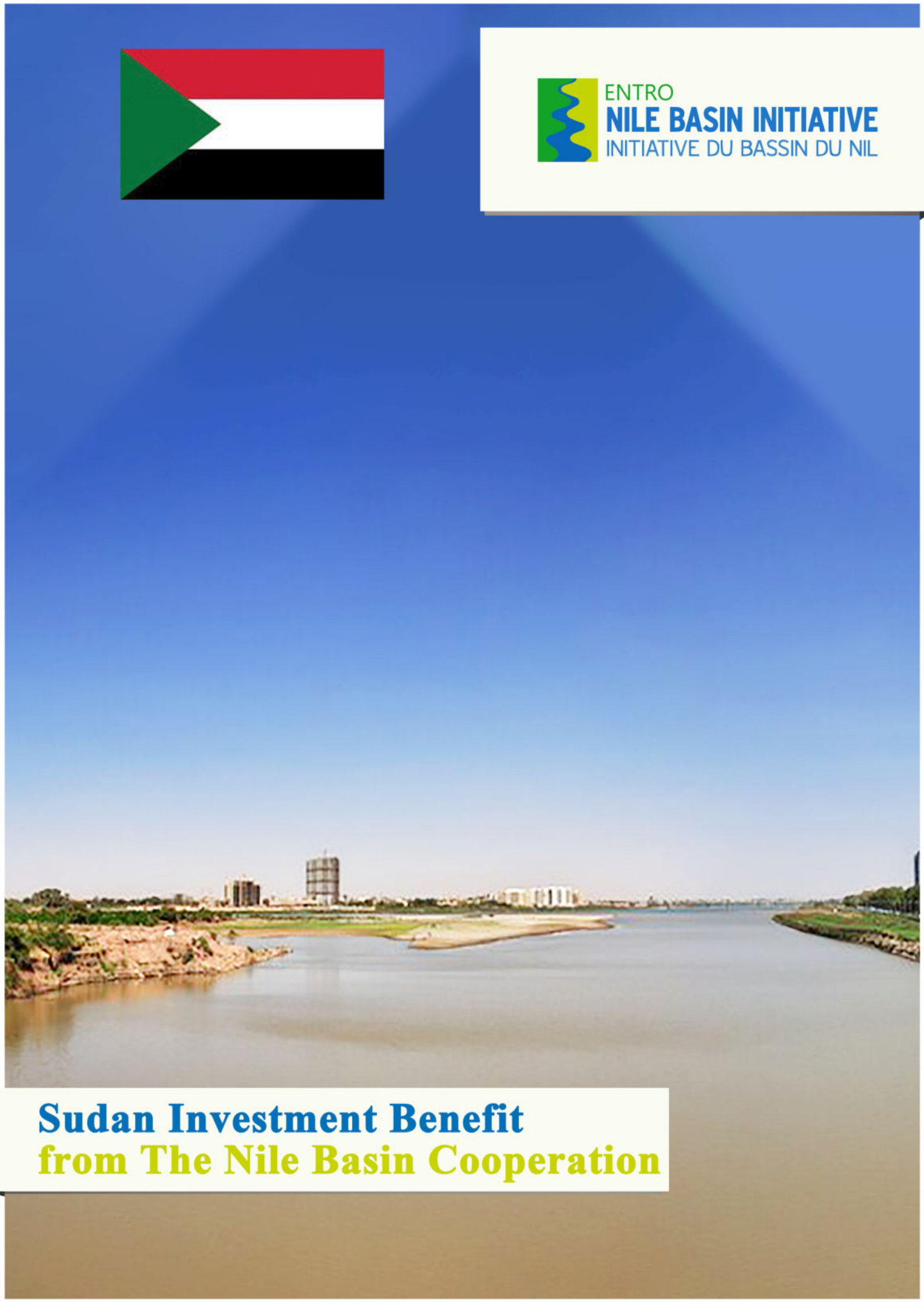

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# Sudan Investment Benefit from The Nile Basin Cooperation

ENTRO

# NILE BASIN INITIATIVE

INITIATIVE DU BASSIN DU NIL

## VISION

"A credible, adaptive regional institution fostering sustainable transboundary cooperation".

## MISSION

"We Work to realize shared benefits of cooperative Water Resources Development and Management in the Eastern Nile".

**ONE RIVER ONE PEOPLE ONE VISION**

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The NBI/ ENTRO Logo can be interpreted as the spirit of unity in the Nile Basin, showing the Nile winding between a filed of Green on the left, symbolizing the lush vegetation of the upstream countries, with a filed of light green on the right, symbolizing the more arid land of the downstream countries. On the right-hand side is the Nile Basin Initiative's name in both English and French the two dominant languages of the region.

**Disclaimer**

The views expressed in this publication are not necessarily those of NBI's member states or its development partners.

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**Acknowledgement**

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# SUDAN INVESTMENT BENEFITS FROM THE NILE BASIN COOPERATION

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## ABOUT ENTRO

*Eastern Nile Technical Regional Office (ENTRO) Addis Ababa, Ethiopia*

ENTRO was established in 1999 and comprises Egypt, Ethiopia, and Sudan (South Sudan joined in 2012). ENTRO supports the countries in preparing cooperative water resources investment programs and projects, capacitating and strengthening institutions and providing secretariat support to its governance. The goal of ENTRO is sustainable socio-economic development through the equitable utilization of, and benefit from, the common Eastern Nile Water resources. Since its establishment, ENTRO has played significant role in advancing and enhancing cooperation among the Eastern Nile Countries on water resource development and management.

Eastern Nile though linked to and from one hydrologic unit of the entire Nile Basin, bears unique features, making a compelling case for the four countries to form ENSAP.

These features include:

**Hydrology:** This sub-basin supplies over 86% of the Nile flow over a 3–4-month period, characterized by seasonal and inter-annual variability.

**Topography:** The cool, high, and rugged Ethiopian highlands offer huge hydropower generation and water saving potential

**Environment:** Land degradation and environmental problems has resulted in huge sediment load in the Nile.

**Culture:** The four countries share common religions and intricate historical and cultural linkages.

**Demography:** The four countries make nearly two-thirds of the entire Nile Basin population.

**Geography:** The four countries are geographically interlinked making infrastructure interconnection power, road, rail possible.

**Economy:** Owing to scale, the four countries could make foundation for a viable regional integration possibility.

# ABOUT SUDAN

The Sudan is overall flat, plain land predominantly desert in the North. more so its three main tributaries (the Blue and White Niles and Atbara River) have by and large shaped the settlement pattern and agricultural production of the country, by and large, shaped the settlement pattern and agricultural production of the country. The total area of Sudan is estimated at 1,861,484 square kilometers. Khartoum, Sudan's Capital city, is where the White Nile and the Blue Nile converge (confluence) to form the main Nile. Major concentration of Sudan's population is located in Khartoum, and areas between the White and Blue Nile and Darfur. Among the environmental problems challenging Sudan are desertification, deforestation and soil erosion, biodiversity loss, periodic droughts and water pollution. The Sudan is the third largest country in Africa.

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## SUMMARY OF SUDAN PROJECTS AT IDENTIFICATION STAGE

| |
|---|
| Energy Sharing Arrangements in the Eastern Nile Basin |
| Coordinated Operations of Water Infrastructure |
| Promoting Efficient Irrigated Agriculture |
| Watershed management for Climate Resilience |
| Environmental and Social Assessments and Safeguards |
| Water Re-Use and Salinity Management |
| Water Quality and Sediment Management |
| Improved Groundwater Use, Monitoring and Management |
| Enhanced Climate Change Adaptation Capability |
| Coordination and Phasing of win-win ENB Development Packages |

## SUMMERY OF THE SUDAN PIPELINE PROJECT AND STATUS

| | |
|---|---|
| **IDEN Projects** | |
| Eastern Nile Irrigation and Drainage Studies (ENIDs) | Feasibility study completed for Ethiopia and Sudan |
| Eastern Nile Watershed Management Project (ENWM) | Study completed and operational |
| Eastern Nile Power Trade Project (ENPT) | Study completed |
| Ethio-Sudan Interconnection | Operational |
| **Post-IDEN Investment projects** | |
| Restoration of Kerib land along the Upper Atbara River | Project preparation completed |
| Water Harvesting in the gash Delta, Kassala | Project preparation completed |

**Sudan: Basic Country Data**

- **Total country area:** 1.861,484 square kilometers
- **Area in Nile Basin:** 1,396,113 square kilometers (75%);
- **Sudan Nile Basin part as % of total Nile Basin:** 44%
- **Total population: 26.6 million (1999):** 45.5 million (2019)
- **Agriculture contribution to GDP:** 39.6%;
- **Population in the Nile basin:** 87%
- **Nile dependence:** 77% of Sudan's fresh water supplied from Nile
- **Access to potable water:** 60.2% (2017)
- **Access to electricity:** 59.8% (2018)
- **Nile ecosystem and Biodiversity:** Dinder National Park (the oldest protected park in Africa); riverine, Mayas associated ecosystems.
- **GDP Per Capita:** USD 623 (2018); 1112 (2017)
- **Per capita water storage:** 43 cubic meters;
- **Irrigated land in the Nile Basin:** 1.8 million hectares

**Sudan and NBI**

- **Founding Member of NBI**
- **CFA: Non-signatory;** froze participation in NBI in 2010; and resumed since 2012
- **Hosted SVP:** NTEAP (Nile Transboundary Environment Project)
- **Hosted one Nile Development Forum (NBDF) in 2008**
- **Hosted one Regional Nile Day Celebration (Khartoum)**
- **Country Contribution to NBI (1999-2019):** Total USD Equivalent 9,544,250 (USD 3,376,955 in cash; USD 6,167,295 in-kind)

# SUDAN BENEFITS FROM NILE BASIN COOPERATION

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## COMPLETED PROJECTS

## INVESTMENTS IN ENERGY, WATER AND FOOD SECURITY(WATER RESOURCES DEVELOPMENT)

## ETHIOPIA-SUDAN POWER INTERCONNECTOR


*Transmission Line*

The Gedaref- Bahr Dar - Gondar-Shehedi Metema Transmission Line Fully commissioned at the end of 2013, the Ethiopia-Sudan Power Transmission Interconnector (515 km Ethiopia-Sudan Power Transmission Interconnector that comprises the 194km Gondar-Bahr Dar Transmission Line and the 321km Ethiopia (Gondar-Shehedi-Metema) Sudan (Gedaref, has enabled 300 MW of power trade between the two countries. Ethiopia obtains USD 10-15 million in electricity sales revenue annually. Nearly 1.4 million households (in both Ethiopia and Sudan) can access affordable and reliable electricity.

Apart from improved reliability of supply, Sudanese consumers have gained from lower tariffs of US$ 0.05 per kWh for imported electricity compared to US$ 0.096 per kWh from power generated domestically.

Improvements in reliability and security (due to comple¬mentary nature of the power generation systems of the two countries) of supply have enabled lighting of schools and homes, better access to social services, and greater opportunities for business development. Small- and medium-sized industries such as flour mills, rural water supply installations, tanneries and coffee processing plants are creating employment and contributing to poverty alleviation.

The role of ENTRO in the above project was among others, updating Environmental and Social Impact assessment Studies (ESIA) and Resettlement Action Plan (RAP). ENTRO facilitated resource mobilization for this construction as well as negotiation for Power Purchase Agreement, Construction Agreement and Operation and Maintenance Agreement. ENTRO was also Involved in the monitoring of implementation of the ESIA and RAP studies during the construction period. Other key benefits for Ethiopia are the ability to better integrate reserve capacities, and in the process improve reliability of supply on the interconnected system while saving capital and operating costs. In addition, more reliable and secure supplies have secondary benefits through lighting of schools and homes, better access to social services, and greater opportunities for business development. Small and medium-sized industries particularly flour mills, rural water supply installations, tanneries, and coffee processing plants are then better able to create employment and contribute to poverty alleviation.

## EASTERN NILE JOINT MULTI-PURPOSE(JMP) STUDY

Sudan took part in the landmark Eastern Nile Joint Multi-Purpose (JMP) Study which identified the Abbay/ Blue Nile sub basin as most suitable for cooperation among the three countries (Egypt, Ethiopia and Sudan) for joint large-scale transformational multipurpose win-win sub-basin cooperation in infrastructure development.

JMP identified the Abbay/Blue Nile sub-basin as most suitable for cooperation among Egypt, Ethiopia, and Sudan on joint large-scale transformational multipurpose sub-basin cooperation in infrastructure development from which each country could derive benefits. Even though the JMP did not result in implementable projects as initially envisaged, the study nevertheless yielded two useful working papers,:

1. Paper #1: 'Environmental and Social Perspectives on Blue Nile Multipurpose Development' and
2. Paper #2: 'Strategic Options Assessment for Blue Nile Multipurpose Development'.

These studies have become the foundation for the ongoing Eastern Nile dam safety and coordinated operation of dam cascades studies, critical for ensuring the safe and optimal operation of over 30 large and small dams located across the Eastern Nile in the three countries.

Building on these studies, ENTRO has been advancing preparation for Eastern Nile Basin cooperation from which Ethiopia is benefitting.

**Project goal**: - is to contribute to transformational and sustainable socio-economic development, economic integration, and stability in the EN region. A more immediate development objective of the JMP is to undertake cooperative and sustainable development and management of the shared Blue/Main Nile water resources.

**Project Description**: - Move from single sector/or unilateral to multipurpose program.

**Project Objectives:** - undertaken cooperative and sustainable development and management of the common Blue/Manin Nile water resources through the JMP-1 project, putting in place the requisite transboundary institutions: linking the three countries thru multipurpose storage and power system infrastructure: improving watershed and flood plain management: modernizing irrigation system, promoting related investment (eg. in transport, private sector, rural electrification, etc) and to define JMP more closely and to enable identification of the first set of investments within a broader joint multipurpose program.

**Beneficiaries:** - Scoping study completed. 2 working papers; Working paper 1; Environmental and social perspectives on Blue Nile Multipurpose project development. Working paper 2; strategic option s assessment for Blue Nile Multi-Purpose development

The JMP included:

. "**One System Inventory**", which established a 'no-borders' database of natural. resources and information across the Eastern Nile sub-basin.

. An independent **Scoping Study** that examined water resources matters to broadly assess. development options in the basin, which would fulfill JMP criteria.

The preparation of **Thematic Papers** on "Financing and Implementation Arrangements" and on "Institutional and Broad Legal Considerations".

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## BARO AKOBO SOBAT MULTIPURPOSE WATER RESOURCE DEVELOPMENT STUDY (BASMWRDS) THREE SHORT TERM PROJECTS

**Project Description**: - A study launched to assess the water resources in the sub basin and explore the opportunities for optimal management and development. Project has an area of 186,000 km square.

**Project Objective**: - To enhance water resources planning and management capabilities in the sub basin through preparation of water resources development plan and projects that respect social, economic, and environmental integrity.

**Beneficiaries**: - Study Completed. Three short term feasibility study projects completed. 9 medium term and long-term projects identified, and 3.6 million Peoples are beneficiaries.

Key Study Output

. **Integrated Water Resources Development and Management Plan (IWRDMP)** for the sub-basin: The purpose of the plan is to promote socio- economic development in the basin through implementation of a certain number of projects. The Plan also includes a communication Strategy, Monitoring and Evaluation and a framework for adaptive management.

. **Strategic Social and Environmental Assessment (SSEA)**. The SSEA has guided the elaboration of the plan, it has screened the potential projects and assessed their cumulative impacts (environmental and social; positive and negative) to maximize benefits and minimize negative impacts of development in the basin. The main purpose of the SSEA is to inform strategic decisions at the river basin scale. The role of stakeholder consultation has been prominent throughout the process.

. **Three feasibility studies aimed at fast-tracking priority short term projects:**

i. The Kinyeti River multipurpose project (South Sudan)
ii. The Majang multipurpose project (Ethiopia)
iii. The Akobo-Gambella floodplains transboundary development program (Ethiopia and South Sudan)

Terms of reference for feasibility studies and Environmental Impact Assessments for three larger (medium and long-term duration of implementation) projects.

## GROUND WATER

# GROUND WATER AVAILABILITY AND CONJUNCTIVE USE ASSESSMENT IN THE EASTERN NILE

**Source of Finance for the Assessment:** Under its Nile Cooperation for Result (NCORE) Project

**Scope of the assessment:** the assessment was conducted in the Eastern Nile (EN) Region and covered EN five river sub-basins of Abbay - Blue Nile, Tekkeze - Atbara, Baro - Akobo - Sobat - White Nile and the Main Nile.

**Key objectives:**

- To make assessment of the existing and readily available knowledge of groundwater resource potential in the Eastern Nile that includes characterization, mapping, recharge and safe yield;
- Using already existing information to initiate the establishment of a comprehensive groundwater date base in the Eastern Nile. This data base can further be expanded as more data and information become available;
- Harmonize groundwater monitoring practice between Eastern Nile countries;
- Start a process to initiate and facilitate future inclusion of groundwater considerations into national and transboundary Eastern Nile water resources planning and management activities; and,
- Establish a common understanding of groundwater policies, institutional issues, data and capacity gaps in the Eastern Nile riparian countries.

**The outputs of the assessment:**

The Eastern Nile basin is underlain by four major categories of aquifers. The basement rock aquifers occupy 30 % of the basin area, most of which is exposed in arid areas of Sudan and Egypt. The consolidated multilayered sedimentary rock aquifer covers 24% of the surface area of Eastern Nile basin but contains one of the most prolific aquifers with very big storage. The multilayered unconsolidated sediments, occupying 34% of the basin areas is the most exploited aquifer for irrigation water use in Sudan and Egypt. Volcanic rock aquifers cover 12% of the basin area, wherby 80% of the volcanic aquifers are confined within Ethiopia. More than 30 individual aquifers have been identified in the Nile Basin. Out of these the following are found to be the most prominent aquifers both by their aerial extent and the ground water potential

- The Nubian Sandstone Aquifer in Sudan
- The Umm Ruwaba multilayered unconsolidated aquifer in Sudan and South Sudan
- The Nile Valley unconsolidated loose alluvial sediments in Egypt
- The Nile Delta multilayered loose alluvial sediment in Egypt
- The Baro Akobo unconsolidated alluvial sediment, including Alwero sandstone in Ethiopia
- The Gezira formation in Sudan
- The Upper Basalt Volcanic aquifer in Ethiopia.

The assessment also revealed that the Eastern Nile contains, several geologically/geographically distinct groundwater basins (whose boundaries doesn't necessarily coincide with the present-day Eastern Nile Surface Water Basin) with enormous groundwater storage and potential. Most of these groundwaters basins, not all, are bounded within old, now buried Mesozoic rifts. The basins contain multilayered aquifers.

The most prominent ones are:

- The Blue Nile Rift groundwater basin, occupying 76,000 km2
- The White Nile Rift groundwater basin, occupying 100, 800 km2 (encompassing the East Korodfan basin)
- The Nile Nubian and the Sharan Nubian Sandstone groundwater basins, collectively encompassing 246,000 km2 area in Eastern Nile basin of the Sudan
- The Bahr El Arab Rift groundwater basin, occupying more than 500,000 km2 (but with ill-defined boundary and encompassing the Baggara and Sudd groundwater basins)
- The Nile Delta groundwater basin, occupying just 20000 km2 but with groundwater storage of 200-billion-meter cube
- The Gadaref groundwater basin in Sudan, 22, 000 km2
- The Atbara groundwater basin, 32,000km2
- The Lake Tana groundwater basin, 12000 km2.
- The Baro Akobo groundwater basin, with storage potential of 200 billion m3

The assessment identified area under groundwater-based irrigation currently exceeds 367,000 ha., out of this 227,600-ha irrigation is happening in Egypt, 135,000ha in Sudan and 5000 ha in Ethiopia. In Sudan the potential for groundwater irrigation stands at nearly 1.4 million ha. Given high groundwater storage there is huge prospect for expanding groundwater-based irrigation in Sudan, South Sudan and Ethiopia.

| Country | Annual renewable groundwater resources, Million Cubic Meter/yr | Total groundwater storage including fossil groundwater [BMC] | Annual groundwater withdrawal Million Cubic Meter/ yr | Area of land under groundwater irrigation (ha) |
|---|---|---|---|---|
| Egypt | 4600* | 200,000*** | 8045 | 227,600 |
| Sudan | 3000 | 6000 | 2456 | 135,000 |
| Ethiopia | 28300 | 1800 | Negligible | 5000 |
| South Sudan | 4000 | 2035 | 100 | Negligible |
| **Total** | 35,300** | 210,000 | 10,500 | 367,000 ha |

**Summary of Output of the Study:**

1. Development of Database of EN Ground Water with their Potentials and their analysis
2. Development of GW Monitoring System for further consideration by Member Countries.
3. Develop Indicative EN Ground Water Atlas.

**Countries benefited from the assessment:** Egypt, Ethiopia, South Sudan and Sudan.

## EASTERN NILE WATERSHED MANAGEMENT PROJECT

**Objective:-** To establish a sustainable framework for the management of selected watersheds in the sub-basin to improve the living conditions of the people, enhance agricultural productivity, protect the environment, and reduce sediment transport and siltation.

**Project Goal:**-Provide enhanced support (to facilitate investment) for the sustainable management of the Eastern Nile sub basin.

**Beneficiaries:**-the following watershed management projects has been implemented in the three countries: Upper Rib, Upper Gumera, and Jemma (Ethiopia); Dinder, Ingasena, Lower At- bara, Lau (Sudan) and Lake Nasser-Nubia (Egypt).

**Project Description:** -The ENWSM Project has built a significant degree of experience in the analysis, identification, and preparation of watershed interventions from a transboundary, basin-wide, hydrologic-unit perspective. A regional knowledge base in the form of the CRAS has been established. Fast track projects worth about USD 80 million, which have piloted important regional approaches to watershed management, are implemented. The area of cultivated land whose use is unsustainable is estimated at 4.7 million ha. ENTRO initiated and implemented WSM as a fast truck project from 2004 - 2015 at various levels.

Towards meeting its objective, the Watershed project undertook two sets of activities in parallel between 2004 -2008:
I) Regional Cooperative Assessment (CRA) study for watershed Management and
II) Preparation of investment ready projects for national implementation (fast track projects).

**Status:** - Both sets of activities were successfully completed.

**Eastern Nile WSM CRA Study:** - The CRA study is geared at enhancing the understanding of benefits and costs accruing to WSM projects across the sub-basin's countries and assessed transboundary Analysis of WSM interventions.

**Investment projects preparation:** - Investment projects prepared for Egypt, Ethiopia, and Sudan. Implementation of WS Investment projects.

**Project's achievement and its benefits:**

Apart from enhanced shared understanding and commitment between Sudan and Ethiopia about the watershed problems affecting the two countries, the Eastern Nile Wa¬tershed Management (ENWSM) project, an ENSAP Project, has enabled joint action.

Consequently, the Eastern Nile Watershed Management (ENWSM) has resulted in the following:

A) Rehabilitation of 27,000 ha of degraded agricultural land. As a result, farm yields for dominant crops have shown significant improvement, with sorghum yields increasing from a baseline 519 kg/ha to 1,249 kg/ha in Dinder and from 1,249 kg/ha to 3,391kg/ha in Atbara. Similarly, sesame yields increased from 202 kg/ha to 336 kg/ha in Dinder and white bean yields from 887 kg/ha to 2,480 kg/ha in Lower Atbara.

B) Over 300 km of livestock routes have been mapped, demarcated and opened for pastoralists, reducing cattle transit conflicts.

C) Over 5,010 ha of rangeland have been reseeded with nutritious and soil rehabilitating varieties of fodder. Fodder production has been initiated in 24 villages
Under the Eastern Nile Watershed Management project, a new round of investment projects will benefit 185,000 people in Tilkuk and 120,000 people in Atbara.

## ENTRO CONDUCTED EN IRRIGATION SYSTEM PERFORMANCE ASSESSMENT AND OPTIONS FOR IMPROVEMENT STUDY

**The Objective of the Study:**
to guide national and regional water resources developments planning through the development of comprehensive picture of the current situation and base of the irrigated areas, their water use and the irrigation technology with a view of having a better knowledge of existing irrigation developments in the Eastern Nile.
The study comprises three main components:
**(1): Scoping and Situation analysis**
**(2): Development of Preliminary Options for Improvement**
**(3): Regional validation and consultation and capacity building workshop:**
The output of the study Includes:

1. Update of Irrigation database of the EN region
2. Identification and compilation of Irrigation technologies used in the Region
3. Preliminary assessment result of the performance of Irrigation Schemes in the Region.
4. Proposal/Options for improvement of Irrigation Technologies and their water use in the Region.
5. Review, Validation and Capacity building events.

**Status**: - The study completed.
**Beneficiaries Countries**: EN Countries.

The Eastern Nile Irrigation and Drainage Studies Project supports the development and expansion of irrigated agriculture as well as strengthening the productivity of existing small- and large-scale agriculture through improved agricultural water use. At least 50,000 people will benefit from 7600 ha (plus 107,000 ha in other areas) under the Wad Meskin irrigation project.

## IMPACT ASSESSMENT OF EASTERN NILE WATERSHED INTERVENTIONS FOR SCALING UP

***Watershed area before Intervention*** ***planted and protected 3yrs after Intervention***

*Watershed area before intervention* *planted and protected 3 yrs after intervention*

ENTRO conducted EN Impact Assessment of Eastern Nile Watershed Interventions for Scaling up from 2018 – 2019.

**Objective of Study:**

1.To assess the biophysical, institutional and the socioeconomic-livelihood improvements consequent upon selected project interventions and identify factors accounting for the impact

2. To Identify and eventually select most viable best practices that yield demonstrable positive results for scaling up to larger watersheds and sub-basins

3. In collaboration with the regional consultant, organize national workshops to present and deliberate on the findings

4. In collaboration with the regional consultant, organize national training on Scaling up and the need/value of mainstreaming safeguards in watershed management projects.

**The study focuses on Impact Assessment for Scaling up**

- Identification of Institutional, Socioeconomic/livelihood and Biophysical Impacts on Watershed Management Projects in Ethiopia and Sudan.
- Development of M&E Manual
- Capacity Building

**Output of the study**

- The impact assessment report of Implemented water shade management Projects in Ethiopia and Sudan
- Development of M&E Manual
- Training on the Developed Manual

**Beneficiaries Countries**

- EN Countries (Ethiopia, South Sudan and Sudan)
- Status: - completed.

## ETHIOPIA-SUDAN (RABAK)- EGYPT(NAGE HAMADI) REGIONAL TRANSMISSION

The Eastern Nile Power Trade Studies proposed the Eastern Nile Regional Transmission Line, connecting the grids across Ethiopia, Sudan and Egypt and has the potential to enable the country to generate up to USD 600 million per year from electricity exports. Under this study the Rabak-Nage Hamadi Transmission Line was identified.

After the identification, the Feasibility study for the Ethiopia-Sudan (Rabak) – Egypt (Nage Hamadi) power interconnection has been completed. The study covered Ethiop-Sudan 1,200 MW or 9,200 MWh/yr and Ethiopia- Egypt 2,000 MW or 7,700 MWh/yr interconnections that will facilitate import and export of power between the three countries.

## 1,750KM2 FLOOD PREPAREDNESS/EARLY WARNING PROJECT

The Eastern Nile Flood Preparedness and Early Warning Project-
Phase 1: established the National Flood Forecasting Centers in Sudan and Ethiopia and has completed flood risk mapping over 1,750 km2. At least 50,000 people benefit directly and another 500,000 indirectly from these project interventions including people from 107 flood-prone communities.

Phase II of the project focused on capacity development in flood risk management and national level technical and institutional strengthening, including thru provision of equipment and training, as well as covering new areas such as in the Tekeze-Seitit sub-basin. For over seven years now a 72-hour time lag flood bulletin has been issued to National Centers and relevant authorities, including in Su¬dan, during the three month-flood season forecasting and early warning thus enhancing preparedness.

In 2006 it was decided to phase the implementation of FPEW with two phases, with the first phase – FPEW I – focused on building the institutional capacity and developing critical baseline information to enhance the readiness of EN countries to implement subsequent FPEW phases. While second phase – FPEW II – focuses on the structural measures and up-scaling of the pilot interventions

FPEW Phase I has successfully completed in 2010. The first Phase of the FPEW project; FPEW I delivered a platform for institutional settings and data/information collections/sharing at community and national levels, together with enhancing regional coordination and cooperation with the recommendation for the follow-on the subsequent phases (FPEW phase II).

The proposal of FPEW II has evolved from national and regional consultations to focuses on the structural measures and up-scaling of the pilot interventions. The project proposal, prepared by an international consulting firm, was finalized in 2007 and distributed to different stakeholders and donors to secure funding. Though funding was not secured to work on FPEW II, after the completion of FPEW I project ENTRO initiated with Eastern Nile countries and created a regional Flood Forecast and Early Warning (FFEW) system under the Eastern Nile Planning Model project (ENPM) and the FFEW activity continued under the current Nile Cooperation for Result project (NCORE). The FFEW, has been an important part of ENTRO's activity that continuously been conducted since 2010 for every flood season (June-September). The FFEW has helped the Eastern Nile countries in reducing the loss of life and money by preparing flood forecast.

The Flood Preparedness and Early Warning (FPEW) fast-track sub-project was among the seven projects identified within IDEN. The project gave emphasis to regional coordination, pilot flood preparedness and Emergency response and flood forecasting, warning and communication systems with three parts.

**Part A - Regional coordination:** Strengthening regional coordination, through (i) establishing a Regional Flood Coordination Units, responsible for managing and implementing day-to-day implementation of the project (now established at ENTRO); enhancing regional cooperation in flood forecasting and management matters, and assisting in the strengthening of national flood warning systems; (ii) conducting annual flood forums to facilitate sharing of experiences among

- Primary direct beneficiaries from early warning and risk maps estimate were :

- 8 flood affect pilot communities around Lake Tana areas in Ethiopia (> 500,000 people) and
- 8 pilot communities living in the floodplains of the Blue Nile, Main Nile and Atbara rivers in Sudan (> 1 million).
- Capacity building - training: beneficiaries: 500 flood affected communities.
- Early warning messages reached roughly 150,000 vulnerable people in flood season in Ethiopia and 200,000 in Sudan

- Enhanced regional collaboration.

**Status (Start date, level of progress, end date)**

- Strat date: May 2007
- Progress: completed
- Completion Date: December 2010,

# MULTI SECTOR INVESTMENT OPPORTUNITY STUDY (MSIOS)




The Eastern Nile Multi-Sector Investment Opportunity Analysis (EN-MSIOA) study is one of several specific studies being undertaken to achieve the general objective of the NCORE in EN. A closer look at the water resources development plans of individual countries indicates that those developments will face both positive and negative externalities which ideally require a new approach of adaptive management and sustained cooperation among the Eastern Nile riparian countries. Thus, the EN-MSIOA study is aiming to develop a regional water investment strategy for the EN region that broadly supports socio-economic development, poverty reduction, and the reversal of environmental degradation.

A multi sector investment opportunity assessment (MSIOA) is thus needed to identify a coordinated water infrastructure investment strategy for the EN, comprised of prioritized water-related investments (regional or national with regional significance), that promotes shared, sustainable economic growth and development in the EN region.

**Project Description:** - An assessment focused on identifying a coordinated water resources investment strategy that promotes shared understating, economic growth in EN.

**Project Objectives**: - The overall objective is to develop a regional water investment strategy for the EN region that broadly supports socio-economic development, poverty reduction, and the reversal of environmental degradation.

. Sustainable management of common EN water resources.

. Cooperative investment planning that considers the water scarcity of the basin and the social, and the environment. And the economic implications of such investments.

The study is divided into four (4) main tasks, namely:
Task 1: Inventory and Situation Analysis;
Task 2: Strategic Scoping of EN Multi-Sectoral Investments;
Task 3: Multi-Sectoral Analysis of Investment Opportunities; and
Task 4: MSIOA Final Products. The deliverables and activities under the MSIOA study include the following categorized under each task.

**Task 1: Inventory and Situation Analysis Task:**

- The inception report of the MSIOA study has been submitted. ENTRO engaged EN stakeholders to comment on the report and the final version of the report has been submitted incorporating the comments,
- Baseline mapping of physical resources (climatic, hydrologic, geographic, socio-economic, environmental, etc…),
- The inventory and characteristics of existing water resources management and development projects and potential investment options (soft and hard investments),
- An overview of the water resources of the eastern Nile basin and the catchment characteristics of each sub-basin,
- A sectoral review aimed at providing the necessary background and identifying the various development and management projects, both existing and planned, especially those of regional significance,
- Assessment of major issues, hotspots, constraints/risks and opportunities,
- Identification of strategic economic, environmental and social issues relating to proposed investments based on project characteristics, locations, experience from similar projects, expert opinion, and rudimentary analysis,

ENTRO distributed the Situation Analysis (SA) report to different stockholders for their feedback and conducted a consultation workshop November 15-16, 2014. Methodology for the next step of the MSIOA study and identifying main indicator was also initiated during this workshop.

**Task 2: Strategic Scoping of EN Multi-Sectoral Investments report:**

The scoping of investments looked at the different types of interventions that may be considered and what sort of scoping criteria can be used to identify and evaluate potential interventions for inclusion in the MSIOA. Based on these criteria, a number of water resources development and management interventions under thematic and sectoral headings were briefly described and put forward for further consideration.

**Task 3: Multi-Sectoral Analysis of Investment Opportunities report:**

The Analytical Framework includes two core components; the EN Basin Simulation Model (ENBSM) and the Multi-Criteria Analysis (MCA). The ENBSM produces both water resources-related and socio-economic outputs which can be used together with other indicators in the MCA. These were used to evaluate a total of 12 basin-wide development scenarios looking into the impacts and benefits. "MSIOA- Scoping Consultation Workshop" was conducted in Addis Ababa in February 2015. The two deliverables (Task 2 and Task 3) were distributed to the EN stakeholders before the workshop. 34

**Task 4: MSIOA Investment Strategy and Action Plan**

The MSIOA team worked closely with ENTRO to incorporate feedbacks and update the reports and deliverables. The MSIOA Investment Strategy and Action Plan is the subject of this report. The Inves tment strategy is expected to guide decision-makers at the regional and national levels in deciding which projects should be excluded or included and what to be the priorities.

## IRRIGATION AND DRAINAGE DINGER IN WAD MISKEN IN SUDAN

The Project implemented in Ethiopia and Sudan. It has two components: An Engineering Sub-study; and Cooperative Regional Assessment Sub-study (CRA)
Engineering sub-study component has 3 phases:
Inception: the draft and final report were submitted in September 2007 and December 2007 respectively.
Phase 1: Diagnosis and planning of activities: resulted in identification and proposal of 15,000 ha to be studied at feasibility level.
Phase 2: Feasibility study of 7,500 ha gross in Ethiopia and 7,500 ha gross in Sudan, Project areas are Dinger Bereha in Ethiopia and Wad Misken in Sudan.
Phase 3. Detail Design/preparation of Projects which is completed in 2010.

# ONGOING PROJECTS

## IRRIGATION, FLOOD, DROUGHT RISK MITIGATION DAM SAFETY AND INTEGRATED WATER PROJECTS, PLATFORM FOR COOPERATION

## FLOOD AND DROUGHT RISK MITIGATION

### FLOOD RISK MITIGATION PROJECT

**Project Name**

- Nile Cooperation for Climate Resilience (P172848) – NCCR – ( 01-Mar-2021 to 28-Nov-2025)
- Component 3. Improving Mechanisms for Cooperation in the Eastern Nile (ENTRO - US$9.5 million).
- Flood and drought risk mitigation (US$1.0 million)

**Project description**

**Enhancement of Riverine FFEW system for the EN region.** The focus of the project has been forecasting riverine floods. Building on the FFEW system developed through NCORE, this activity has enhanced the reliability of the FFEW system. (a) The existing FFEW system has been improved partly based on community survey and ground topographic survey conducted. (b) Building on an upgraded FFEW, ENTRO is supporting enhancement of national flood forecasting centers for the Nile countries.

**Background, location, nature, rationale/problem**

Nile river flood regularly impacts Nile countries livelihoods and economies and expected to increase due to climate change. Regular flood water is often causing tremendous damage to Ethiopia, Sudan and South Sudan, affecting more than a million people livelihood (displacement, asset losses, heath issues) every year; with > 500 MUSD risk of damage and > 100,000 ha farmland losses in the Eastern Nile countries.

In 2020 (17.43m) and 2006 (17.4m) were the twohighest floods that happened in the Blue Nile basin over the past 44 years, which resulted in increasing the runoff of the Nile as well as loss of properties and people. These floods impacted many communities causing ignificant human and agricultural losses (crops, seeds, fodder, pumps, stock, etc). Historically, the region has experienced severe floods in 1878, 1946 (17.1 m), 1988 (17.0m), and 1999. The 1988 flood combine with heavy storm in Khartoum (Aug 4, 210 mm/day) is still vivid in the memories of many people to the extent that it has become the benchmark for comparing flood levels and severity. Flood Preparedness and Early warning is one of the Eastern Nile Program to reduce human suffering and damages and works have started as early as in 2001 recognizing the need to mitigate flood with regional approach which requires joint action and cooperation.

## ENTRO has played a pioneering role in flood forecasting of the EN region in the last two decades.

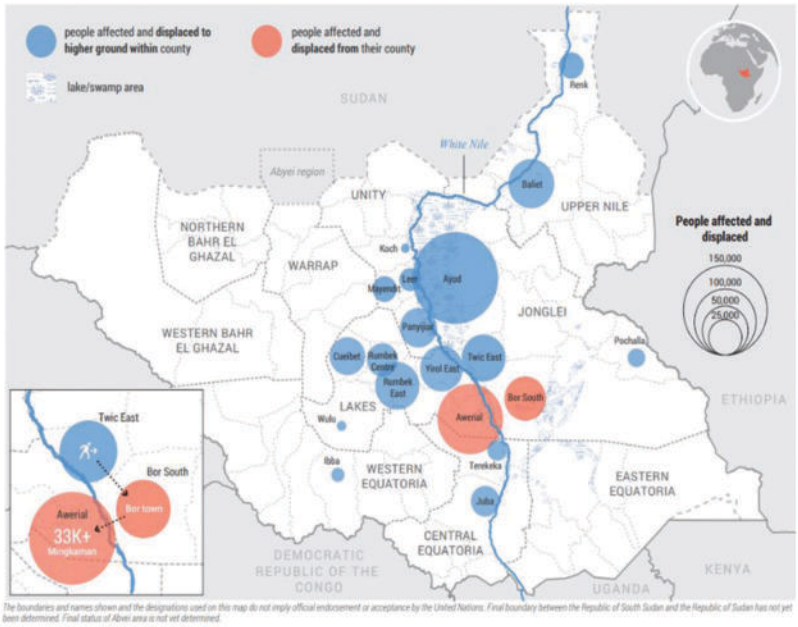
Upon ENCOM establishment of the regional flood coordination unit at ENTRO and the National flood forecasting centers in the three EN countries, the Eastern Nile – Flood Forecasting and Early Warning System (EN-FFEWS) has served as the only regional flood forecast tools utilized by national and local government, development partners, and other stakeholders through emails, text messages, and online bulletins since 2010. The flood reports are disseminated to the public through a range of channels, including in coordination with national flood forecast centers, through the ENTRO web portal, and email.

During peak flood season, a growing number of institutions at the subnational, national, and regional levels, including United Nations agencies, rely on daily forecasts generated by ENTRO to provide timely relief assistance. Among those at highest risk are subsistence farmers and livestock pastoralists who are exposed to more frequent and extreme floods with the onset of climate change.

Approximately 350,000 people across the region receive early warning messages during the flood season and daily alerts in flood-prone areas, while 1.7 million more people across the region benefit indirectly from these alerts and messages.

Technical capacity of national governments has also been enhanced through FFEW training programs.

South Sudan has been experiencing severe and recurrent flooding, particularly in recent years. The floods have had devastating impacts on communities, infrastructure, agriculture, and overall economic stability. Large parts of South Sudan, including regions such as the Sudd wetlands, are low-lying and highly susceptible to flooding, especially during the rainy season. The riverine floods are caused by the White Nile (much influenced by Lake Vitoria level rise), river Bhar El Gazal, and Baro-Akobo-Sobat-river its tributaries frequently overflow, exacerbating the flood situation.




The boundaries and names shown and the designations used on this map do not imply official endorsement or acceptance by the United Nations. Final boundary between the Republic of South Sudan and the Republic of Sudan has not yet been determined. Final status of Abyei area is not yet determined.

**Project Objective**

The overall the NCCR project objective is to improve mechanisms for cooperation on water resources management and development in the Nile Basin. Specifically, is to improve enhanced service for preparedness against flood and drought risks through provisions of flood and drought forecasting. This work will directly contribute to improved national capacities to accommodate the impact of climate variability, which is the core element of climate-resilient water resources management. Strengthening regional information systems, tools and plans for flood and drought risk mitigation, including enhancing the regional flood forecast and early warning system and developing a drought monitoring system.
Salient features of the Flood and Drought Risk Mitigation project of the NCCR are given in subsequent sections.

**Flood Risk Mitigation sub-project includes three Work Packages:**

**A) Work Package 1** - Surveying and Data Collection (topographic, infrastructure, socio-economic) works conducted regarding including:

- Collect terrain datasets of flood prone areas,
- Compile historical hydro-meteorological datasets,
- Determine key characteristics of flood prone communities, and
- Validation and dissemination workshop was conducted from 9-11 August 2023 in Juba, South Sudan.

**B) Work Package 2** - Enhancement of the Eastern Nile Flood Forecasting and Early Warning System and Flood Risk Mapping (consultant DHI). The project will be completed in July 2024.

- Enhancement of the EN-FFEWS has been made. Presently flood hazard assessment and flood extent mapping is being produced with later activities on flood vulnerability assessment, flood risk assessment, and flood impact assessment. Capacity building at national and regional level, and validation and dissemination workshop (11-13 February 2024) have been planned.

**C) Work Package 3** - Support in Establishing Flood Community Awareness and Preparedness with the following activities undergoing and to be completed in December 2024:

- Develop Flood Management Strategies for Flood Prone Communities awareness and preparedness.
- Develop Flood Community Awareness and Preparedness Plan.
- Develop Implementation Plan
- Develop Local Interventions for Flood Protection

**Benefits/Expected Benefits/ Beneficiaries**

The key Benefits of the ENTRO Flood Forecast and Early Warning program are Enhanced Flood Resilience and Preparedness, Improved Water Resources Management through capacity building, **Economic, Social, Community** and Environmental and Regional Cooperation and Integration.

**Enhanced Flood Resilience and Preparedness:**

Early Warning Systems: The developed early warning systems significantly improved the ability of communities and authorities to prepare for and respond to flood events. This has led to reduced loss of life and property damage.

Flood Risk Mapping: Mapped flood-prone areas and generating flood risk maps provided crucial data to inform infrastructure planning and emergency response strategies. Flood Risk Mapping was done 2010 (Lake Tana and Khartoum flood prone areas) and in 2024 (BAS, TSA, Lake Tana and Blue Nile flood prone areas).

**Improved Water Resources Management through capacity building:**

ENTRO contributed to institutional capacity building by providing flood forecasting and early warning system (EN-FFEWS model), training and capacity-building programs for national flood forecasting centers of Ethiopia, Sudan and South Sudan and flood affected communities to enhance their ability to prepare and manage flood-related challenges effectively.

**Economic Benefits:**

The early warning system of EN-FFEWS has protected livelihoods by reducing the adverse impacts of floods on agriculture and other economic activities of communities residing in the floodplains and surrounding areas.

Improved flood management has helped safeguard critical infrastructure such as roads, bridges, and irrigation systems, reducing repair and maintenance costs.

**Social and Community Benefits:**

Early warning systems and better-prepared institutions by creating flood awareness and preparedness have contributed to safer communities in Ethiopia, South Sudan and Sudan, reducing the trauma and disruption caused by floods.

**Regional Cooperation and Integration:**

The flood risk mitigation project fosters cooperation between the Eastern Nile countries (Egypt, Ethiopia, South Sudan, and Sudan), enhancing collaborative water resource management.

Through joint efforts and shared resources, the project strengthens the collective capacity of the region to manage flood risks and other water-related challenges.

In summary, The ENTRO Flood Forecast and Early Warning program offers a comprehensive set of benefits that enhance flood resilience, protect livelihoods, and promote sustainable development in the Eastern Nile region. By integrating advanced early warning systems, institutional capacity building, and creating community awareness, the project has created a safer and more better livelihood for the communities it serves as compared to the baseline (without the project).

**Sector:** Climate Risk management

**Funding source, Budget and amount/MUSD**

2021-2025 - 1.0 MUSD

**Status (Start date, level of progress, end date)**

Strat date: 01 March 2021

Progress is 70%

Completion Date: 28 Nov 2025

# DROUGHT RISK MITIGATION PROJECT

*Smart Water Magazine*

**Project description.**

Development of Nile Basin-wide drought risk early warning system (Nile DEWS) has been undertaken by ENTRO since Jan 2022 after establishing drought need assessment. Nile-DEWS is building on the pilot drought dashboards developed by Princeton Climate Analytics and DHI group respectively under NCORE and utilizing the recent development in EO and drought impact ground data.

To develop a comprehensive basin-wide drought forecast system that serves decision-making at both the national level and community level, ENTRO assessed the developed pilot dashboards and collect feedback from Basin countries and identified the required functionality. Assessment of historical drought records is being conducted to identify drought-prone areas across the Basin. The drought forecast system (Nile -DEWS) is based on a multi-model weighted ensemble and statistical model that are coupled with a hydrological model to forecast both climatological, hydrological and agricultural droughts. In addition to online drought forecasts, which will be updated continuously, publication of periodic bulletins that summarize the estimated drought impact on each country is a potential service to be provided through this project.

Necessary capacity development training is being undertaken to understand the basic nature of drought, how to interpret the drought forecast system, and necessary measures to mitigate drought hazard for national governments in parallel with development of the forecast system.

Drought Monitoring and Early Warning System aimed at detecting the *onset* of drought conditions can facilitate *timely* and *effective* responses that *enable* government, organization, farming, pastoral, urban communities and individual *to respond* rapidly and effectively:

- Pastoral – stocking feed, gov early buy livestock at good price, pre-positioning water, …
- Rainfed cropping - supplying drought resistance seed; on farm water conservation, gov. lend cash to farmers, ….
- Government - early procurement of food items (nationwide) …
- Reservoir operators – working out the details of water rationing and saving mechanisms

**Background, location, nature, rationale/problem.**

Drought – adversely affects food and water security – causes serious issues for the stability of broader social and environmental systems. The Nile region is known to be prone for extreme climate event like flood and drought. Successive years of low and erratic rainfall have left large are of the basin in severe drought that cause in crop failure, water storage and has raised serious food security in the region. Although the period from 1950 to 1988 saw 18 droughts some leading to serious famines with the worst was during 1984-5. The drought in late 2015 caused by an El Nino weather phenomenon that disrupted rainfall patterns in East Africa with 8 million people put on the Government's Safety Net program. In 1913-14 were worst droughts in recorded history, while dry years in 1979-84 coincided with the drought in the Sahel that extended to Ethiopia and the Sudan resulting in dramatic drop of the Nile flow causing great suffering.

**Project Objective**

The main objective is to develop, enhance and operationalize the drought early warning system inclusive of monitoring and forecasting components (DEWS) for the Nile basin as well as strengthen the capacity of Nile basin centers and Nile basin countries in drought early warning systems.

**Expected Nile DEWS benefits.**

- Advance joint development of basin-wide drought forecast models, information dissemination platforms, and capacity building.
- Through drought early warning mitigate the drought impact on agriculture, water supply, and environment.
- Enhance regional Nile wide collaboration.
- Improve stakeholder awareness of and preparedness for drought risks.
- Build capacity on drought early warning modelling system, and use of drought early warning information.

Robust Nile DEWS will offer several benefits through early detection and preparedness and action and contribute to better decision-making during drought events through:

- Early Detection: Drought forecasting provides lead time (from two weeks up to three months) for planners and decision-makers. Detecting drought conditions early allows for proactive (mitigation) and reactive (emergency) responses.
- Reduced Impact: By providing timely information to the relevant stakeholders, Nile DEWS helps minimize the risk of drought impacts on agriculture, water availability, and overall food security.
- Human Safety: Effective early warning generated from Nile-DEWS can mitigate human fatalities, health risks, and poor water and food security associated with droughts.
- Cost Reduction: Implementing Nile-DEWS reduces high costs related to post-drought rehabilitation and relief efforts.

**Sector**

Climate Risk management

**Funding source, Budget and amount/MUSD**

NCCR-WB - 0.45 MUSD

**Status (Start date, level of progress, end date)**

Strat date: Jan 2022
Progress: ongoing Firm consultancy work
Completion Date: May 2025.

**Benefited Countries:** NB Countries.\

## SKILLS-CAPACITY BUILDING

Capacity building of nationals in areas, including: scholar¬ships; internships; media training; negotiations training; project planning and management; Integrated Water Resources Management (IWRM); Decision Support Systems (DSS); expert working group consultations on ongoing studies (SOB, Wetlands studies; cascade coordination, watershed management; SSEA/ environmental and social safeguards, policies, upstream investment studies such as MSIOAs); knowledge-exchange study visits to RBOs, etc.

## HYDRO-DIPLOMACY

**Objective of hydro-diplomacy**

- Training National Negotiation Teams; Study Visits; provision of platforms for targeted stakeholders with potential to contribute to the peaceful resolution were undertaken by ENTRO.
- EN Hydro-diplomacy Dialogue Forum, EN Water Law Forum and EN Security Forum – Tana were among hydro-diplomacy work conducted by ENTRO.

**Countries Benefited:** Ethiopia, Egypt, South Sudan and Sudan

## MEDIA CAPACITY BUILDING:


*Media Training Juba, Sudan.*

Engaging the media, keeping them informed through robust communication and participation has been given due emphasis as one of the building blocks of Eastern Nile Basin. Thus, ENTRO partners with the media in the member States to raise awareness on the opportunities and benefits of Nile cooperation and the need for the EN countries to work together to address the shared challenges, risks, and threats. This was done in line with The NBI Communication and Stakeholder Engagement Strategy 2018-2023 identifies and prioritizes the media among NBI's key stakeholders, whose support deemed critical to the successful attainment of the NBI Shared Vision Objective. To this end:

- Tailored media training targeting communication professionals from Egypt, South Sudan, Sudan and Ethiopia conducted with funding support obtained from the German Government thru GIZ (FA).
- Under NCCR project (ongoing since 2021) two rounds of media training conducted and training engaged journalists working in different media outlets (from Ethiopia, Egypt, South Sudan and Sudan) ENTRO management and Staff, and ENSAPT ladders. Overall participants capacitated though program.

**Countries Benefited:** Egypt, Ethiopia, South Sudan and Sudan

## INNOVATIVE STAKEHOLDERS FORUM:

The main objective of this forum is to engage five critical Eastern Nile Stakeholders – the Faith Community (mainly of the two predominant faiths Christian and Muslim), Hydropower/Dam operators and Ex-Diplomats (who have good knowledge of the Nile issues), media house owners, parliamentarians to promote all-inclusive Eastern Nile Cooperation and avoid or at least minimize misunderstanding and mistrust that hinders the shared vision.

Under NCCR project (ongoing since 2021) two rounds of innovative stakeholder's forum conducted and the forum engaged Eastern Nile Stakeholders (from Ethiopia, Egypt, South Sudan and Sudan), ENTRO management and staff and ENSAPT ladders. Overall --- participants attended and exchanged information on the status of Nile Cooperation and benefits gained through investment in EN.

# INTERNSHIP AND YOUNG PROFESSIONALS PROGRAM

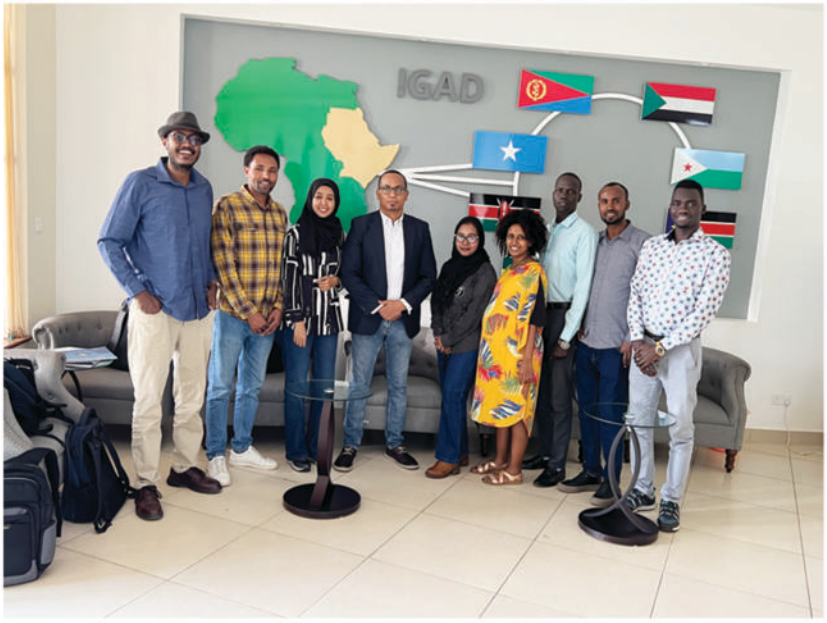
## 1. Background

ENTRO has taken the initiative to establish the Internship and Young Professional program as part of its core activities and successfully implemented in the last 12 years. The internship program started in December 2011 when ENTRO worked with the World Bank to modify the implementation arrangement of the Eastern Nile Planning Model (ENPM) project. This has helped ENTRO to engage the countries through partnership with scientific communities (Eastern Nile Universities) despite the political differences at the time.


*Interns During Filed Visit*

The internship program has proven popular in fostering cooperation and allowing ENTRO to expand its professional network. The program has also delivered results and proven proven more effective in terms of building regional capacity and bringing a diversity of expertise and outreach opportunities to ENTRO engaging the member countries through this unique and structured capacity development program. Up to now 25 different batches of the internship program have been implemented with the financial support from the World Bank under different projects such as Eastern Nile Planning Model (ENPM), Nile Cooperation for Results (NCORE) and Nile Cooperation for Climate Resilience (NCCR).

ENTRO internship opportunities is beneficial to the young professionals by providing them an exposure to working as team in a regional institute; working in a multi-cultural environment; develop a regional perspective for their work; learn new skills, tools, techniques, and methodologies; interact with other regional and international staff/consultants/interns; visits to water resources development projects and infrastructures; participate in a workshop and professional networking events; and contribute to the work of ENTRO in fostering and improve cooperation on water resources development and management within the Eastern Nile Basin.




*7th Internship Batch*

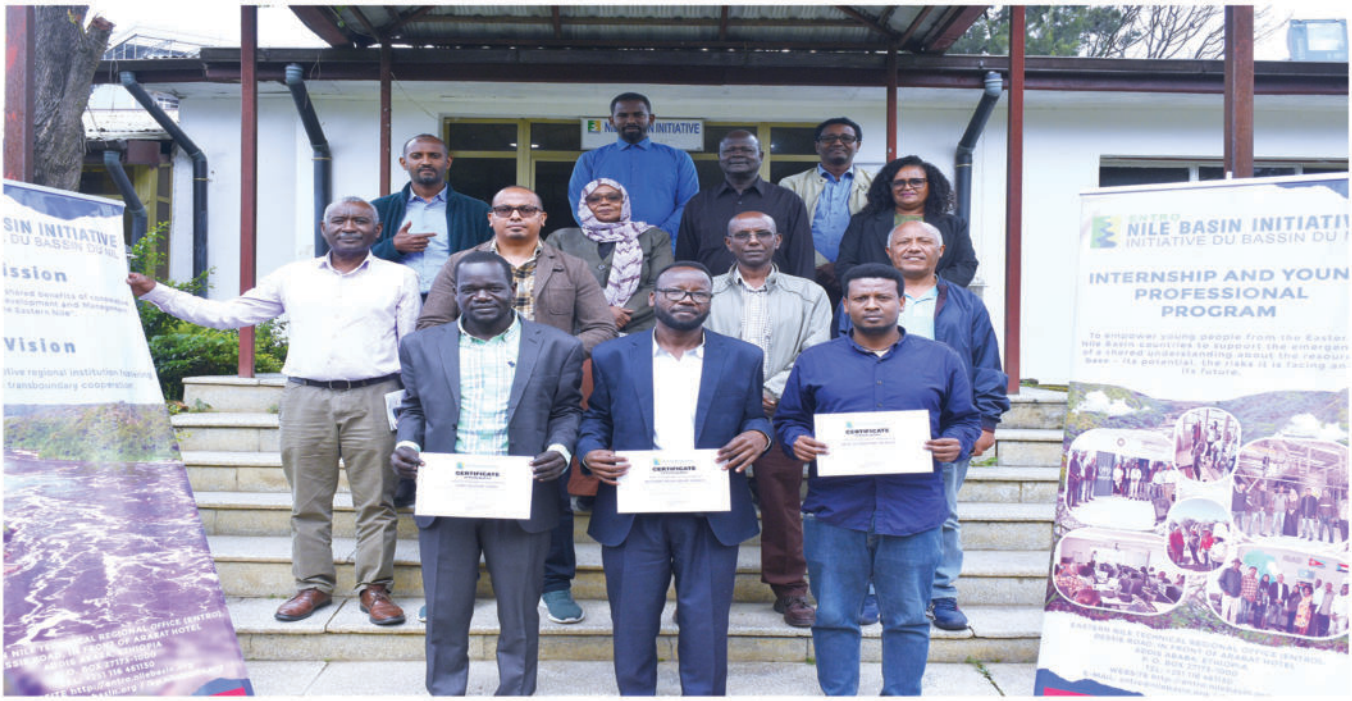
Interns from Egypt, Ethiopia, South Sudan, and Sudan have been enrolling under the ENTRO's Internship and Young Professional program. As a result, Eastern Nile countries did acknowledge the contribution of the program and recommended its sustainability and expansion. Considering the ever-increasing number of applications to enroll into the program and to meet the demands of learning new skills and knowledge, the program has been extended its reach outside academia to include Young Professionals from other government ministries (specifically water affair ministries), private sector, civil society, and other

## 2. OBJECTIVES

The Internship and Young Professionals (I&YPs) program at ENTRO has two overarching objectives to achieve in the transboundary water management and cooperation of the Eastern Nile Basin. These objectives are:

1) To Create a knowledge community among young professionals from the Eastern Nile Basin Countries to support/facilitate the emergence of a shared understanding about the Nile resource base its potential, the challenges it is facing, and establish enabling environment/platform for transboundary water cooperation.

2) To engage early career professionals in transboundary dialogue and trust building among relevant Nile Basin stakeholders to enhance cooperation, mitigate risks, and harness opportunities.




*8th internship Batch During Graduation*

## 3. PROGRAM CATEGORIES

There are four categories structured to implement the 3-months internship and young professionals' program at ENRO. These are:

**Category one: Regular Internship Program (for Interns)**

This category mainly engages young people from the Nile basin countries to work together in selected challenge that address water issues, as well as other water management issues at the basin level. This

category targets youths from disadvantaged contexts, who have ideas with the potential to improve water issues in the region, but who have not had significant training and/or funding opportunities before. The selection will strive for gender balance. ENTRO also build the capacity of those interns by giving them continuous training sessions and engaging them in different capacity building programs, field demonstrations, and workshops. This internship gives for the youth the chance to start their career and help them acquire better idea of what they want to do in the future.

*5th Batch*

**Category Two: Joint Studies (for Interns)**

This category aims to empower young leaders from the region to carry out joint studies by offering them the opportunity to work in different institutes in the basin in addition to NBI centres. The interns will be provided an intensive training program and mentoring support by senior level experts. This programme will bring young leaders capable of successfully designing sustainable and inclusive water projects that significantly improve living conditions of the Nile Basin communities, while supporting the Nile Basin cooperation. This new component of the internship program will be coordinated directly by ENTRO, and the joint studies will be done cooperatively with different EN institutes.

**Category Three: Flood Management Team-FMT (for Young Professionals):**

This category is periodic engagement of young professionals for Eastern Nile Flood Management and Forecasting activity. This is one of the activities that ENTRO initiated as a regional cooperation effort coordinated by the Eastern Nile countries. The program has been running for the last twelve flood seasons and created a system that links multiple stakeholders to work together to address flooding and reducing the risk of flood devastation. To support this program, ENTRO engage young professionals from Eastern Nile countries with previous experience in performing flood forecasting and early warning tasks and work together with ENTRO flood team.

**Category Four: Regular Young Professionals Program:**

This is the category where young professionals with some experiences are invited to fill some gaps of ENTRO by giving them specific tasks. While contributing to development and enhancement of knowledge and analytical tools, these young professionals also benefit by building their capacity, acquiring new skills and exposure on issues of the Nile basin.

## 4. THEMATIC AREAS

ENTRO built capacities of inters for the last 12 years with 25 batches of internship program implementation and given an opportunity to exercise and improve their technical capacities in multiple thematic areas which have relevance for transboundary water management and cooperations. The following are some of the thematic areas, but not limited to, where interns have been engaged:

- Flood and Drought Management
- Hydrological and Climate analysis and modelling
- Agriculture and hydropower development
- Environment and sustainability
- Water-Energy-Food-Ecosystem (WEFE) nexus
- Water information management system
- Watershed management
- Water governance, diplomacy, and Institutions
- Remote sensing and spatial modelling
- Data, toolkits, models development and application
- GIS and Remote Sensing (Spatial analysis and mapping)
- Dam safety and reservoir management.
- Groundwater potential assessment
- Climate change, etc

The internship program has been implementing using the above listed thematic areas and provided interns and young professionals an opportunity to engage or participate in the form of Assessment (Case study), Tailor made capacity development trainings, and Field visits demonstration (for practice). This approach permitted ENTRO to provide to interns to have first-hand knowledge and be on track to become an expert in the Nile Basin water management issues.


*6th Batch*

## 5. RESULTS

### 5.1 Overall Program Implementation

Since the start of the internship program at ENTRO in 2011, 25 batches of internship batch have been implemented that enrolled 216 interns and young professionals from the four countries of the Eastern Nile. These are Egypt, Ethiopia, South Sudan, and Sudan. The program was financed by the World Bank through three projects namely ENPM, NCORE, and NCCR. The following summary shows the overall implementation results of the Internship and Young Professional program since its commencement.

Table [1]: Total number of ENTRO Interns

| Implementation Years | Projects | Total Number | Gender | | Country | | | |
|---|---|---|---|---|---|---|---|---|
| | | | Male | Female | Egypt | Ethiopia | South Sudan | Sudan |
| 2011-2024 | ENPM, NCORE, NCCR | 216 | 166 | 50 | 20 | 89 | 44 | 63 |

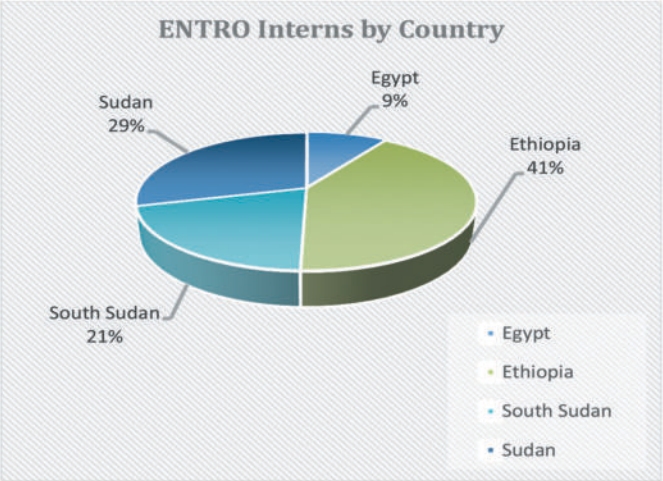



Figure [1]: ENTRO Interns by Country

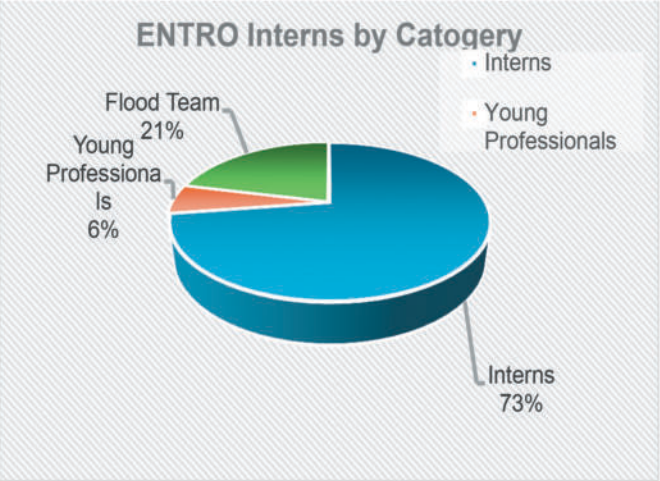



Figure [2]: ENTRO Interns by Category

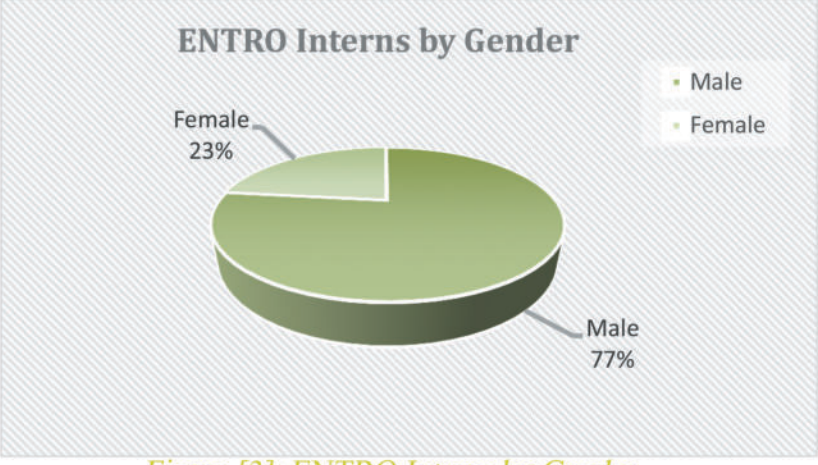



Figure [3]: ENTRO Interns by Gender

### 5.2 Countries Benefit

The internship and young professional program have supported member countries in terms of building capacities of early and mid-career professionals with contemporary knowledge and skills that are necessary for the transboundary water resources management in particular and water sector in general. On the other side, ENTRO has also benefited through the program in terms of obtaining new datasets, information, and toolkits which have been generated by Interns. Moreover, the program has significant impact on increasing the number of water professionals' network across the Eastern Nile region in addition to the technical capacity development. Most of the Alumni interns who have attended ENTRO's internship and young professional program are currently working in water affair ministries, water research centers, universities, and the private sector in their respective county as well as in regional and international organizations such as NBI, World bank, etc.

*4th Batch During Filed Visit*

## *DAM SAFETY CAPACITY BUILDING (COUNTRY BENEFIT)*

**Background**

In the Nile Basin, hundreds of large storage dams are in operation, with many more in various stages of planning and construction. However, data management is poor, especially for aging and small dams. Dam failure is a major man-made disaster worldwide, often caused by poor planning, design, construction, operation and aging infrastructure. Collaborative efforts among countries aim to improve dam safety management and address the risks associated with transboundary basins, preventing potential disasters. Most large dams in the basin are government-owned, highlighting the need for better oversight and regulatory functions.

However, many countries lack fully developed dam safety regulatory frameworks and technical capacity. Many of large dams are of transboundary significance, requiring a cooperative approach to the safety of downstream communities. The overall dam safety management in the region is very poor with some variation between the member countries. The challenge becomes more urgent in the context of old and aging dams in some parts of the basin and the ambitious plans put in place by countries for further dam development in other parts of the basin.

ENTRO has undertaken various capacity-building initiatives under programs such as NCORE and NCCR, funded by CIWA through the World Bank, and COCD, supported by GIZ, to enhance dam safety management practices among member states.

**Projects Description:**

ENTRO has undertaken various capacity-building initiatives under programs such as NCORE and NCCR, funded by CIWA through the World Bank, and COCD, supported by GIZ, to enhance dam safety management practices among member states.

**i. Dam Safety Capacity Building Component under NCORE Project**

**Project Objective**

The NCORE project, initiated in 2013, aimed at institutionalizing and coordinating dam safety efforts across Nile Basin countries. It focused on strengthening institutions, improving technical skills, and establishing Dam Safety Units (DSUs) within water ministries.

**Beneficiaries**

The Three Eastern Nile Countries (Ethiopia, South Sudan and Sudan) are benefited from the NCORE dam safety capacity building program. Participants include government decision makers, regulators, dam owners, dam operators, universities and others were drawn from the member states.

**Key Study Output**

Under NCORE project ENTRO has developed the Eastern Nile Dam Safety Guidelines, recognized by the International Commission on Large Dams (ICOLD), and conducted also numerous training activities, benefiting 350 participants from different country (mainly Ethiopia, South Sudan and Sudan All this effort has culminated in the establishment of National Dam Safety Units within the water ministries of Ethiopia, South Sudan, and Sudan, in addition to furthering trust and confidence among this riparian.

**ii. Dam Safety Capacity Building Component under NCCR Project**

**Project Objectives**

The NCCR project, launched in 2021, aims to enhance institutionalization and coordination of dam safety management in the region with a broader basin-wide approach.

**Beneficiaries**

In the NCCR dam safety capacity building program, all member states NBI Countries (Burundi, DRC, Ethiopia, Kenya, Rwanda, South Sudan, Sudan, Tanzania and Uganda) benefitted. Participants included regulators, dam owners, operators, universities, and others.]

**Key Study Output**

The project output includes regional training sessions and the development of basin-wide regulatory framework and reference guidelines. ENTRO's efforts also extend to establishing a Regional Dam Safety Training Centre to further improve dam safety management across the region.

**iii. Coordinated Operation of Cascade Dams**

On the other hand, ENTRO has developed a Road Map to establish coordinated reservoir operation mechanisms for Eastern Nile countries, aiming to enhance water use efficiency. This initiative focuses on four key pillars: harmonizing reservoir operation procedures, assessing benefit-sharing options, implementing basin-wide forecasts, and enhancing dam safety regulations. Financed by GIZ-EU support, the project progressed through three phases. Phase-I focused on data collection and stakeholder facilitation. Phase-II prioritized options for coordinated dam operation, informing strategic water resource analyses. Phase-III developed Eastern Nile Reference Guidelines for design flood analysis, addressing spillway design standards.

Thanks to the efforts and support provided by CIWA, WB, and GIZ, experts and institutions in the Nile Basin have benefited, with ENTRO giving greater attention to the Eastern Nile Region.

## THE EASTER NILE PLANNING MODEL

The Eastern Nile Planning Model (ENPM) was an initiative by the Eastern Nile Technical Regional Office (ENTRO) included into the 2006-2011 Strategic Plan of ENTRO. It is aimed at managing and organizing vast amounts of knowledge and information related to the Eastern Nile sub-basins. The ENPM was developed to address the challenge of disaggregated data across the Eastern Nile sub-basins, which include Tekeze-Setit-Atbara (TSA), Baro-Akobo-Sobat (BAS), Abbay/Blue Nile (ABN), and Main Nile. The ENPM provides toolkits for preliminary water balance calculations, detailed system schematics of the sub-basins, and databases for dams, reservoirs, and irrigation schemes. It supports decision-making and planning for ENTRO, utilities, planners, , universities, research centers, and project planners.

The ENPM continued throughout all ENTERO Strategic Plans 2012-2016, 2017-2022 and included as Modeling and Knowledge Management System in the 2022 -2027 Strategic Plan.

**Component 3: Improving Mechanisms for Cooperation in the Eastern Nile**

**A. Sub-components: Modeling and Knowledge Management Systems (2022-2027, ENTRO Strategic Plan)**

**Project Objectives:** To strengthen modeling, knowledge products, and analytical framework for the Eastern Nile water resources planning and management system through; [1] cooperation for climate resilient water resources management and informed water resources development, [2] utilization of modeling tools developed under the ENPM and NCCR that include maintenance and enhancement of the models to cooperate with future analysis

ENTRO conducts MKMS as following:

- Modeling Systems: ENTRO utilizes various modeling systems to simulate and predict hydrological patterns, water resource allocation, and the impact of different water management scenarios. These models help in planning and decision-making processes for water resource management across the Eastern Nile region.
- Knowledge Management: ENTRO's knowledge management involves collecting, organizing, and sharing knowledge related to the Eastern Nile's water resources. This includes data on hydrology, climate change, socio-economic factors, and environmental impacts. The knowledge management system ensures that this information is accessible to stakeholders, including member countries, researchers, and policymakers.

- Integration of MKMS: ENTRO integrates modeling systems with knowledge management to create a cohesive framework that supports the strategic planning and implementation of water-related projects. This integration allows for a more informed approach to managing the complex challenges of water resource management in the Eastern Nile basin.
- Capacity Building: ENTRO also focuses on capacity building in MKMS by providing training and technical support to member countries. This empowers local experts to utilize modeling and knowledge management tools effectively, ensuring that the Eastern Nile countries can independently manage their water resources in the future.

## A. Benefits of Collaboration of MKMS.

- Cooperation plays a crucial role in the field of Knowledge Management and Modeling, especially in the context of Eastern Nile Countries Water Resources Planning Tools and Models Development. By collaborating with various stakeholders and organizations ENTRO can leverage the collective expertise and resources to enhance the efficiency and effectiveness of water resource management strategies.
- One of the key benefits of cooperation in this domain is the pooling of knowledge and data. Through collaboration, different entities can contribute their unique insights, data and information, leading to a more comprehensive understanding of water resources in Eastern Nile countries. This collective knowledge can then be used to develop sophisticated modeling tools that accurately represent the complex dynamics of water systems in the region.
- Furthermore, cooperation facilitates the packaging of data and information in a more accessible and actionable format. By working together, ENTRO/stakeholders can streamline data collection processes, standardize formats, and develop user-friendly interfaces for accessing and utilizing information related to irrigation, climate, water use, and other crucial factors. This, in turn, can improve decision-making processes and support more informed policy development in the water sector.
- Additionally, collaboration allows for the development of specialized services tailored to the specific needs of Eastern Nile countries. By pooling resources and expertise, ENTRO and its partners in the Easter Nile Countries can create innovative tools and models that address the unique challenges faced in water resources planning and management in the region. This can lead to the implementation of more effective strategies for sustainable water use, irrigation practices, climate adaptation, and overall water resource development.

Generally. , cooperation is instrumental in advancing Knowledge Management and Modeling for water resources planning in Eastern countries. By fostering collaboration among stakeholders, ENTRO can optimize the utilization of data and information, develop tailored tools and services, and ultimately improve the management of water resources in the region.

## PROJECTS IN THE PIPELINE WITH DIRECT BENEFITS TO SUDAN

A) Ethiopia (GERD) – Sudan (Khartoum) TL Project
B) Integrated Fisheries and Water Resources Management: Jebel Aulia Dam & Renk - Malakal

## ETHIOPIA(GERD)- SUDAN (KHARTOUM) (TL)

The ETHIOPIA (GERD) – SUDAN (KHARTOUM) (TL) Project, is being prepared under the Nile Equatorial Lakes Subsidiary Action Program (NELSAP) regional frame¬work. The NELSAP, a cooperative investment program within Nile Basin Initiative (NBI), was established to fa-cilitate the identification, preparation and resource mobilization for cooperative investment projects at a sub-basin level within the framework of the NBI. The ETHIOPIA (GERD) – SUDAN (KHARTOUM) (TL) Project, for which the feasibility studies and detailed designs are being un¬dertaken is one of the three prioritized projects selected by the two countries of Sudan and Ethiopia to carry forward in the Nile Basin.

The main objectives of ETHIOPIA (GERD) – SUDAN (KHARTOUM) (TL) project include provision of trans¬mission capacity to cater for grid interconnection between Egypt and Sudan, provision of transmission infrastructure to cater for future grid interconnections to other coun-tries, promotion of regional cooperation through sharing of power generation resources and facilitation of rural electrification and improve the standard of living for the population in project areas.

The Project comprises a power transmission interconnector between Ethiopia and Sudan, including 580km of new 500kV transmission lines, of which approximately 16km will be in Ethiopia, starting at the Grand Ethiopia Renaissance Dam (GERD), and approximately 564km will be in Sudan, terminating in Khartoum.

This interconnector project will facilitate trading in electricity and promote power systems stability between Ethiopia and Sudan as well as other countries in the Eastern Africa Power Pool (EAPP). The interconnector will have a transmission capacity of 4,000 MW.

The Project will enable Sudan to make use of Ethiopia's cleaner energy resources, most notably, Africa's soon to be largest hydro-electric scheme, the Grand Ethiopia Renaissance Dam project, which will have a generation capacity of 6,000MW and to which this Project will have a direct connection.

The Project also includes two new 500kV capacitated substations at Rabak and Jebel Aulia (both in Sudan), and power line bay extensions at the following existing substations: Grand Renaissance (500kV Ethiopia), Rabak (220kV, Sudan) and Jebel Aulia (220kV, Sudan). It is estimated that the project will benefit at least 5,600 000 people and now requires USD 515m (30m for Ethiopia, and 485m for Sudan) for project finalization, tendering and implementation. The ETHIOPIA (GERD) – SUDAN (KHARTOUM) (TL) Project, has an overall Internal Rate of Return (IRR) of 7% and Net Present Value (NPV) of 15.5 million USD(m USD).

The ETHIOPIA (GERD) – SUDAN (KHARTOUM) (TL) Project, was developed through a consultative process that involved Permanent Secretary/Director Ministries responsible for Energy & Finance & Planning, Ethiopian Electric Power (EPP), and the Sudanese Electricity Transmission Company (SETCO). The impact of Climate change due to Higher ambient air temperatures (due to climate change) could strain power infrastructure by simultaneously reducing transmission capacity and increasing peak

electricity load. Additional interconnectors will help reduce this risk by having more supply available. Furthermore, interconnectors are a fea-sible option to help reduce greenhouse gas emissions and "decarbonize" the electricity sector, especially when renewable energy such as hydropower (with less emissions) in this project are utilized.
The project is at the stage of Preliminary Design, Feasibility Study and preliminary ESIA.

## INTEGRATED FISHERIES AND WATER RESOURCES MANAGEMENT OF JEBEL AULIA DAM & RENK - MALAKAL AREA

**The objective of this South Sudan/Sudan project is to increase the productivity of the fisheries sub-sector through promotion of sustainable management of fisheries, water resources, and the ecosystems surrounding the Jebel Aulia Dam. This will also enhance pro-poor macroeconomic growth for poverty and food insecurity reduction.**

**Expected Results / Output**

The Project will result in:

- Establishment of a knowledge base to enable a good, science-based, understanding of the situation of fisheries in the Jebel Aulia Reservoir
- Development the Reservoir/Lake Management Plan
- Fisheries Management Plan
- Integrated Capacity Building and Stakeholders' participation Plans
- Scoping of investments (project profiles) to facilitate decision making by both the public and private sector
- A joint fisheries and water management framework put in place, and
- Pilot identified project profiles implemented.

The project has been conceptualized in a concept note dated February 2018 and it is estimated that USD 12m is required for feasibility studies, detailed design, independent ESIA and RAP studies and implementation in this phase of the NEL-IP.

**Project Summary**

- **Problem Definition:** Sudan is dependent on fish imports to satisfy the per capita fish consumption, which is currently limited to 1.1kg (2012). Fisheries development is a useful instrument for poverty alleviation, food security and malnutrition reduction.
- **Previous studies:** A concept note has been developed by NELSAP in 2018.
- **Current status:** Proposed as priority project for NEL-IP phase 1
- **The next step:** for feasibility studies, detailed design, independent ESIA and RAP studies and implementation

**Countries:** South Sudan and Sudan

Anticipated beneficiaries: Around 2 million in the vicinity of the White Nile River from Malakal and Renk (in South Sudan) to the Jebel Aulia Dam near Khartoum in Sudan could potentially benefit from this project

For the Sudan Republic: The Federal Ministry of Animal Resources and Fisheries and its Fisheries Ad¬ministration, the Fisheries Training Institute (Ministry of Animal Resources and Fisheries) and the Fisheries Research Centre (Ministry of Science and Technology).

For South Sudan: The Ministry of Animal Resources and Fisheries of South Sudan and a Fisheries Training Center in Padak (Jonglei State)

Jebel Aulia Dam and Renk project has an overall Internal Rate of Return (IRR) of 637% and Net Present Value (NPV) of 3081.5 million USD(m USD). Its Estimated Net Direct Benefit will be USD 8,000 million.

The impacts of climate change will affect and change the industries of fisheries and aquaculture, and therefore affect food security and livelihoods in the Region. With the adoption of an ecosystem approach to fisheries, the project can be used to address the impacts of climate change on fisheries.

Key features of this approach include maintaining ecosystem integrity while improving human well-being and equity and promoting enabling governance.

Three objectives that must be at the core of the approach are: ensuring ecological well-being, ensuring human well-being, and ensuring the ability to achieve (governance and external factors).

Furthermore, managing the water resources of the area in a more integrated and sustainable manner will help ameliorate the potential negative impacts of climate change on water resources

Concept Note developed, Feasibility, preliminary designs reports complete.

## FOOD SECURITY

Apart from enhanced shared understanding and commitment between Sudan and Ethiopia about the watershed problems affecting the two countries, the Eastern Nile Watershed Management (ENWSM) project, an ENSAP Project, has enabled joint action. Consequently, the ENWSM has resulted in: rehabilitation of **27,000** ha of degraded agricultural land. As a result, farm yields for dominant crops have shown significant improvement, with **sorghum** yields increasing from a baseline **519 kg/ha to 1,249 kg/ha** in Dinder and from **1,249 kg/ha to 3,391kg/ha** in Atbara. Similarly, sesame yields increased from **202 kg/ha** to **336 kg/ha** in Dinder and white **bean yields** from **887 kg/ha to 2,480 kg/ha** in Lower Atbara. Over **300 km of livestock** routes have been mapped, demarcated and opened for pastoralists, reducing cattle transit conflicts. Over **5,010 ha of rangeland have been reseeded** with nutritious and soil rehabilitating varieties of fodder. Fodder production has been initiated in 24 villages. Under the Eastern Nile Watershed Management project, a new round of investment projects will benefit **185,000** people in Tilkuk and **120,000 in** Atbara.

**Benefit Highlights – Investments in Water Resources, Sudan:**

- **200 MW** electricity imported from Ethiopia, with cost savings to consumers.
- **1.4 million** households (in Sudan and Ethiopia) accessing electricity
- **5010** ha of rangeland reseeded.
- **7600ha irrigated** land benefiting 50,000 farmers
- **27,000ha** degraded land rehabilitated,
- **Yield** improvement thru improved farming practices
- **300 km** livestock routes demarcated and opened for pastoralists

## WATER RESOURCES PLANNING AND MANAGEMENT

The Eastern Nile Flood Preparedness and Early Warning Project - Phase 1 established the National Flood Forecasting Centers in Sudan and Ethiopia and has completed flood risk mapping over **1,750 km2.** At least **50,000** people benefit directly and another **500,000 indirectly** from these project interventions including people from 107 flood-prone communities. Phase II of the project focused on capacity development in flood risk management and national level technical and institutional strengthening, including thru provision of equipment and training, as well as covering new areas such as in the Tekeze-Seitit sub-basin. For over seven years now a 72-hour time lag flood bulletin has been issued to National Centers and relevant authorities, including in Sudan, during the three month-flood seasons forecasting and early warning thus enhancing preparedness.

Under the Nile Basin Hydrological Monitoring System establishment, Sudan will rehabilitate or otherwise newly establish **13 hydrological stations** out of the basin wide 50. Sudanese experts have been utilizing the **Nile DSS applying** them in tasks associated with operational flood forecasting in Abbay/Upper Blue Nile Sub-basins, watershed management and in simulation exercises on GERD.

## LOWER ATBARA AND DINDIR AREA WATERSHED MANAGEMENT PROJECT.

The underlying strategy was to improve the health of the forest and rangeland resources/ecosystems to reduce land degradation, water loss, decrease sedimentation, make the land to be more productive and improve the livelihoods of the communities in the project areas.

**Benefit Highlights - Water Resources Planning-Management, Sudan:**

- 12 Hydrological stations to be rehabilitated and/or newly installed
- Sudan will benefit from domesticating from over 30 NBI polices of transboundary significance
- Coordinated Operation of Cascade Dams and Dam safety will increase synergy, efficiency and safety within Sudan and across Egypt.

**Project's achievement and its benefits:**

- About 24,008 ha of degraded forest and rangelands have been rehabilitated through introduction of different SWC techniques and distributing various species of seeds.
- About 10 to 15 tons of forest seed per year were collected during the implementation from natural woodland using locally employed casual labor and Forest National Corporation (FNC) staff for seedling production.
- More than 200 thousand seedlings annually are produced by the surrounding communities and used in the different reforestation activities.
- Around 400 ha of community forests or woodlots were rehabilitated.
- Over 400ha communal forest rehabilitated and as the result sheet soil erosion minimized.
- Over 12,000 ha of opened rangeland rehabilitated.

- An area of 2000 ha of communal village grazing land using a more intensive silvo-pastoral approach implemented.
- A total of 43,718 ha has been put under improved sustainable land and water management system: including agriculture (19,710 ha), rangeland (17,828 ha) and forestlands (6,180 ha).
- Over 18,000 HH started to use improved crop and land husbandry practices on their agricultural land. In addition, about 8110 ha treated with different SWC techniques.
- Due to project intervention the average yield of sorghum for participating farmers in Dinder increased by 116% and by 146% in Atbara.
- Sesame yield increased by 73% in the years 2013, 2014, and 2015 in Dinder.
- White bean average yield during the years 2013, 2014, 2015 of participating farmers increased by 143% in Atbara.
- An estimated 18,133 HHs started using/adopted new agricultural practices. These include 15,468 for improved crop seeds and crop land husbandry, 2,080 for improved fruit tree seedlings. 585 HHs benefited from improved animal production practices.
- About 28 business groups with 483 members were organized, trained and engaged in beekeeping, benefited from honey production.

**ONE RIVER ONE PEOPLE ONE VISION**


DESSIE ROAD, IN FRONT OF ARARAT HOTEL

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