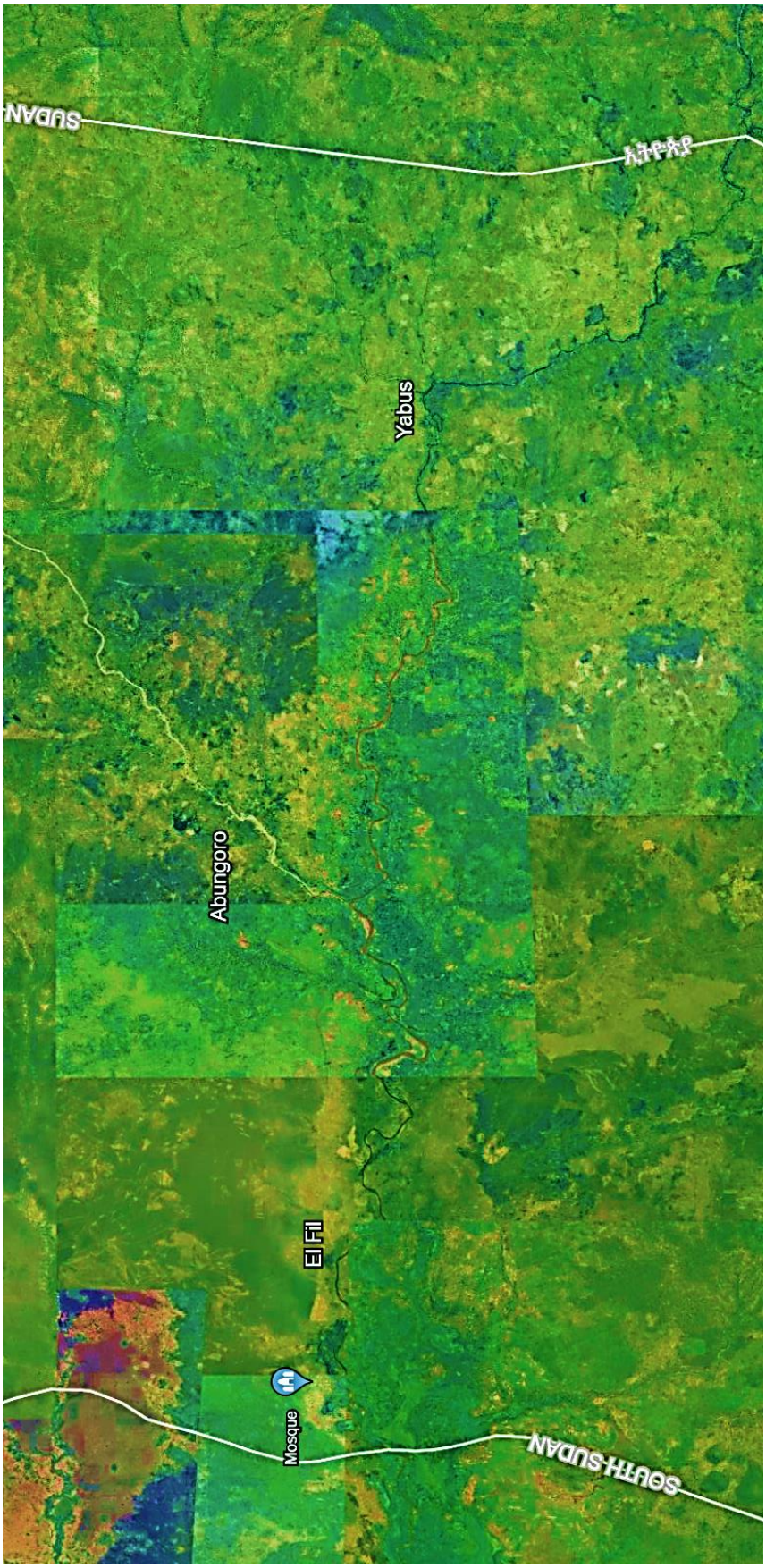
ENTRO
NILE BASIN INITIATIVE
INITIATIVE DU BASSIN DU NIL

Regional Climate Resilience Program for Eastern and Southern Africa

Component 2: Climate Resilient Infrastructure & Assets Management

Sub-Component 2.1: Closing the Climate Resilient Infrastructure Gap

Terms of Reference for Flood Management Interventions Feasibility Study Consultancy Services in the Yabus River Catchments and related riverine systems, covering Ethiopia, South Sudan, and Sudan



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1. Introduction

The Nile Basin Initiative (NBI) is an intergovernmental partnership established to develop and manage River Nile cooperatively. NBI was launched on 22nd February 1999 by the Nile basin riparian countries with an objective to achieve basin-wide sustainable socio-economic development, benefits sharing and environmental sustainability. To date, 10 riparian states of Burundi, DR Congo, Egypt, Ethiopia, Kenya, Rwanda, South Sudan, Sudan, Tanzania, and Uganda are members of the NBI. The NBI establishment secretariat (Nile-Sec) is based in Entebbe-Uganda.

To initiate concrete joint investments and actions on the ground, two Subsidiary Action Programs (SAPs), one for the Eastern and one for the Nile Equatorial Lakes, were established at sub-basins level with their executive arms as follow:

1) The Eastern Nile Technical Regional Office (ENTRO)", as an executive arm of the Eastern Nile Subsidiary Action Program (ENSAP) based in Addis Ababa, Ethiopia.
2) The Nile Equatorial Lakes Subsidiary Action Program (NELSAP) Coordination Unit (NELSAP-CU)" based in Kigali, Rwanda as NELSAP executive arm.

The Nile Basin, in addition to its environmental value, including biodiversity and the hydrological cycle, provides drinking water, water for agriculture, hydropower, tourism, fisheries and navigation. These benefits are directly or indirectly threatened by human activities and natural factors related to climate change and variabilities. The effects from humans and climate have wide ranging consequences for society, health, economic development, and the natural environment.

Ahead of COP 26, several bodies of the United Nations called upon the world's leaders to 'urgently accelerate action to address the water-related consequences of climate change. Climate change effects are characterized by recurrent flooding, intermittent droughts, increased water erosion, and ecosystem degradation. Floods have severe impacts on the social, economic, and ecological realms, including loss of lives, disruption of production systems, destruction of transportation infrastructure, damage to public and private properties, and deterioration of public and environmental health. Consequently, the damage arising from flooding severely affects livelihoods and hinders economic growth and delivery of services, which is inconsistent with the sustainable development of flood-prone areas.

According to the recent Intergovernmental Panel on Climate Change (IPCC) report, climate change is dramatically affecting the water cycle, making droughts and floods more extreme and frequent and decreasing the natural water storage in ice and snow. Rising temperature and variability in flow patterns of water bodies also strongly affect water quality both on the surface and in the ground. Changing precipitation patterns are already impacting agriculture, food production systems, and all the livelihoods are becoming increasingly vulnerable, as well as ecosystems, and biodiversity.

Furthermore, the UN World Water development Report 2020, emphasizes that water is the "climate connector" that allows for greater collaboration and coordination across many targets for climate change (Paris Agreement), sustainable development (2030 Agenda and SDGs) and disaster risk reduction (Sendai Framework).

2. Background

NBI provides an all-inclusive regional platform for multi-stakeholder dialogue, information exchange and joint planning on the management and development of the transboundary water and related resources of the Nile Basin. Addressing hydrometeorological hazards and planning for flood mitigation has been one of the key action areas of the NBI since its establishment in 1999. Over the years, the NBI, with support from various development partners has supported countries in flood risk management. The Flood Preparedness and Early Warning (FPEW) Project that ran until 2010 operated in Egypt, Ethiopia, and Sudan created a regional flood preparedness and early warning program, reducing the risk of flood devastation for over 2 million people in the region. This regional cooperation effort coordinated by the NBI created a system that linked multiple stakeholders to work together to address flooding and its impacts[1].

The World Bank through the Cooperation in International Waters in Africa (CIWA) trust fund is supporting Nile Basin countries with a USD 30 million grant to implement the Nile Cooperation for Climate Resilience Project - NCCR (2020-2025) with USD 9.5 million allocated to the Flood and Drought Risk mitigation thematic area. The Objective of this thematic area is to enhance preparedness/resilience against flood and drought disasters through development of decision-support information services. This includes assessment and identification of flash floods' hotspots in the Nile Basin, development of flash floods early warning system to minimize loss of life/property and infrastructure damage, identification of investment options and development of investment roadmap for improved natural disaster management in the Nile basin countries. The NCCR project will support national meteorological and hydrological services in the NBI member states through development of a reliable and effective flash floods early warning system for the Nile Basin. It will increase local expertise and regional cooperation in flash floods management while improving related disaster management efficiency.

In addition, the World Bank through IDA is supporting the NBI (ENTRO and NELSAP) to implement Phase 1 of the Regional Climate Resilience Program (RCRP) for Eastern and Southern Africa – P180171 Program. The Program is envisioned as a regional multi-phase engagement, through a Series of Projects (SOPs), with the higher-level aim of strengthening the resilience to climate-related shocks, with a specific objective of strengthening the resilience of vulnerable populations prone to climate-related shocks. The overall Program focuses on catalytic medium to large scale investments to reduce people exposure to climate shocks, with a focus on high return storage/protective water

[1] https://entrospace.nilebasin.org/handle/20.500.12351/238.

infrastructure and safety nets. The first phase will be focused on strengthening systems for the proper design, implementation, and O&M of these investments for climate resilience, to increase their readiness for implementation, improving their preparedness to manage climate risks, and to expand the scope for adaptive safety nets to protect the most vulnerable.

The activities described in these Terms of Reference are supported by the RCRP. The activities focus on improving climate resilience through integrated transboundary flood management in South Sudan where infrastructure works will be financed through the first SOPs in collaboration with Ethiopia and Sudan through the Yabus River catchments. The implementation of these activities will build upon the ongoing efforts under the NCCR project, particularly those under thematic area 1 of the NCCR (flood and drought risk mitigation). The Rationale for this Feasibility Study Consultancy Services is elaborated in Annex 1.

3. Objective of the Feasibility Study Consultancy Services

The overall goal of this feasibility study consultancy services is to develop sustainable flood mitigation and adaptation solutions in more flood susceptible areas in the Yabus River catchments and associated riverine, which involves Ethiopia, South Sudan, and Sudan. This will involve carrying out a detailed assessment of the Yabus River catchments, its riverine hydrological dynamics and preparation of an integrated transboundary flood management plan, involving regional/local authorities and communities from the three countries in planning and management. The aim being to promote coordinated transboundary flood management and development of mitigative/adaptive interventions/measures to enhance preparedness/resilience against flood risk, disasters, and hazards in the most vulnerable areas.

The specific objectives of this feasibility study consultancy services in the Yabus River catchments and related riverine systems, are:

1) **Setting up of a Flood Forecast and Early Warning System (FFEWS):** To set up FFEWS for River Yabus catchments and related riverine systems that will be integrated into the existing Eastern Nile (EN) FFEWS.

2) **Topography Mapping:** Conduct comprehensive topographic mapping of River Yabus catchments and related riverine systems.

3) **Hydrological Studies:** Conduct hydrologic studies for River Yabus catchments and related riverine systems, including investigating the rainfall pattern and hydrology of the area (e.g., runoff, stream/river flows, evaporation, ground-surface water interaction, etc.).

4) **Flood hazard mapping:** map the flooding extent, depths, and frequency, leading to an improved understanding of the spatial distribution of the specific flood intensities hazard in the Yabus River Catchments and related riverine systems for

different return periods of up to 500 years (2, 5, 10, 50, 100, 200 and 500 years) using historical data where available, blended with other data sources (e.g., satellite-based rainfall estimates).

5) **Flood hazard exposure mapping:** map population, infrastructure, ecosystems, and other socio-economic activities exposed to pluvial and fluvial floods in the Yabus River Catchments and related riverine systems. Then assess vulnerability/resilience to floods by considering:

   (i) demographic and social indicators (e.g., age group, gender, disability, number of members in a family),

   (ii) asset and environment quality indicators, e.g., type of buildings, land use characteristics (e.g., building density over the area), land cover classification, soils, and geology).

   (iii) existing institutional structures (formal local government institutions, community-based institutions, and partner organizations) concerned with the affairs of local populations on ground, including flood response and management in the catchment.

   (iv) any existing structural or non-structural measures for adapting to or mitigating flood hazards.

6) **Risk mapping and assessment:** combine evidence on hazard, exposure, vulnerability, and resilience to develop a detailed strategic inundation risk map of the Yabus catchments and associated riverine systems that will be integrated into the existing EN Flood Risk Mapping for both pluvial and fluvial. This will include estimates of likelihoods and magnitude of impacts for floods of different return periods of up to 500 years, to facilitate an accurate engineering design for specific at-risk areas.

7) **Structural and non-structural measures:** Develop an integrated flood management plan, comprised of identified suitable structural (engineering-based solutions) and non-structural interventions (natural/social based solutions) as appropriate for flood control. Other considerations, include strategies for joint flood risk monitoring, operations, and maintenance to enhance flood preparedness, by fostering cooperation among local, national, and regional stakeholders in the Yabus catchments and associated riverine systems.

8) **Capacity Building:** Promote community and local participation in flood management and planning through increased awareness creation and establishment of Flood Forecasting Centers to empower communities and local authorities to manage climate risks in selected areas in the Yabus River Catchments and associated riverine systems.

9) **Identification of locations and specification of floods resilience interventions:** Based on the terrain, flooding characteristics, availability of construction materials, and access to the other implements: Identify locations; specify, and design types of flood risk reduction and management infrastructure/facilities to be constructed/installed across the entire catchment/riverine. These include manual staff gauges, for use in flood forecasting, mitigation, and calibration in the flood plains.

10) **Identification of locations and specification of water infrastructure for productive uses linked to floods/drought resilience interventions:** Determine key socio-economic characteristics of flood prone communities and as part and parcel of resilience to floods program, in parallel, water infrastructure for productive uses linked to floods and drought mitigation/adaptation must be integrated with focus on alternative livelihoods besides the traditional ones.

4. Main Tasks for this Feasibility Study Consultancy Services

The client will task the consultant to deliver this consultancy services in the following various stages, during which the client will hold discussions with the consultant to regularly assessed, and continuously discuss challenges and constraints being encountered and possible interventions with an aim of ensuring standard work is completed within the agreed timelines.

4.1 Inception Phase

Within the first month of the commencement of the assignment, the Consultant will mobilize and hold a planning meeting with the Client's regional and national technical teams to agree on an approach and timetable for rendering the services, including work plan and budget. They will carry out necessary literature review (review and analysis of existing relevant secondary sources of information such as previous assessment reports from the various national, regional, and global publications on the sub-sector, some of which have been captured under section seven "7. References"). They will also undertake a field reconnaissance mission to the project areas to familiarize themselves with the context and the specific issues involved. All relevant basic information and data needed for this assignment will be identified and compiled. After that the consultant shall propose an adequate methodology for conducting the assignment as per the tasks outlined below, including use of opensource data, remote sensing, field surveys, and clearly laying out of an inclusivity approach to consider gender, youth, elderly, and disabled where appropriate (i.e., with optimum stakeholder and local community involvement). The Consultant then prepares and submits a concise and focused draft inception report for review by the client, and after receiving and addressing reviews by the client, the Consultant shall submit a draft final inception report. A first stakeholders' workshop will then be organized for stakeholders, partners, and representatives of the participating communities to review and update the draft final inception report at an appropriate location relevant to the project area.

After the first stakeholders' workshop, the Consultant shall review and submit a final inception report.

Deliverable: *Is an updated inception report within three months of the commencement of the assignment.*

4.2 Conduct Comprehensive Topographic Mapping of Yabus and Related Riverine

The Consultant will review available mapping on the Yabus catchments and associated riverine systems from the existing previous studies and reports, including historical topographic maps. This will be blended with other data sources, e.g., high resolution satellite imageries and remote sensing, i.e., using DTM/DEM with vertical resolutions < 1 m (only for the Yabus plains prone to flooding) to be budgeted and procured by the consultant under the approval of ENTRO). They will then establish a geodatabase, and GIS mapping system; conduct land surface, and bathymetric surveys for ground truthing; and produce comprehensive detailed topographic maps for the Yabus River catchments, associated riverine systems, and the flood plains. These detailed topographic maps must show transport networks, services (including schools, health centres, markets, and livelihood schemes). The maps should be produced in a large scale possible at catchment level and larger scales possible for local administrative units' parts involved (counties/localities/Woredas).

Deliverables: *Are 1) report and topography maps across the Yabus catchments and associated riverine systems, ranging from one at a large scale possible (at least 1:2,500,000) at the catchment level to ones at larger scales (at least 1:1,000,000) at the level of Admin. Units; and 2) the geodatabase/GIS mapping system and models used in easily accessible formats, in addition to any other related references.*

4.3 Carrying out Hydrological Studies of Yabus Catchments and Related Riverine

The Consultant will use available historical data from the existing previous studies, reports, and other documentation where applicable, including historical rainfall patterns, and river/stream data. These will be blended with other data sources (e.g., satellite-based rainfall estimates), to investigate the rainfall pattern and perform hydrological analysis using specifically developed/selected appropriate models/tools. The tools/models (most preferably open-source tools or develop and run a suitable hydrological model) will be developed/selected in consultation with the client (ENTRO) and their approval. The consultant will establish continuous hourly timestep hydrological model for the Yabus watershed for use in the flood and water resources assessment. Assess and quantify surface runoff, stream/river flows, sediment load/transport, evaporation, ground-surface water interaction, probability of flood occurrence, etc.). Establish a geodatabase and GIS mapping system and produce detailed separate/combined hydrological atlases/maps (including a well-detailed drainage and riverine maps of the Yabus catchments and associated rivers and water bodies). These detailed hydrological maps must show transport networks, services (including schools, health centres, markets, and livelihood schemes).

The atlases/maps should be produced in a large scale possible at catchment level and at larger scales possible for local administrative units' parts involved (Counties/Localities/Woredas).

Deliverables: *Are 1) the hydrology of River Yabus and associated riverine report furnished with different detailed hydrological atlases/maps (including drainage and riverine maps) across the catchments and associated river systems, ranging from one at a large scale (at least 1:2,500,000) possible at the catchment level to ones at larger scales (at least 1:1,000,000) at the level of local Administrative Units involved (counties/localities/Woredas); and 2)* the *geodatabase/GIS mapping system and models used in easily accessible formats, in addition to any other related references.*

4.4 Setting up of FFEWS for River Yabus catchments and related riverine systems

Based on 4.3, the Consultant will review and make use of the related existing systems and ongoing activities, such as the early warning information generated from the Flash Floods Early Warning System (FFEWS) developed during the NCCR for BAS. Set up FFEWS for River Yabus catchments and related riverine systems that will be integrated into the existing EN FFEWS, which has three components (meteorological forecasts with rainfall as an output, hydrological forecasts with runoff or flow/discharge as an output, and flood forecasts with water level as an output). Identify sites for installation of manual/automatic gauging stations within the Yabus River Catchments, related riverine systems, and flood plains to support monitoring of water levels, calibration of models and strengthening or establishment of Flood Forecasting Centers within the Yabus catchments and associated riverine systems where appropriate.

Deliverables: Are 1) a concise report of established FFEWS and model; and 2) installed gauging stations for the Yabus catchments and associated riverine systems, as appropriate.

4.5 Flood Hazard/Extent Mapping in the Yabus and Associated Riverine Systems

The Consultant will review available reports and mapping on the flooding extent, depths, frequency, velocities, and magnitude, including historical flood records, topographic maps, land use information, rainfall patterns, river and stream data, drainage infrastructure, and floodplain maps. These will be blended with other data sources (e.g., satellite imagery and remote sensing, i.e., using DTM/DEM). Perform hydraulic modelling using appropriate tools (most preferably open-source tools or by using and improving on the existing MIKE based ENTRO modelling systems and additional model using HEC), to simulate flood behaviour, water levels, and flow velocities. Based on adequate digital terrain models with appropriate spatial resolution (e.g., high-resolution DEM in conjunction with Tasks 4.2 & 4.3), the Consultant should model floods with 2D hydrodynamic modelling tools in the flood prone areas.

Establish a geodatabase and GIS mapping system to delineate flood extents and generate flood hazard map that depicts areas prone to flooding in the Yabus River catchments and related riverine systems for different seasons and return periods of up to 500 years. These

flood hazard maps must show transport networks, services (including schools, health centres, markets, and livelihood schemes). The maps should be produced in a large scale possible at catchment level and at larger scales possible for local administrative units (Counties/Woredas/Localities).

Deliverables: *Are 1) the flood hazard report and maps of River Yabus and associated riverine, ranging from one at a large scale possible (at least 1:2,500,000) at the catchment level to ones at larger scales (at least 1:1,000,000) at the level of local Administrative Units involved (counties/localities/Woredas); and 2)* the *geodatabase/GIS mapping system and models used in easily accessible formats, in addition to any other related references.*

4.6 Flood Hazard Exposure (vulnerability) Mapping in the Yabus River and Related Riverine

The Consultant will review the available literature, including the local knowledge, experiences over years, and determine key socio-economic characteristics, assets, and population at risk within the flood-prone areas. Assess physical and non-physical vulnerability/resilience to pluvial and fluvial floods by zooming into the areas affected by floods identified on the flood hazard/extent maps in 4.5 above. These include considering factors such as:

1) land use entities such as types of buildings and materials, public/private infrastructure (houses, markets, roads, telecoms/electricity/water supply/sewerage lines/networks, dikes/levees, canals/drains, pumping stations, etc.).

2) social/people (population density and socio-economic conditions), economic activities/loss, ecosystems (environmental impacts).

3) institutions for responding to and managing flood impacts, e.g., operating early warning systems and issuing accordance messages.

The Consultant should create a geodatabase and GIS mapping system and produce flood risk/vulnerability maps within the Yabus Catchments and associated riverine at the largest scale possible, portraying the potential consequences in terms of damage to property, infrastructure, and human life in the zones affected by floods.

As far as possible, non-physical vulnerabilities will be assessed for each flood prone community by County/Locality/Woreda. The consultant shall clearly lay out an approach to take into consideration differential vulnerability (e.g., vulnerability by gender and income or livelihood group).

With this, the Consultant shall establish for each flood prone community relationships between flood damages, flood extents, socioeconomic situations, and flood preparedness adaptation circumstances.

Deliverables: *Are 1) the flood hazard exposure report and maps, with buildings and corridors grid of a single location/township affected by the floods at largest scales possible*

(at least 1:500,000) across the Yabus River catchments and associated riverine systems; and 2) the geodatabase/GIS mapping system and models used in easily accessible formats, in addition to any other related references.

4.7 Flood Risk Mapping and Assessment

The Consultant will conduct site-specific technical, social, and economic flood risk assessments across the Yabus River Catchments and related riverine systems, based on the largest maps of single locations/townships affected by the floods in 4.5, & 4.6 above. The assessment should include building blocks and corridors grid, together with the previous flooding extent marks visible on trees and walls; in addition to impacts on livelihoods, which must also be considered alongside other flood risks. Combine evidence on hazard/extent, exposure, and vulnerability through spatial overlay analysis to develop a detailed inundation risk map of the Yabus catchments and associated riverine systems, including estimates of likelihoods and magnitude of both economic and noneconomic effects/impacts of floods for different return periods of up to 500 years.

The Consultant is tasked to provide flood risk assessment results for each flood-prone community (including the oil production flooding risk/impact on communities) within the Yabus Catchments and associated riverine, in the form of flood risk maps at the largest scale possible, depicting flood extents with varying flood levels and return periods, as well as identify vulnerable land use entities and critical local flood protection infrastructure, such as levees and dikes. The Consultant should create a geodatabase and GIS mapping system and provide the maps in QGIS readable formats, embedded in ENTRO's existing spatial mapping platforms.

Deliverables: *Are 1) the flood risk report and maps associated with various flood return periods, at largest scales possible (at least 1:500,000) across the Yabus River catchments and associated riverine systems; and 2) the geodatabase/GIS mapping system and models used in easily accessible formats, in addition to any other related references.*

4.8 Structural and Non-Structural Flood Intervention Measures, at Prefeasibility Level

Within 9 months of commencement, the Consultant will use flood hazard, extent, vulnerability, and risk maps in 4.5, 4.6 & 4.7 above to provide information key to designing and identifying effective mitigative/adaptive flood control and alternative livelihoods interventions/measures, including engineering designs and other considerations for specific watersheds/catchments and at-risk areas. To create resilience to floods or reduce their intensity and associated impacts in short-, medium- and long-term, the Consultant shall conduct field surveys in the identified/selected flood prone communities and associated catchment/watershed areas, capturing accordingly their key socio-economic characteristics, populations and local knowledge on flood risk reduction, preparedness, and mitigation/adaptation through consultations with the people on ground. As part and parcel of floods' risks reduction and resilience to floods program, in parallel, water infrastructure for productive uses and watershed interventions linked to floods and drought

mitigation/adaptation must be integrated with focus on alternative livelihoods besides the traditional ones.

The Consultant will create a geodatabase and GIS mapping system to produce layouts, preliminary designs and cost estimates of the proposed flood risk reduction, preparedness, and mitigation/adaptation infrastructure and associated livelihood interventions (e.g., drains, dikes, retaining walls, Dams/Haffirs, farms and associated farming practices canal/drains/terraces, drinking water supply facilities, public toilets, and access works) at amplified scales possible as appropriate. Also, this consultancy will include identification of sites for installation of manual/automatic gauging stations within the Yabus River Catchments, related riverine systems, and flood plains to support monitoring of water levels.

The consultant should strive, liaising with relevant agencies/organizations/companies through a process that, among other things, involves focused group discussions in collaboration with the local authorities and communities, to develop costed flood management strategies and interventions inclusive of implementation arrangements. The consultant will then produce a draft flood assessment and mitigation/adaptation proposal report, which will be reviewed by the client and other stakeholders. Through a second stakeholders review workshop, the Consultant will facilitate a validation workshop for regional, national, and local participants from the three countries and ENTRO representing stakeholders, partners, and affected communities to review and update it, at an appropriate location relevant to the project area. It will be discussed, and comments collated by the consultant and address them in a draft final flood assessment report.

Deliverables: Are 1) an updated flood assessment and mitigation/adaptation proposal prefeasibility study report, furnished with preliminary designs and costs' estimates of the proposed floods mitigation/adaptation infrastructure and associated livelihood works as appropriate prepared at amplified scales possible (at least 1:50,000); and 2) the geodatabase/GIS drawing system and models used in easily accessible formats, in addition to any other related references.

4.9 Selected Floods Management Interventions, Feasibility Studies, Detailed Designs, Tender Documents and TOR Preparation

The consultant will carry out feasibility studies, and detailed designs; and prepare tender documents, ESIA, and RAP for the implementable identified and prepared floods mitigation/adaptation interventions under 4.7. They shall also develop terms of references (TOR) for Feasibility Studies, Detailed Designs, preparation of Tender Documents, ESIA, and RAP where applicable, especially for the ones focusing on alternative livelihoods besides the traditional ones, i.e., alternative farms where water can be managed for agricultural production under irrigation and drainage systems.

Deliverables: Are 1) tender documents for the implementable identified and prepared floods mitigation/adaptation interventions, inclusive of detailed design layouts (at a scale

not less than 1:5,000) and appropriate cross-sections; technical specifications; and costs' estimates; and 2) terms of references (TOR) for Feasibility Studies, Detailed Designs, preparation of Tender Documents, ESIA, and RAP as applicable.

4.10 Integrated Flood Management Plan

Within 12 months of commencement, the consultant, working closely with the communities, local authorities, partner organizations on ground; in addition to close collaboration with national and regional stakeholders: Will develop an integrated flood management plan, including strategies and recommendation of most feasible structural (engineering-based solutions) and non-structural (natural/social based solutions) to enhance flood resilience in the flood prone areas in the plains of Yabus catchments and associated riverine prone to flooding.

The plan will be based on: 1) findings from the floods' assessments baseline relevant data collected or generated under 4.2 through 4.6 (the detailed topographic, hydrological, and floods hazard/extent/exposure/risk maps); 2) prefeasibility study report to be accomplished under 4.7; 3) review of the related institutional/policy framework, plans, documentation/reports, and ongoing initiatives/activities, such as the early warning information generated from the Flash Floods Early Warning System (FFEWS) developed during the NCCR.

As prerequisites for climate change adaptation and mitigation measures, the consultant is expected to propose suitable flood management strategies, encompassing flood risks reduction, response, and preparedness, by considering a wide range of interventions to mitigate/manage and adapt to floods. These include 1) identification of sites for flood control or water harvesting structures; 2) watershed management interventions; 3) land use zoning; designing/constructing roads' infrastructure without obstructing natural riverine flows; 4) spatial planning in townships' demarcation (e.g., to prevent establishment of settlements in highly exposed areas to flooding); 5) joint flood risk monitoring, operations, and maintenance; and 6) fostering cooperation among local, national, and regional stakeholders in the Yabus catchments and associated riverine systems, to enhance flood preparedness.

The flood management plan strategies should consider integral aspects of the Yabus catchments and associated riverine as a hydrological unit that catches, store and release water through a network of streams into main rivers and other water bodies. In a broader sense, the plan should follow an integrated water resources management (IWRM), which is an undertaking to maintain equilibrium between elements of watershed/catchment natural ecosystem (land, water, vegetation, etc.) on one hand and humans' activities in utilizing the elements on the other. As such, the plan will include examining any potential impact on the other Nile riparian states or communities downstream or upstream and draw up a joint monitoring action plan that includes sharing of related data and information at all levels (regional, national, and local).

The consultant will then produce a draft Yabus catchment and associated riverine integrated flood management plan, inclusive of details of all proposed technical interventions, investments required, environmental/social considerations, and implementation steps, which will be reviewed by the client and other stakeholders. Through a third stakeholders review workshop, the Consultant will facilitate presentation to the regional, national, and local participants from the three countries and ENTRO, representing stakeholders, partners, and affected communities to review and update it, at an appropriate location relevant to the project area. It will be discussed, and comments collated by the consultant and address them in a draft final integrated flood management plan.

Deliverable: *Is a draft final integrated flood management plan proposal, aimed at ensuring sufficient quality water availability, floods control, and safe/pleasant environment.*

4.11 Capacity building in Flood Risk Management at Local, National, & Regional Levels

Within 15 months of commencement of the assignment, the consultant will undertake an assessment of capacity building needs of the participating communities, authorities, and organizations with respect to flood management and livelihood improvement activities in the Yabus catchments and associated riverine. A capacity building program (comprised of equipment and necessary training modules on integrated flood management and response) involving the three countries should be developed and reviewed by the client and other stakeholders.

The capacity building program must incorporate related government officials as well as community needs and local organizations, inclusive of gender, youth, elderly, and disabled/handicaps issues. It shall include carrying out awareness creation among participating communities and government officials at both national and local levels, in the three countries to empower them on how to respond to climate risks and on how to jointly monitor floods in the Yabus catchments and associated riverine systems.

The consultant is expected to train the staff of stakeholders and partners on-the-job during delivery of the consultancy assignment, starting with data collection; and quality control and processing activities such as the geodatabase establishment, GIS mapping system, assessments related to floods, structural and non-structural flood intervention measures planning, designing, implementation, for hands-on training, ownership and continuity to undertake essential tasks of floods by the stakeholders and partners. Through ENTRO, the Consultant shall help in strengthening/establishing Flood Forecasting Centers for the Yabus catchments and associated riverine systems where appropriate.

On a fourth stakeholders' workshop, in collaboration with the client (ENTRO) the Consultant will launch the awareness creation and capacity building program and facilitate it (using PowerPoint together with any other means of illustration) to the identified regional, national, and local participants from the three countries and ENTRO, representing

stakeholders, partners, and affected communities, at an appropriate location relevant to the project area.

Deliverables: *Are 1) a concise report of stakeholders'/partners' personnel trained on-the-job during delivery of the consultancy assignment; 2) capacity building needs assessment report; 2) capacity building program and awareness creation materials/manuals developed;3) a concise report of the first training conducted for the stakeholders'/partners' personnel on capacity building program; and 4) Flood Forecasting Centers strengthened/established for the Yabus catchments and associated riverine systems where appropriate in the three countries.*

5. Consultant's Deliverables

Task Ref.	ID	Deliverable	Type	Explanation and Remarks	Targeted Date (After Commencement)
Inception Phase (Inception Report Write-up, Review and Validation)					
0	0.1	Inception Report (section 4.1)	Report	**(i)** The inception phase is preceded by entry/planning phase involving public-community sensitization and awareness meeting in the Yabus River Catchments and associated riverine, to introduce the project to local communities and authorities in three locations (one in each of the three countries); and to identify, map and engage key stakeholders at a regional planning meeting hosted by ENTRO. **(ii)** The inception report fleshes out the TOR and the technical proposal with emphasis on methodology and approach. **(iii)** The Inception report will be presented in an Inception Workshop – see Deliverable No. 0.4	3 Months
0	0.2	Meetings	Three Back to Office Field Reports	Public-community sensitization and awareness meetings (to be seen in conjunction with Deliverable No. 0.1)	3 Months
0	0.3	Meeting	Meeting minutes	Regional planning meeting (to be seen in conjunction with Deliverable No. 0.1)	3 Months

Task Ref.	ID	Deliverable	Type	Explanation and Remarks	Targeted Date (After Commencement)
0	0.4	Validation of Inception Report	Workshop	To be seen in conjunction with Deliverable No. 0.1	3 Months
WP1, the Interim Phase (Baseline Preparation, Review and Validation)					
1	1.1	Interim Report	Baseline Outputs	The interim phase constitutes WP1, comprising of baseline studies, preparations, reviews, and validations.	9 Months
1	1.2	Topographic atlases/maps, geodatabase/GIS mapping system, models, and any other related references (section 4.2)	Maps/Reports/models/systems/data	Report and topography maps across the Yabus catchments and associated riverine systems, ranging from one at a large scale possible (at least 1:2,500,000) at the catchment level to ones at larger scales (at least 1:1,000,000) at the level of Admin. Units; and 2) the geodatabase/GIS mapping system and models used in easily accessible formats, in addition to any other related references. To be seen in conjunction with Deliverable # 1.1	9 Months

Task Ref.	ID	Deliverable	Type	Explanation and Remarks	Targeted Date (After Commencement)
1	1.3	Detailed hydrological atlases/maps (including drainage and riverine maps), geodatabase/GIS mapping system, models, and any other related references (section 4.3)	Maps/Reports/ models/systems/data	The hydrology of River Yabus and associated riverine report furnished with different detailed hydrological atlases/maps (including drainage and riverine maps) across the catchments, associated river systems and floodplains, ranging from one at a large scale possible *(at least 1:2,500,000)* at the catchment level to ones at larger scales (at least 1:1,000,000) at the level of local Administrative Units involved (counties/localities/Woredas); and 2) the geodatabase/GIS mapping system and models used in easily accessible formats, in addition to any other related references. To be seen in conjunction with Deliverable # 1.1	9 Months
1	1.4	Established FFEWS (including installed gauging stations for the Yabus catchments and associated riverine systems (section 4.4)	Reports/systems/hydro-met station	Set up FFEWS for River Yabus catchments and related riverine systems that is integrated into the existing EN FFEWS, which has three components (meteorological forecasts with rainfall as an output, hydrological forecasts with runoff or flow/discharge as an output, and flood forecasts with water level as an output). The identified sites for installation of manual/automatic gauging stations within the Yabus River Catchments, related riverine systems, and flood plains to support monitoring of water levels, calibration of models and strengthening or establishment of Flood Forecasting Centers within the Yabus catchments and associated riverine systems where appropriate. To be seen in conjunction with Deliverable # 1.1	9 Months

Task Ref.	ID	Deliverable	Type	Explanation and Remarks	Targeted Date (After Commencement)
1	**1.5**	Flood hazard atlases/maps, geodatabase/GIS mapping system, models, and any other related references (section 4.5)	Maps/Reports/models/systems/data	The flood hazard report and maps of River Yabus and associated riverine, ranging from one at a large scale possible (at least 1:2,500,000) at the catchment level to ones at larger scales (at least 1:1,000,000) at the level of local Administrative Units involved (counties/localities/Woredas); and 2) the geodatabase/GIS mapping system and models used in easily accessible formats, in addition to any other related references. To be seen in conjunction with Deliverable # 1.1	9 Months
1	**1.6**	Flood hazard exposure maps, geodatabase/GIS mapping system, models, and any other related references (section 4.6)	Maps/Reports/models/systems/data	The flood hazard exposure report and maps, with buildings and corridors grid of a single location/township affected by the floods at largest scales possible (at least 1:500,000) across the Yabus River catchments and associated riverine systems; and 2) the geodatabase/GIS mapping system and models used in easily accessible formats, in addition to any other related references. To be seen in conjunction with Deliverable # 1.1	9 Months
1	**1.7**	Flood risk maps, geodatabase/GIS mapping system, models, and any other related references (section 4.7)	Maps/Reports/models/systems/data	The flood risk report and maps associated with various flood return periods, at largest scales possible (at least 1:500,000) across the Yabus River catchments and associated riverine systems; and 2) the geodatabase/GIS mapping system and models used in easily accessible formats, in addition to any other related references. To be seen in conjunction with Deliverable # 1.1	9 Months

Task Ref.	ID	Deliverable	Type	Explanation and Remarks	Targeted Date (After Commencement)
	1.8	An updated flood assessment and mitigation/adaptation proposal prefeasibility study report; and the geodatabase/GIS drawing system and models used in easily accessible formats, in addition to any other related references (section 4.8)	Reports/layouts/systems/data	Production of a draft flood assessment and mitigation/adaptation proposal report, furnished with preliminary designs and costs' estimates of the proposed floods mitigation/adaptation infrastructure and associated livelihood works (layouts), prepared at amplified scales possible (at least 1:50,000) as appropriate. The geodatabase/GIS drawing system and models used in easily accessible formats, in addition to any other related references. This is to be seen in conjunction with Deliverable No. 1.1	9 Months
1	1.9	Validation of Baseline Report (section 4.8)	Workshop	Engage key stakeholders to validate the baseline/interim report of hydrological studies, floods mapping/assessments, and pre-feasibility study of the proposed structural/non-structural flood interventions (infrastructure and associated livelihood works as appropriate furnished with layout plans/designs and costs' estimates) in the Yabus River Catchments and associated riverine. This is to be seen in conjunction with Deliverable No. 1.1	9 Months

Task Ref.	ID	Deliverable	Type	Explanation and Remarks	Targeted Date (After Commencement)
1	1.10	Detailed Designs, ESIA, RAP, Costs' Estimates, Tender Documents and Terms of References (section 4.9)	Documents	Carrying out of feasibility studies; conducting of detailed designs; estimating costs; preparation of tender documents inclusive of drawings (layouts at a scale not less than 1:5,000 and appropriate cross-sections) and technical specifications; and conducting of ESIA, and RAP for the implementable for the identified/selected floods mitigation/adaptation interventions under 4.8. Development of Terms of References (TOR) for Feasibility Studies, Detailed Designs, Preparation of Tender Documents, ESIA, and RAP as applicable for the envisaged identified/selected floods mitigation/adaptation interventions under 4.8. This is to be seen in conjunction with Deliverable No. 1.1	9 Months
WP2, the Final Planning Stage (Integrated Floods Management Plan Preparation, Review and Validation)					
2	2.1	Final Report (section 4.10)	Plan Document	The final planning stage constitutes WP2, during which key stakeholders are engaged in reviewing, and validating an integrated flood management plan for the Yabus River Catchments and associated riverine, inclusive of all the proposed interventions, i.e., with their technical details, investments required, environmental/social considerations, and implementation steps such as tender documents for the prepared ones ready for implementation, and TOR for Feasibility Studies, Detailed Designs, preparation of Tender Documents, ESIA, and RAP for the identified ones.	12 Months

Task Ref.	ID	Deliverable	Type	Explanation and Remarks	Targeted Date (After Commencement)
2	2.2	Validation of an Integrated Flood Management Plan	Workshop	A draft final integrated flood management plan proposal, aimed at ensuring sufficient quality water availability, floods control, and safe/pleasant environment. To be seen in conjunction with Deliverable # 2.1	12 Months
WP3, Commencement of Capacity Building Interventions/Activities (implementation of no regret projects)					
3	3.1	Capacity Building Outputs (section 4.11)	Training manuals/personnel trained/installations/reports/ manuals/etc.	Commencement of Capacity Building Interventions/Activities (implementation of no regret projects) constitutes WP3, during which a capacity building program, comprised of equipment and necessary training modules on integrated flood management and response, including awareness creation materials among participating communities and government officials developed is implemented to empower them on how to respond to flood risks and on how to jointly monitor floods in the Yabus catchments and associated riverine systems.	15 Months
3	3.2	Personnel Trained	Trainees	A concise report of stakeholders'/partners' personnel trained on-the-job during delivery of the consultancy assignment. To be seen in conjunction with Deliverable # 3.1	15 Months
3	3.3	Needs Assessment	Report	Capacity building needs assessment report. To be seen in conjunction with Deliverable # 3.1	15 Months

Task Ref.	ID	Deliverable	Type	Explanation and Remarks	Targeted Date (After Commencement)
3	3.4	Materials/Manuals	Documents	Capacity building program and awareness creation materials/manuals developed. To be seen in conjunction with Deliverable # 3.1	15 Months
3	3.5	Report	Report	Concise report of first training conducted for stakeholders' & partners' personnel on capacity building program. To be seen in conjunction with Deliverable # 3.1	15 Months
3	3.6	Centers strengthened/established	Report	Flood Forecasting Centers strengthened/established for the Yabus catchments and associated riverine systems at national/local level where appropriate in the three countries. To be seen in conjunction with Deliverable # 3.1	15 Months

6. Implementation Arrangements

Administratively, under the overall supervision of ENTRO's Senior Project Coordinator, the Consultant will report to the RCRP Lead Technical Specialist. It is envisaged that the assignment will take up to 15 calendar months, during which the Consultant shall accomplish the tasks prescribed, prepare, and submit the deliverables, in English, in agreed formats, duplicates, and schedule to the Client (refer to Annex 2: Tentative Workplan).

6.1 Reporting and Monitoring of the Outputs

To regularly assessed, and continuously discuss challenges; constraints being encountered and opportunities possible with an aim of ensuring standard work is completed within the agreed timelines: Besides the deliverables schedule, after commencement of work, there will be periodic updates to all stakeholders as appropriate:

1) Weekly, monthly, and quarterly work status and progress reports send by emails, so that results from the activities are shared with the other stakeholders through ENTRO's ED, including with the World Bank, regional task teams, and national working groups to review the Consultants' outputs and provide comments. especially during the major milestones of the project, consultation meetings and validation workshops.
2) Quarterly workplans during the subsequent reporting period.
3) Coordination meetings of the teams engaged in the execution of work and the Client, conducted as deemed necessary to the extent feasible, preferably back-to-back with the joint meetings and workshops involving stakeholders and the other partners. These administrative meetings shall be led by the Consultant's Team Leader and the Client's RCRP Lead Technical Specialist, to identify:
    (i) problems that impede or may impede work progress.
    (ii) opportunities to advance work progress more expeditiously, and
    (iii) any other relevant unforeseen situation/information/issues.
4) A final consultancy report that summarizes the Consultant's work on the assignment, lessons learned, and recommendations towards improving future similar undertakings, and strengthening Water Resources Planning and Management Program implementation at ENTRO.
5) All reports shall be delivered as soft copies (documents like Microsoft Word files and PDF-files – in addition to tables as Microsoft-Excel-files). Only agreed deliverables shall be submitted in 5 high quality hard copies, or in geodatabase/GIS system (Datasets) that includes collected data, models, and user guide/manual.

6.2 Obligations of the Client

The Consultant will be supported by ENTRO's team of experts, comprising of flood risk, water resource planning, modelling, ICT, etc. team. In addition:

1) The Consultant will leverage use of the ICT establishment at ENTRO (remote and physical), including computer /server rooms, developed modelling systems, and any other additional services that can be obtained through it, such as granting access to licenses.
2) The client will facilitate the availability and identification of stakeholders to be involved in the project processes, including interviews, meetings, FGDs, workshops, training sessions, etc.
3) The client will help in organizing events (consultative/review meetings, workshops, trainings, etc.), including through liaising with stakeholders on the selection of participants, venues, etc.
4) Without prejudice to the consultant ultimate responsibility for collecting the required data/information, the Client will strive to provide all relevant data/information (being hydrological, meteorological, and other relevant aspects of the Yabus catchments and associated riverine) at its disposal, and in liaison with the other partners official sources will be availed to the consultant to be used for this consultancy.
5) The client will liaise with the relevant government agencies in the three countries for assistance to:

    (i) Obtain any necessary information and documents required from them, which the Client considers essential for conducting the assignment.

    (ii) Grant access to locations, which the Client considers essential to be visited during conducting of the assignment.

6) The client will supervise, provide comments, approve the consultancy work, and pay their dues as per the contract in a timely manner.

6.3 Administration and Coordination of the Consultancy Work

1) Effective working relationships with ENTRO and other regional and national team members and stakeholders are an important element of this consultancy.

2) ENTRO must ensure that the performance of the work is in line with the TOR and related norms, and the Consultant's team leader must ensure that the Consultant's team activities are consistent with the work plan, cultural and national sensitivities of the EN countries, and high professional standards.

3) ENTRO must ensure that the Consultant make appropriate efforts to ensure that there is equitable stakeholder access to trainings, workshops, consultations and/or other services of the consultancy such that there is neither direct nor indirect discrimination because of gender, age, disability, ethnicity, or similar personal factor.

4) ENTRO must ensure that the Consultant consider and incorporate comments from national and regional stakeholders.

5) All Consultant travels to and from (and within) the project area under the EN Basin for the purpose of this consultancy or liaison with the community of agencies, stakeholders, and others, must be documented in the work plan that the Consultant and ENTRO will finalize at the beginning of the consultancy. Travel or schedule deviations from the work plan will likely arise, and these must be cleared through ENTRO. The Consultant must maintain an up-to-date work plan throughout consultancy as contingencies arise.

6) The Consultant will also be responsible for planning, in consultation with ENTRO, and conducting regional workshops and training described in the scope of work. However, travel expenses for participants of the meetings (excluding the Consultant's staff) and organization costs (including provision of meeting facilities and amenities) will be provided by ENTRO.

6.4 Consultant Qualification Requirements

The Consultant Firm should demonstrate experience in i) conducting of floods' assessments, and management plans; ii) catchment management plans, including stakeholder engagement, participatory planning as well as hands–on experience in community-based project planning, implementation, capacity building, and management; and iii) transboundary water issues.

Generally, the Consultant's team shall demonstrate experience in i) topographical/hydrometeorological data collection/analysis; ii) geo-spatial (GIS/RS) analysis; iii) hydrologic modelling of watershed/catchment, and flood plains; iv) information management systems; v) watershed/catchment, and flood plain socio-economic analysis; vi) flood hazard, exposure, impact, and risk mapping/analysis; vii) water resources engineering, and management; viii) hydrology; and ix) Procurement aspects.

The Consultant shall be able to demonstrate a sufficiently experienced team. Specifically, the Consultant's team needs to include the following experts:

1) **Team Leader**: The team leader must have extensive experience working in developing countries with significant knowledge in project planning, participatory methods, and capacity building activities coupled with technical understanding gained through a career working in water resources development and management in complex situation

involving multidisciplinary teams and myriad of stakeholders in different transboundary and ecosystems/environmental contexts. The total expected level of efforts for the Team Leader is eight (8) person-months distributed over 15 months, and he/she will have:

(i) a minimum qualification of MSc or equivalent in either water resources engineering, hydrology, or related specialisations coupled with a proven related basic qualification (i.e., bachelor's degree in civil engineering or equivalent in related fields).

(ii) a minimum of at least 15 years of regional and international professional experience in developing countries, including in relation to floods impact/analysis, water resources development, management, and modelling and related software applications.

(iii) Knowledge of integrated land and water resources management and hands–on experience in community-based project planning, management and capacity building will be an added advantage.

2) **Water Resources Modeller:** The main role of the modeler is to develop hydrologic and hydraulic models to produce flood hazard, vulnerability, and risk maps. He/she shall be responsible for i) model set-up, calibration, validation, and its application; and ii) quality control and assurance of data input, processing outcomes and the results. The total expected level of efforts for him/her is five (5) person-months distributed over 15 months, and he/she shall have:

(i) at least a minimum qualification of MSc. degree or equivalent in water resources engineering, hydrology, hydraulics, or closely related specialisations (coupled with a proven related basic qualification, i.e., bachelor's degree in water resources management/engineering, hydro-informatics, information management systems, physical sciences, or equivalent in other related fields).

(ii) a minimum of 10 years proven/demonstrated professional working experience in data acquisition, and processing; hands-on GIS, and remote sensing applications; and hydrometeorological modelling, hydrological analysis, and flood extent/risk mapping/modelling.

3) **GIS/Remote Sensing Specialist:** The total expected level of efforts for him/her is five (5) person-months distributed over 15 months, and should possesses:

(i) a relevant MSc., master's degree or equivalent in GIS or Remote Sensing or related specializations coupled with a proven related basic qualification in Climatology, Geography, physical sciences or equivalent in related fields.

(ii) at least 5 years proven/demonstrated professional working experience in the use of remote sensing and GIS in water resources mapping/analysis especially watersheds/catchments mapping/assessments.

4) **Sociologist with economics insights:** He/she shall be responsible for analysing non-physical vulnerabilities and social impacts for each flood prone community by County/Locality/Woreda. These should include considering factors such as vulnerability by gender and income or livelihood groups, and socio-economic conditions. The total expected level of efforts for him/her is four (4) person-months distributed over 15 months, and he/she shall have:

    (i) A minimum qualification of a MSc or equivalent in either sociology or closely related fields such as anthropology, agricultural economics, or related specialisations coupled with a proven related basic qualification, i.e., bachelor's degree in arts/humanities or equivalent in related fields.

    (ii) At least 15 years working experience in social impacts' assessments, including in relation to flood impacts/risks analysis, as well as demonstrated experience working in transboundary contexts.

5) **Institutional and capacity building specialist:** He/she shall be responsible for analysing institutional and policy frameworks. These should include considering factors such as understanding of community engagement principles, theories, and best practices; stakeholders' involvement; and institutional development. The total expected level of efforts for him/her is four (4) person-months distributed over 15 months, and he/she shall have:

    (i) A minimum qualification of a MSc or equivalent in either public administration or closely related fields such as community development, or related specialisations coupled with a proven related basic qualification, i.e., a bachelor's degree in a relevant field such as communications, public relations, or equivalent in a related discipline.

    (ii) At least 10 years professional working experience in engaging communities and institutions for effective projects planning, and implementation in diverse cultures; and institutional strengthening (training of personnel and provision of support) as well as demonstrated experience in conducting stakeholders' consultations, including in transboundary contexts.

6) **Procurement specialist:** He/she shall assist in all procurement aspects under the consultancy performance, including preparation of tender documents and TORs, as appropriate. The total expected level of effort for him/her is two (2) person-months distributed over 15 months, and he/she shall have:

    (i) A minimum qualification of a MSc or equivalent in either procurement or closely related fields such as finance, management, administration, contracts, business, and supply chain; or related work experience, coupled with a proven related basic qualification, i.e., a bachelor's degree in a relevant field such as accounting, commerce, and engineering.

    (ii) At least 10 years of experience as Procurement Specialist or have had responsibilities with an exposure to understanding of principles underlying

good procurement practices with international and multidisciplinary development agencies and organizations.

6.5 Level of Effort and Budgetary Mode

The approximate budget for this Consultancy is indicated in the Request for Proposals. The contract shall be a lump-sum contract, but the Consultant's proposal shall indicate a detailed breakdown of costs by expenditure categories. The consultant will be paid per person-month (5 person-month) in accordance with negotiated and agreed rates upon submission of deliverables or accomplishment of tasks. The payment includes all the Consultant's costs, comprising of professional fees, costs for travel for consultant team, communication, stationery, reproduction of documents, and any other inputs required for the consultancy outputs/deliverables.

The Consultant will also be responsible for planning and conducting regional workshops and training described in the scope of work. However, travel expenses for participants of the meetings (excluding the Consultant's staff) and organization costs (including provision of meeting facilities and amenities) will be provided by ENTRO.

The cost of any data and/or specialized software required to be made available for the consultancy, including all license fees, shall be indicated separately in the Consultant's proposal; and shall become the Client's property accordingly after acquisition and use.

However, the Consultant is advised that the budget for this consultancy is limited, and the Consultant will need to be innovative in task scheduling and resource utilization.

Any additional services outside the ones described in this TOR and further amendments during contract negotiations/implementation shall be subject to prior written approval by the Client.

7. References

1) FAO-UNHCR Joint Floods Assessment and Mitigation/Adaptation Plan, at a Pre-Feasibility Study level, Bunj and the Surrounding Areas, Maban County, Upper Nile State, November 2021.
2) Flood Vulnerability and Contingency Plan, Mapping and Assessment Report by REACH accompanied with Housing Design Report by ACTED, Warrap State, South Sudan, 2013.
3) Chapters 2, Annex 3 and associated data of the Republic of South Sudan (RSS) Irrigation Development Master Plan (IDMP), 2015.
4) Eastern Nile Groundwater Atlas and Hydrogeology Maps with an explanatory note, ENTRO, Addis Ababa, Ethiopia, 2019.

5) Eastern Nile Multi-Sector Investment Opportunity Analysis (MSIOA), Summary Report, ENTRO, 2017.

6) Baro-Akobo-Sobat Multi-Purpose Water Resources Development Study Project, ENTRO, Addis Ababa, Ethiopia, 2017.

7) Cooperative Regional Assessment (CRA) for Watershed Management Project in the Eastern Nile, Baro-Sobat-White Nile Sub-Basin Transboundary Analysis, ENTRO, Addis Ababa, Ethiopia, 2006-7.

8) Eastern Nile Joint Multipurpose Program (JMP) Reports, ENTRO, Addis Ababa, Ethiopia, 2008.

9) One-System Inventory Annex: Baro-Sobat-White Nile Sub-Basin, ENTRO, Addis Ababa, Ethiopia, 2009.

10) Eastern Nile Planning Model (ENPM) Project, Final Report, Water Balance Model for the Eastern Nile Basin, October 2012, submitted by Hydrologist Dr Ahmadul Hassan.

11) Machar Marshes Eco-Hydrology Assessment Project, Final technical report, HYDROC GmbH for ENTRO, November 2020.

12) BARO AKOBO SOBAT WETLANDS KNOWLEDGE BASE CONSULTANCY DRAFT REPORT, BUSULWA HENRY SSEBULIBA CONSULTANT, WETLANDS AND BIODIVERSITY, 12 June 2012.

13) Machar Marshes Wetland Economic Valuation of Biodiversity and Ecosystem Services for Green Infrastructure Planning and Development, Final Technical Report, prepared for NBI by Dawit Woubishet Mulatu (PhD) (Principal Consultant) Etsehiwot Semreab (Team Member), Tiruwork Arega (Team Member) Tinebeb Yohanes (GIS expert), April, 2020.

14) Report No: PCBASIC0272713, International Development Association, Project Appraisal Document on, a Proposed Grant in the Amount of US$4 Million Equivalent to the Eastern Nile Technical Regional Office for a Regional Climate Resilience Program for Eastern and Southern Africa, the World Bank

15) Toxic Floods? Climate, Natural Hazards, and Risks to South Sudan's Oil Infrastructure. A remote sensing and hydrological model analysis by PAX, with contributions from Utrecht University, The Netherlands, May 2023.

16) Eastern Nile Technical Regional Office (2006). Project Preparation: Flood Preparedness and Early Warning, Technical Background Paper. Volume 1: Main Report. ENTRO

17) Eastern Nile Technical Regional Office (2006). Project Preparation: Flood Preparedness and Early Warning, Technical Background Paper. Volume 2: Appendices. ENTRO

18) Eastern Nile Technical Regional Office (2007). Project Preparation: Flood Preparedness and Early Warning, Project Implementation Plan. ENTRO

19) Eastern Nile Technical Regional Office (2018). 3rd Annual Eastern Nile Flood Forum. Enhancing Flood Forecast and Early Warning in Eastern Nile Basin. Proceedings. ENTRO

20) Eastern Nile Technical Regional Office (2020). Concept Note for Nile Cooperation for Climate Resilience (NCCR) project proposal. Flood Forecasting and Early Warning Enhancement Project. ENTRO

21) Eastern Nile Technical Regional Office (2020). EN-FFEW Enhancement Summary Report. Eastern Nile Technical Regional Office (ENTRO) Flood Forecasting and Early Warning Enhancement Project. ENTRO.

22) Eastern Nile Flood Risk Mitigation (EN-FRM) Project. "Work Package 2 - Enhancement of the Eastern Nile Flood Forecasting and Early Warning System (EN-FFEWS) and Flood Risk Mapping" – Undergoing.

Annex 1: Rationale for this Feasibility Study Consultancy Services

The Eastern Nile (EN) region is extremely vulnerable to floods. A report by EAST AFRICA Seasonal Monitor, 31st July 2021 indicates that the onset of the June to September main rainfall season in the northern sector of East Africa began earlier than normal. Rainfall generally ranged from above average to average in Sudan, much of western Ethiopia, and parts of South Sudan, resulting in excessive streamflow in the Blue and White Niles; and Baro-Akobo-Sobat sub-basins of the Nile River and elevates flood risks. Starting in August, a series of torrential downpours overwhelmed streams and rivers, unleashing floods that affect hundreds of thousands of people and destroyed tens of thousands of homes across the north-eastern Africa nations. So far, the flooding in 2019, 2020 & 2021 appeared to be the most extremes. Extreme flood events may become more common in future because of changes in the weather, which are resulting in a wetter climate over the headwaters of the Nile and more water reaching the river and its tributaries, a scenario that calls for "good land use practices, building of defences against floods, actions at the local/national levels, and government agencies must work closely with river basin organisations" (Andrea Zerboni, Associate professor, University of Milan, authored under Creative Commons licence on September 27, 2020).

A1.1 The Eastern Nile (EN) Flood Preparedness and Early Warning Project (FPEW)

The Integrated Development of the Eastern Nile (IDEN) is an ENSAP project agreed by the member countries in 2002. IDEN consists of several subprojects, one of which focuses on flood preparedness and early warning - the Eastern Nile (EN) Flood Preparedness and Early Warning Project (FPEW) – as floods in the Eastern Nile basins have significant impacts on livelihoods and economies in the region. The Flood Preparedness and Early Warning System (FPEW) project focused on enhancing regional collaboration and national capacity in flood risk management, including flood mitigation, flood forecasting and early warning, as well as flood emergency preparedness and response. The project has been implemented in two phases FPEW I and FPEW II.

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. It delivered a platform for institutional settings and data/information collection/sharing at community and national levels, together with enhancing regional coordination and cooperation with the recommendation for subsequent phases. FPEW I was concluded in 2010.

ENTRO under the FPEW I phase created a regional Flood Forecast and Early Warning System (FFEWS) under the Eastern Nile Planning Model project (ENPM) and the FFEW activity continued under the Nile Cooperation for Result project (NCORE). The FFEW system has continuously been implemented since 2010 for every flood season (June–September). The FFEW system has helped the EN countries in reducing the loss of life and money by preparing flood forecast bulletins for the three flood-prone areas of (i) Lake Tana (Abbay/ Blue Nile-Ethiopia), (ii) Blue Nile - Main Nile (Sudan), and (iii) Baro-Akobo-Sobat (Ethiopia, South Sudan, and Sudan) sub-basins.

Over the last 10 years (2010-2020) of implementation, the FFEW system has not covered the White Nile regime from Malakal to its confluence with the Blue Nile at Khartoum, which also receives inflow from catchments extending towards the uplands west of Ethiopia past south-eastern Sudan with considerable streams north/below/downstream the BAS system, notable of which is River Yabus. Although a complementary exercise is being carried out under the same RCRP in South Sudan, on how to improve water resources monitoring, including with the installation of gauges, this river system being a transboundary, cannot be treated under the South Sudan RCRP component.

A1.2 The Yabus River System

As came in the FAO-UNHCR Joint Floods Assessment Report for Bunj, Maban County, Upper Nile State (UNS), South Sudan, November 2021: Depicted in figure 1, River Yabus, with catchment area of 6,046 km^2 (RSS Irrigation Development Master Plan, IDMP, 2015), originates from Asosa watershed in the far west of Ethiopia with a steep slope of up to 6 degrees, and flows west into the Sudan past the town of Yabus near the borders with Ethiopia and South Sudan, where its bed slope becomes mild (ranging from 0 to 1 degree).

From Bunj town (figure 2), the HQs of South Sudan's Maban County, the Yabus turns southwest and enters Machar Marshes into which River Daga (that also originates in the west of Ethiopia) and Khor Machar (that spills from River Sobat) flow. When the Machar Marshes get filled, River Adar rises and flows into the White Nile at the town of Malut. The other rivers are Khor Tombak/Yale, which also originates from the far west of Ethiopia and flows west into the Sudan, past the town of Kurmuk and then outfalls into Rive Adar.

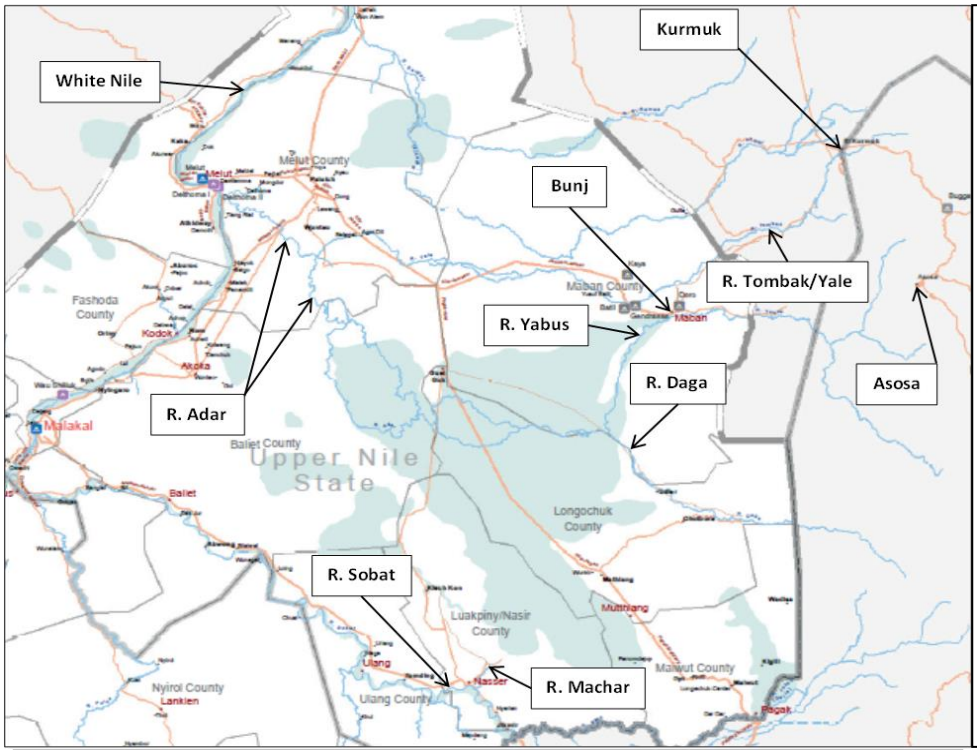


Figure 1: Study Area Snapshot from South Sudan Reference Map (REACH, 15th June 2017)

A1.3 Floods in the Yabus River System

Flooding in Yabus is triggered by annual precipitation. As such seasonal river discharges are determined by water volume and sediment load transported along the watercourses down the gradient from upper watershed areas. The surcharge from the flows, in addition to local rainfall determines the magnitude and frequency of floods in the flat or low-lying areas. In essence, flooding occurs in such a way that when rivers fill, the water overtops and breaks their banks at some places along their courses, creating several breakaway points that follow specific depressions, creating overflow channels that crisscross one another, forming a system of flooded and dryland zones, especially in the plains of Maban where several refugee camps are currently located, largely occupied by people fleeing armed conflict in the Sudan's Blue Nile and Southern Kordofan States.

The White Nile balance over the years has been influenced by the construction of the Jebel Aulia dam (1937) above/upstream the confluence with Blue Nile, southwest of Khartoum. The dam reservoir backwater curve tail extends up to Malut. Also, the high Blue Nile levels act like a natural dam, partially preventing the free passage of waters of the White Nile, creating a flooding mechanism depicted in Annex 1-1. As such the Adar River mouth at Malut and its source of Machar wetland act as a reservoir that also withholds the inflowing rivers of Yabus, Daga and Khor Machr, bringing to a standstill the rivers linked to Machar marshes water balance and the White Nile upstream of Malut (Figure 2).

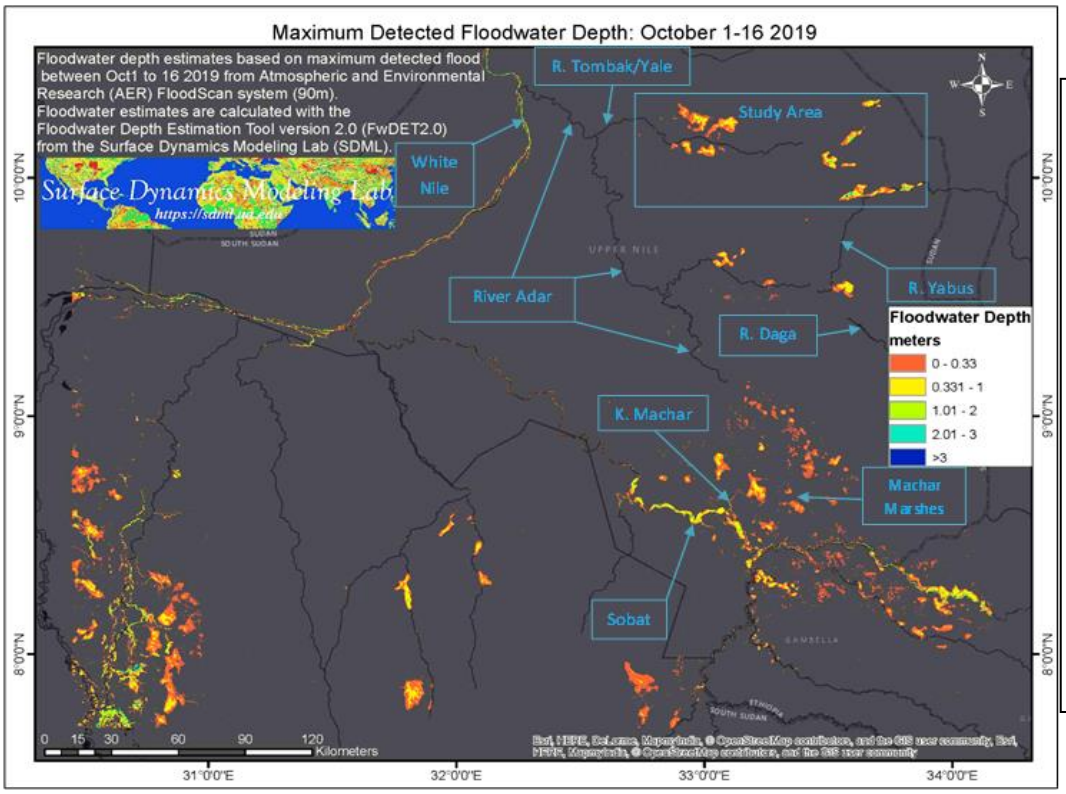


Figure 2: Floods Storyline (FAO-UNHCR Assessment, Maban County, UNS, RSS,

A1.4 Characteristics of the Focus Area

In Maban, as of 2013, apart from WFP, UNHCR and several NGOs are based in Bunj, supporting the refugee camps with stable relief services (Figure 4). There is fair road network that links Bunj with its centres and beyond to the Sudan and then to Ethiopia, and internally within the country. Some of these roads become unusable due to flooding during the months of annual wet season.

Locals move by foot when the roads are not usable and the towns are continuously served via airfields, which are also obstructed by flooding, as can be seen the picture in Figure 3.

Figure 3: Submerged Bunj airstrip in October 2019 (©UNHCR, 24th Oct. 2019)

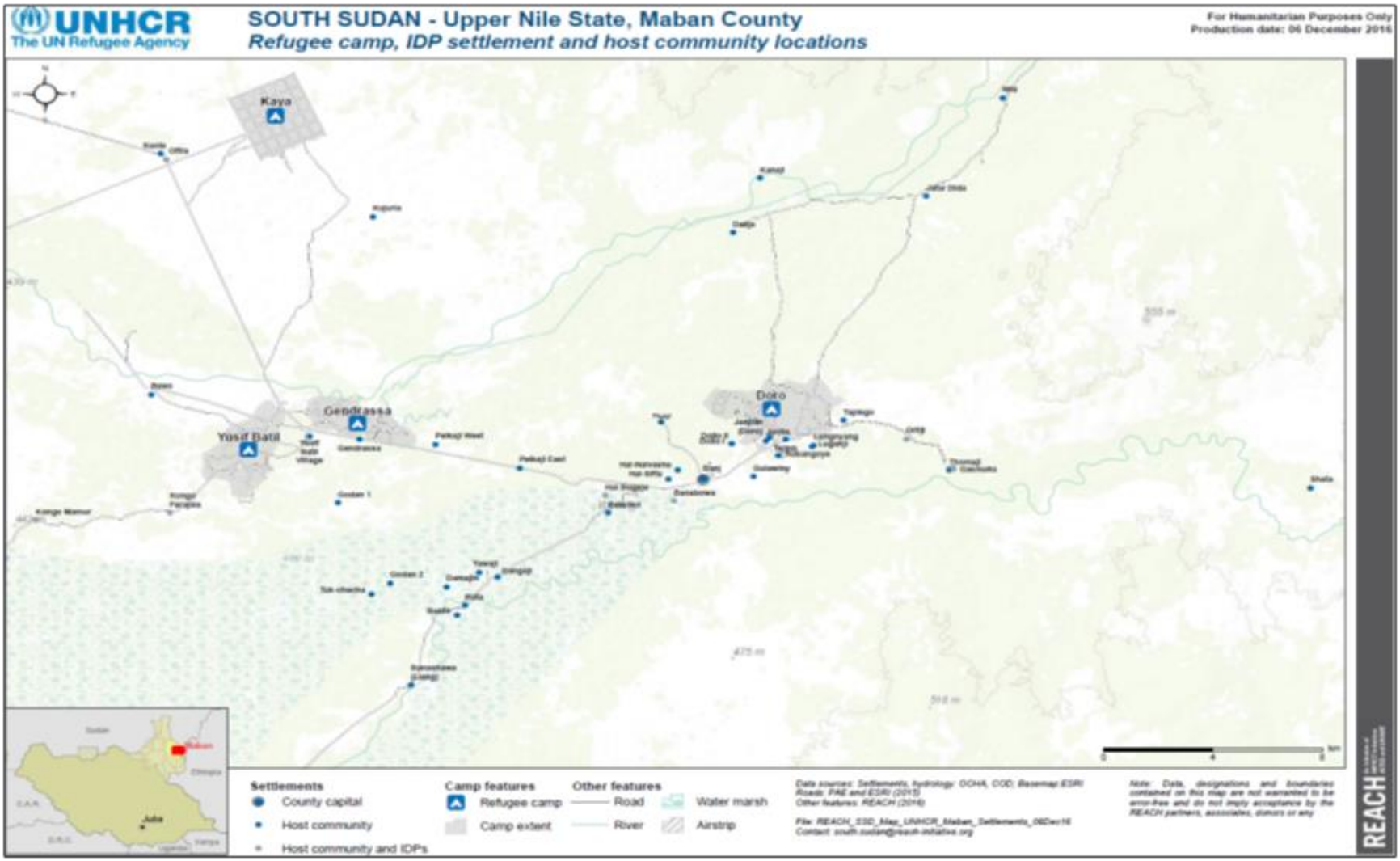


Figure 4: Maban County Village Map showing Refugee Camps (UNHCR, 6th December 2016 in FAO-UNHCR Assessment, Nov. 2021)

A1.5 Spatial and Seasonal Scarcity of Water

In the same flat or low-lying areas prone to floods, scarcity of water is another reality. The rainy season may come late or pause early, because of the climate change. While some parts may be flooding, others may lack the necessary sources of water for watering livestock or irrigating small-scale crop fields. Too much rain or not enough water in different places is a constant issue. Either way, there is food scarcity and hunger in many areas of the country.

Both the floods in River Yabus low-lying areas from river discharges determined by water volume and sediment load transported from upper catchments; and 2) the White Nile backwater curve effects are transboundary in nature. But the lack of transboundary flood management guidelines to guide the three countries to protect the communities in this area causes a huge hindrance to create resilience and bilateral trade exchanges. ENTRO aims to provide member states with an opportunity to explore transboundary solutions to impacts of climate change through supporting joint analysis, planning and implementation of climate resilient interventions to address climate risks and uncertainty in the basin while improving preparedness of basin countries to flood and drought risk.

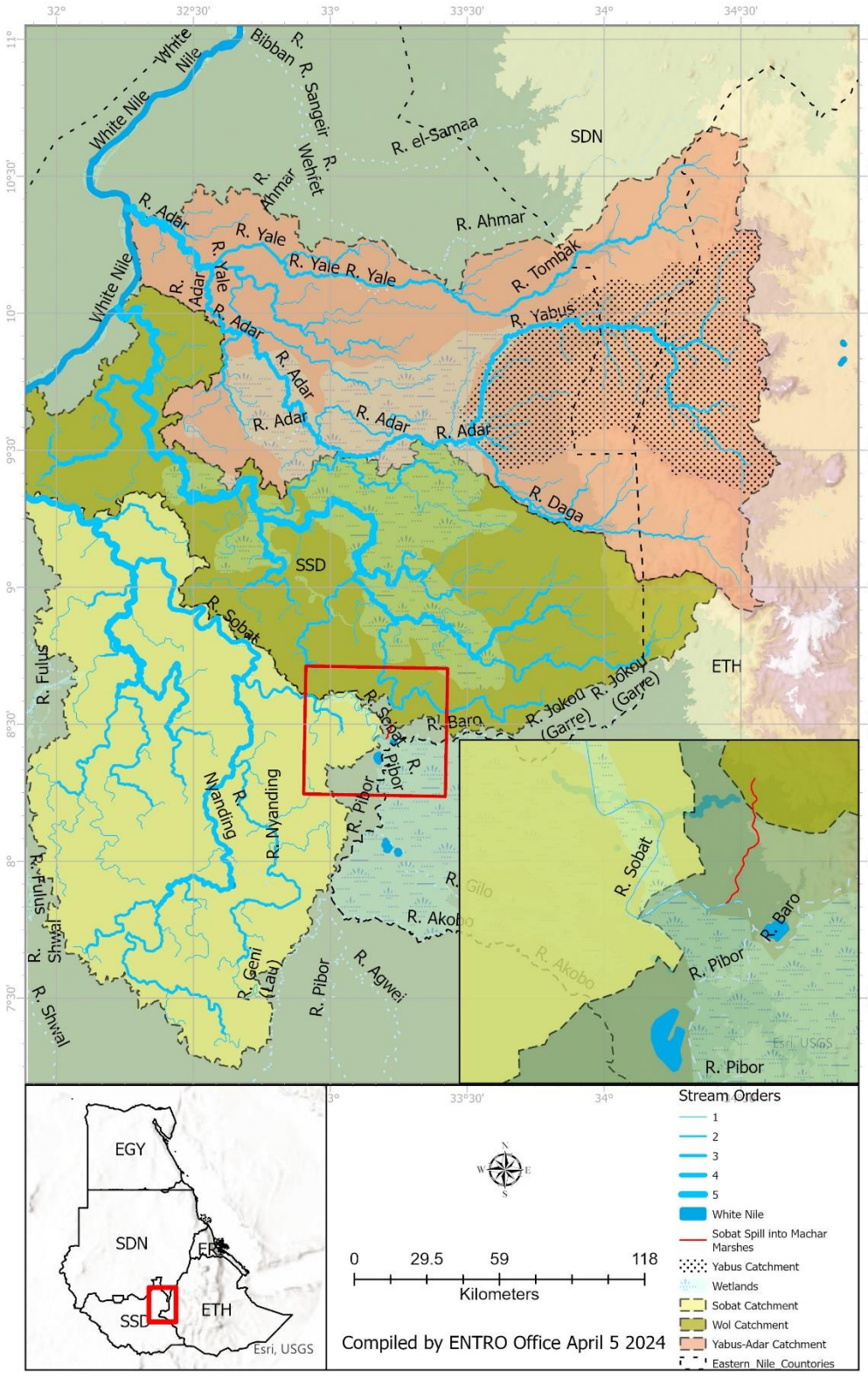
A1.6 Petroleum Exploitation

Petroleum exploration and production activities, are taking place within the White Nile catchments, including the plains of River Yabus and associated rivers or water bodies, both in South Sudan and the Sudan (see blocks 3 & 7 in Annex 1-2). A presentation entitled "Toxic Floods? Climate, Natural Hazards and Risks to South Sudan's Oil Infrastructure"[2] by Pax for Peace, May 2023, depicts Seasonal Flooding, Climate Change, and Flood Risk/Impact of Oil Blocks in the project area (Annex 1-3).

As such, the Yabus and associted rverine/waterbodies system extents impacted jointly by climate change flooding risk is delineated and depicted in Figure 5.

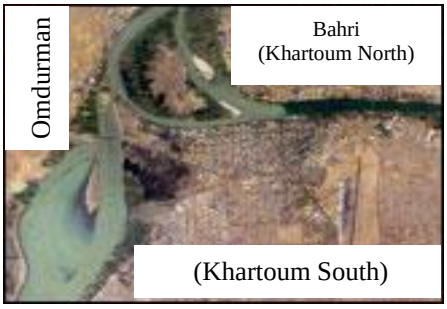
[2] file:///F:/Reading%20Materials/RCRP%20Lead/PAX_Toxic%20Floods.pdf.

Figure 5: River Yabus Catchments and Associted Rverine/Waterbodies

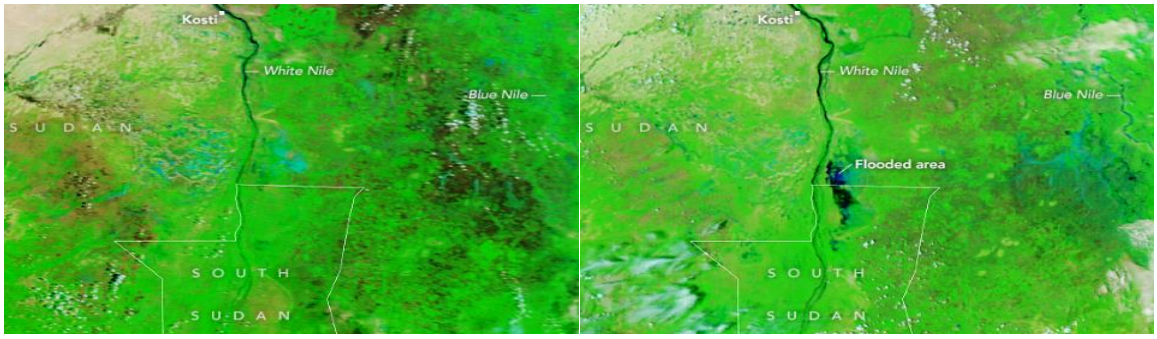


Annex 1-1: White Nile Backward Flow from Junction with Blue Nile

Portrayed in the NASA Earth Observatory images by Lauren Dauphin, using Landsat data from the U.S. Geological Survey, the story by Adam Voiland goes: Sudan's capital city, Khartoum, translates as "Elephant's Trunk." The name describes shape of the Nile where the rivers of Blue (from east) and White (from southwest) Niles unite to form the Nile River that flows northward through Sudan into Egypt, and into Mediterranean. On the western side of the junction is Omdurman, on the north-eastern junction is Khartoum North and on the junction is Khartoum South. Together they makeup "Greater Khartoum, the triangular capital of the Sudan.

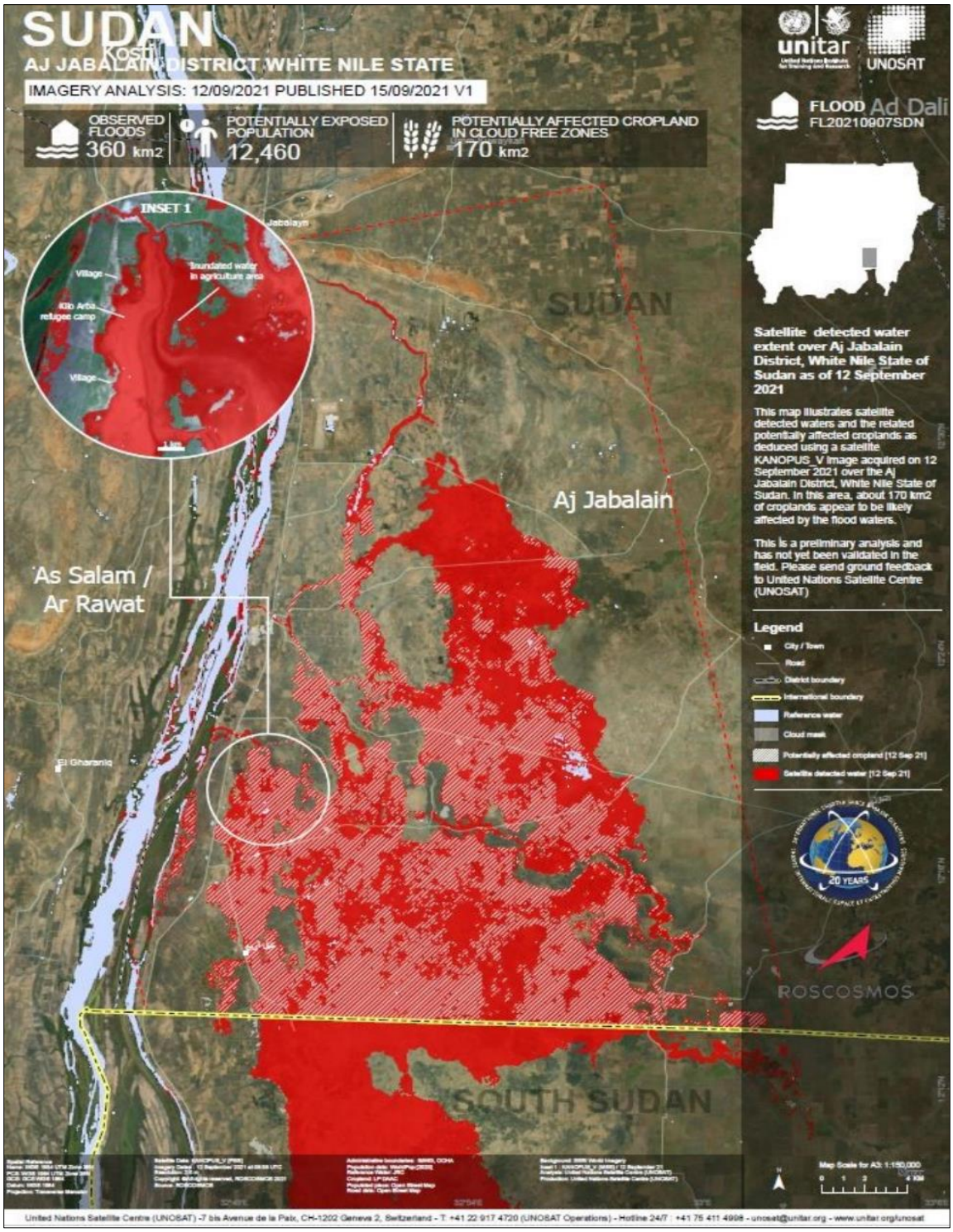


The White Nile originates in equatorial regions, where rainfall occurs almost throughout the year, and as a result it flows at a nearly constant rate. The Blue Nile, which flows out of the Ethiopian highlands, where rainfall is more seasonal swells with rains from the summer monsoons and the flow at these times can be so great that the volume is too much for the river's channel, causing the White Nile to flow backward from the junction with Blue Nile. September 2021 fit that pattern. Starting in August, a series of torrential downpours overwhelmed streams and rivers, unleashing floods that affected hundreds of thousands of people and destroyed tens of thousands of homes across the north-eastern Africa nations. Some of the hardest hit areas were along the White Nile. On September 16, 2021, the Visible Infrared Imaging Radiometer Suite (VIIRS) on NOAA-20 acquired a false-colour image of flooding near the border of Sudan and South Sudan (left on September 16, 2015 and right on September 16, 2021) [3].



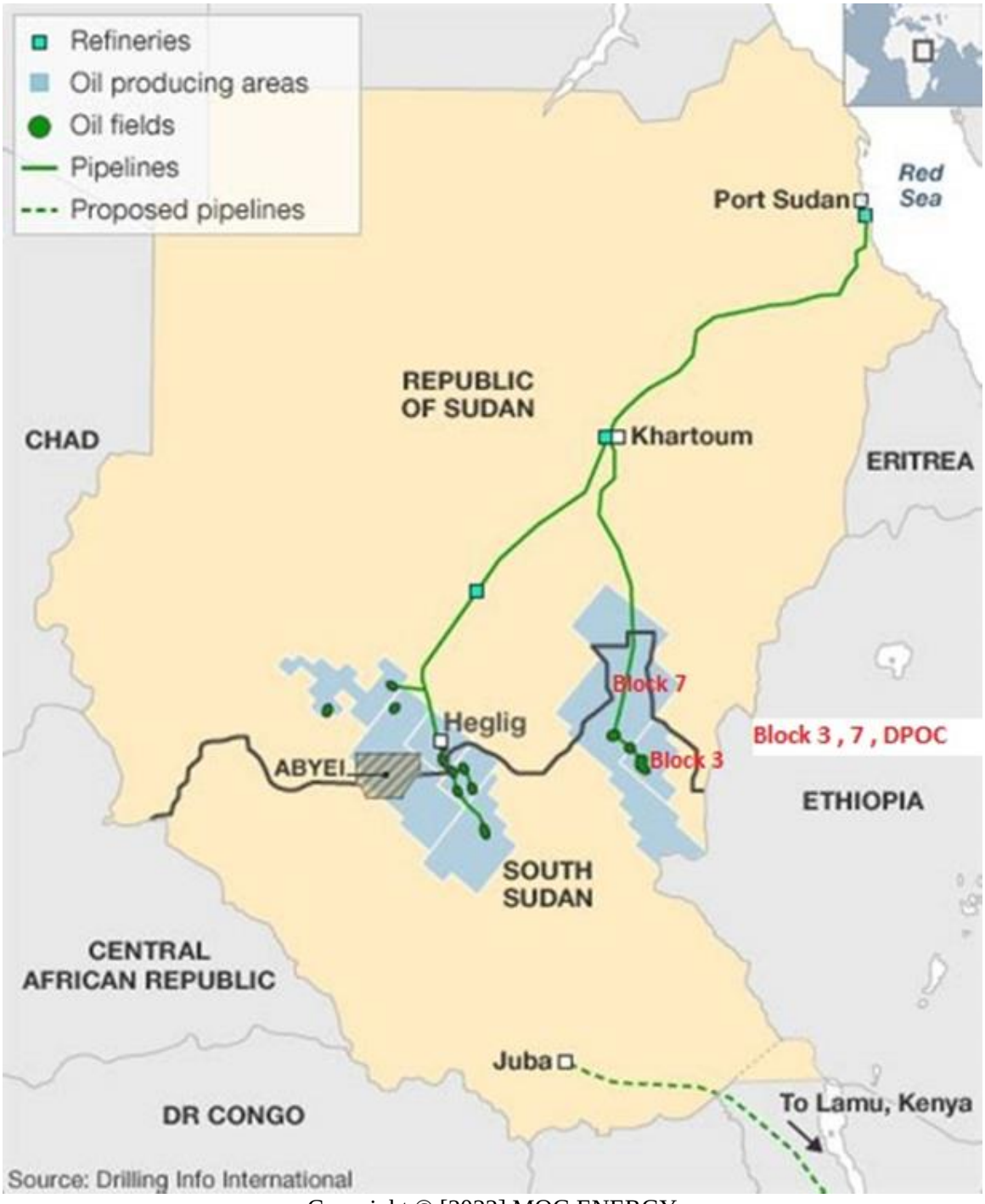
For comparison, the left image shows the same area in September 2015, a year when flooding did not cause major problems in this area. So far, the flooding in 2021 appears to be less extreme than in 2020.

[3] https://earthobservatory.nasa.gov/images/148848/floods-along-the-white-nile.

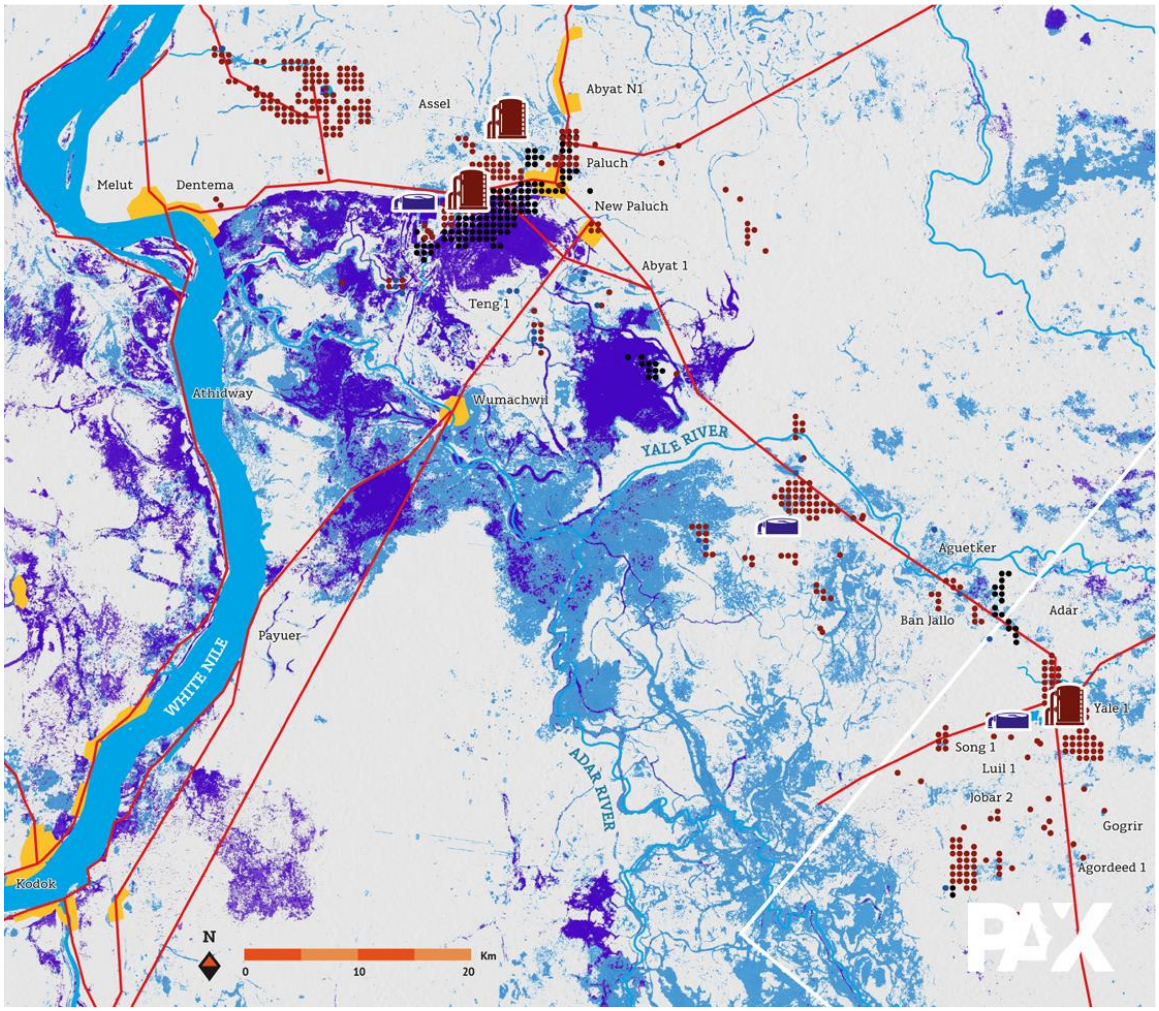


Flooding over El-Jebelein in the Sudan & its extent into South Sudan (September 12th, 2021)

Annex 1-2: Oil Production Blocks in South Sudan and Sudan



Annex 1-3: Seasonal Flooding, Climate Change, and Flood Risk/Impact of Oil Blocks



Annex 2: Tentative Workplan

EASTERN NILE TECHNICAL REGIONAL OFFICE (ENTRO)

Regional Climate Resilience Project (RCRP)

Annual Work Plan 2023/2026

Components	Activities	2023						2024												2025												2026											
Component 2: Climate resilient infrastructure and assets management	***Sub-component 2.1:*** **Closing the Climate Resilient Infrastructure Gap**	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2.1.1	**Yabus Watershed Feasibility study for flood management interventions (baseline, flood management interventions, FFEWS, Early warning and flood protection implemented).**																																									
2.1.1.1	Consultancy Services for Yabus Watershed Feasibility study for flood management interventions in three WPs with few months of overlapping in three years (30 months). **WP1: Baseline study including development of floodplain topography map, asset map, community survey; also status of the Yabus Catchments**, causes, magnitudes, flood plains (flood paths) - identify and assess the progression of flooding by sources (spill and/or direct rainfall), by Yabus River sub-catchmenst (Maban, Bunji flood plains) spills using historical high resolution satellite data from at least five major flood year; development of maps on flood hazard, flood vulnerability, and flood risk; establishment of FFEWS for Yabsu watershed (12 months). **WP2: Feasibility study for flood management interventions** (structural and non-structural) include their social, Economic and Environmental Impact Assessment, and also developing investment plan for the interventions. The prioritized flood management interventions includes institutional structures for flood disaster management, Flood Management Plans, and Guidelines for responses to flood impacts, etc. {including Production of Knowledge products, identification of potential water storage; update Yabaus FEWS system (13 months overlap with phase I by 5 months). **WP3: Implementation if selected cost effective flood management interventions** (at least one structural and one non-structural) and assessing its effectiveness. Moreover consultant will (1) procure and installation of staff gauges for flood alert and indicated flood escape route; communication equipment (radio and mobile) to be used by community and Flood Task Team in Yabus; (2) developed and place flood map zone border using concrete post (with elevation data) for 50 & 100 years return period zones, based on the Phase I hazard maps (15 months overlap with phase II by 6 months).																																										
2.1.1.2	**Preparation of detailed TOR for the Consultant assignment (virtual and physical):** Including drafting, review and consultative meetings for joint review of draft TOR (ENTRO, the Technical Officials from Ethiopia, South Sudan and Sudan / The RCRP Technical Working Group members and the World Bank).																																										
2.1.1.3	**Stakeholder Engagements:** Field visits to identified project operation centres for the Yabus River Catchment and associated riverine (Asosa in Ethiopia, Bunj & Paloch/Malut in South Sudan, and Kurmuk in Sudan) to establish contacts with key stakeholders/partners on the ground, conduct field reconnaissance, and consult with Countries stakeholders during inception phase of the preliminary assessment towards floods management in the Yabus Catchment and associated riverine system.																																										
2.1.1.3.1	**Entry/Planning Phase:** Public-community sensitization and awareness meeting in the Yabus River Catchments and associated riverine, to introduce the project to local communities and authorities; and to identify, map and engage key stakeholders (regional planning meeting at ENTRO).																																										
2.1.1.3.2	**Entry/Planning Phase:** Public-community sensitization and awareness meeting in the Yabus River Catchments and associated riverine, to introduce the project to local communities and authorities; and to identify, map and engage key stakeholders (Bunj and Paloch/Malut in South Sudan).																																										
2.1.1.3.3	**Entry/Planning Phase:** Public-community sensitization and awareness meeting in the Yabus River Catchments and associated riverine, to introduce the project to local communities and authorities; and to identify, map and engage key stakeholders (Kurmuk in Sudan).																																										
2.1.1.3.4	**Entry/Planning Phase:** Public-community sensitization and awareness meeting in the Yabus River Catchments and associated riverine, to introduce the project to local communities and authorities; and to identify, map and engage key stakeholders (Assosa in Ethiopia).																																										

2.1.1.4	**Validation Workshops:** Inception, interim, and final study reports (3 Stakeholder review and validation workshops for study draft outputs)	
2.1.1.4.1	**Inception Phase (Inception Report Write-up, Review and Validation):** Engage key stakeholders during validation workshop of an inception report of the preliminary assessment of floods and feasibilty study workplan in the the Yabus River Catchments and associated riverine (Bunj, Maban County, Upper Nile State, South Sudan).	
2.1.1.4.2	**WP1, the Interim Phase (Baseline Preparation, Review and Validation):** Engage key stakeholders during validation workshop of a baseline/interim report of hydrological studies, floods mapping/assessments, and pre-feasibility study of the proposed structural/non-structural flood interventions in the Yabus River Catchments and associated riverine (Juba, South Sudan).	
2.1.1.4.3	**WP2, the Final Planning Stage (Integrated Floods Management Plan preparation, Review and Validation):** Engage key stakeholders during validation workshop of an integrated flood management plan for the Yabus River Catchments and associated riverine, inclusive of all the proposed interventions (i.e., with their technical details, investments required, environmental/social considerations, and implementation steps such as tender documents for the prepared ones ready for implementation, and terms of references (TOR) for Feasibility Studies, Detailed Designs, preparation of Tender Documents, ESIA, and RAP for the identified ones (Addiss Ababa, Ethiopia).	
2.1.1.5	**WP3, Commencement of Capacity Building Interventions/Activities (implementation of no regret projects):** A developed capacity building program, comprised of equipment and necessary training modules on integrated flood management and response, including awareness creation materials among participating communities and government officials must be implemented to empower them on how to respond to flood risks and on how to jointly monitor floods in the Yabus catchments and associated riverine systems.	
2.1.1.6	**WP4, routinely/continuous capacity building activities (including knowledge products and systems, e.g., FEWS update):** Continuous reading of gauges, recording/processing of data, updating of FEWS and publishing of relevant information.	
2.1.1.7	**Procurement of consultancy services:** Preparations of Expressions of Interests, Evaluations of Expressions of interest, shortlisting of consultancy firms, Advertisements in Regional papers (for the EOI); and Evaluations of Technical and Financial Proposals and Contracting.	
2.1.1.7.1	Advertisement of EOI in National, Regional and International Newspapers	
2.1.1.7.2	Evaluations of Expressions of interest, shortlisting of consultancy firms (Virtually)	
2.1.1.7.3	Evaluations of Technical Proposals (Physical)	
2.1.1.7.4	Evaluations of Financial Proposals (in-house)	
3.1.1	Enhance Flood Community Awareness and Preparedness	
3.1.1.1	Update the design of flood preparedness and EW system for Communities for selected Hotspot (escape route, sirens system, flood shelters, communication tools – mobile / radio), develop guideline (SOP) document (Validation work for the Main Consultancy work 2.1.1)	
3.1.1.2	Consultation, review and validation workshops; Awareness Creation, Outreach and Dissemination communication, trainings, and demonstrations (at least three Workshops/meetings, including gsupply of goods for the mainatenances of escape route, flood zone posts, etc)	