

Sudan Water Sector Strategy

2021 - 2031

The Promise of the Ministry of Irrigation and Water Resources to Transform the Livelihoods of the People of Sudan



TABLE OF CONTENTS

1. ABBREVIATIONS **2**

2. MESSAGE FROM THE MINISTER, MINISTRY OF IRRIGATION AND WATER RESOURCES **4**

3. EXECUTIVE SUMMARY **7**

4. SCOPE AND VISION **15**

5. ANCHORING PILLARS **17**

5.1. National Irrigation Transformation Plan 17

5.1.1. Situation Analyses: Challenges and Opportunities 17

5.1.2. Transformative Packages 21

5.2. National Water Supply Transformation Plan 30

5.2.1. Situation Analyses: Challenges and Opportunities 30

5.2.2. Transformative Packages 40

5.3. Water Resources Management Transformation Plan 53

5.3.1. Situation Analysis: Challenges and Opportunities 53

5.3.2. Transformative Packages 67

6. CROSS CUTTING ISSUES **75**

6.1. Water Quality 75

6.2. Climate Change and Variability 75

6.3. Gender, People with Special Needs, and Inclusion 75

6.4. Refugees and Displaced People 76

7. ACCOUNTABILITY AND TRANSPARENCY IN DELIVERABLES AND IMPACT BY 2031 **77**

8. ENABLERS AND THEMATIC GUIDING PRINCIPLES **85**

8.1. Overall Approach 85

8.2. Thematic Guiding Principles 85

9. IMPLEMENTATION ARRANGEMENTS **89**

9.1. Implementation Approach 89

9.2. Management Structure 89

9.3. Monitoring and Evaluation, Knowledge Management, Networking and Innovation 90

9.4. Resources Mobilisation - Financing the Water Sector Strategy 91

10. STRATEGIC PLANNING HISTORY **93**

1. ABBREVIATIONS

BOT	Build, Operate, Transfer
CBM	Community Based Management
CGIAR	Consultative Group on International Agricultural Research
CSO	Civil Society Organization
DWSU	Drinking Water & Sanitation Unit
FAO	Food and Agricultural Organization
FEWS	Floods Early Warning System
GDP	Gross Domestic Product
GWWD	Groundwater and Wadis Directorate
HRC	Hydraulic Research Centre - Sudan
ICARDA	International Research for Agriculture in the Dry Areas
IWRM	Integrated Water Resources Management
MetaMeta	The Difference in Water, Land and People
MoANR	Ministry of Agriculture and Natural Resources
MoE	Ministry of Education
MoFEP	Ministry of Finance and Economic Planning
MoH	Ministry of Health
MoIWR	Ministry of Irrigation and Water Resources
NCWR	National Council for Water Resources
NGO	Non-governmental organization
NITP	National Irrigation Transformation Plan
NSAS	Nubian Sandstone Aquifer System
NWAP	National Water Allocation Plan
NWC	National Water Corporation
NWD	Nile Water Directorate
NWRM-TSP	National Water Resources Management Transformation Plan
NWS-TP	National Water Supply Transformation Plan
O&M	Operations and Maintenance
PPP	Public Private Partnership
PRMU	Partnership and Resource Mobilization Unit

R&D	Research and Development
RCWH	UNESCO Regional Centre for Capacity Building in Water Harvesting
RM	Resource Mobilization
NSC	National Steering Committee
SDG	Sustainable Development Goals
SWC	State Water Corporation
TCBD	Training and Capacity Building Directorate
UNEP	United Nations Environmental Programme
UNICEF	United Nations Children's Fund
USAID	United States Agency for International Development
WaPOR	Water Productivity through Open-access of Remotely sensed derived data
WB	World Bank
WRMC	Water Resources Management Councils
VFM	Value for Money
WASH	Water supply, Sanitation and Hygiene

2. MESSAGE FROM THE MINISTER, MINISTRY OF IRRIGATION AND WATER RESOURCES



Professor Yasir A. Mohamed,
Minister of the Ministry of Irrigation and Water Resources



I am pleased to share this Sudan Water Sector Livelihoods Transforming Strategy with all our partners as we collectively embark on a rapid, yet thoughtful, path to transform this critical sector that has largely been neglected for the past three decades.

Unlocking the full potential of the Sudan water sector is a huge challenge, but it is a struggle we can and must win through good vision, planning and joint commitments to achieve our four absolute priorities: eradicating hunger and poverty, enhancing food security and livelihoods; creating dignified job opportunities, particularly for the rural youth and women; peace and domestic tranquility.

The Strategy will move from Vision to Impact in the decade 2021 – 2031 through the following three complementary transformative plans:

- The National Irrigation Transformation Plan (NITP)
- The National Water Supply Transformation Plan (NWS-TP)
- The National Water Resources Management Transformation Plan (NWRM-TP)

Employing these three transformative

components of the plans as a vehicle, the Sudan Water Sector Livelihoods Transforming Strategy promises four impacts by 2031:

- A functional water resources management system with the necessary instruments and capacities to close disparities and inequalities within Sudan and facilitate harmony with its neighbours
- All Sudanese people in rural and urban areas, including nomadic communities and their livestock, have improved access to adequate, affordable and safe water supply
- Some seven million Sudanese farming and herding community members are food secure and enjoy better livelihoods
- Dignified and rewarding employment opportunities for about two million Sudanese, particularly rural youth and women are made available.

Twenty to thirty per cent of these achievements are set as a milestone for the end of the 2023 Transition Period. The Ministry of irrigation and Water Resources will earnestly work with all partners to identify and respond to peoples' needs and shape facilitative policies, enable investments in peoples' institutions and infrastructure, and to mobilize and deliver value-adding inclusive services to the benefit of all.

This Livelihoods Transforming Strategy is the product of extensive consultations with various partner institutions and robust internal and external reviews conducted from May to December 2020. This participatory process enriched the content and grounded the Strategy in the local context and shared priorities of the Ministry and the water-sector community active in the country.

On behalf of the Ministry, I would like to convey profound gratitude to every institution and individual that shared their time, perspectives and expertise throughout the strategy development process. The Ministry is fully committed to successfully implementing the Strategy and harnessing its dividends for the deserving people of Sudan.



3. EXECUTIVE SUMMARY

This Sudan Water Sector Livelihoods Transforming Strategy (SWS-LTS) aspires to deliver improved access to water resources for all, as a basic need for domestic use, in its productive sense for agriculture and livestock, in its social sense of equity and coordination among all competing users for sustainability, and in its environmental sense of doing no harm by seeking synergies and complementarities.

In more specific terms, the ambition of SWS-LTS is to contribute to four key priorities of the Sudanese Government and the Ministry of Irrigation and Water Resources (MoIWR): (1) eradicate hunger and ensure food security for at least seven million people in rural farming and herding communities, 2) create a dignified and rewarding employment opportunities for about two million Sudanese, in particular rural youth and women, 3) provide all Sudanese with safe, adequate and accessible water supply services, and 4) contribute to peaceful co-existence among all competing water users. These priorities are very much akin to the focus of the Sustainable Development Goals (SGDs) 1, 6 and 8.

To deliver this four-fold ambition, the MoIWR will lead by example in three critical areas: developing and implementing a facilitative policy and participatory and transparent governance; a paradigm shift in commitment to self-lived roles and responsibilities of all involved stakeholders, and an exponential increase in mobilizing resources coupled with a corresponding absorptive stakeholder capacity in realising the required investments. The Ministry has already established a dedicated Partnership and Resource Mobilisation Unit (PRMU) and a task-force to lead the policy review and development task.

The SWS-LTS will be operationalised through three coherent and impact-driven transformative strategic plans:

1. The National Irrigation Transformation Plan (NITP)
2. The National Water Supply Transformation Plan (NWS-TP)
3. The National Water Resources Management Transformation (NWRM-TP).

National Irrigation Transformation Plan

In the past three decades, the Sudan Irrigated agriculture sector has faced several challenges: lack of investment in new irrigation developments; ageing and partially functioning irrigation facilities; non responsive policies and institutions; and gaps in human resources and institutional capacities. These inadequacies have resulted in a poorly performing irrigation sector characterized by inefficient use of water, low cropping intensity and productivity, and the concentration of irrigation developments in a limited area of the country causing wide disparities in socioeconomic development.

The National Irrigation Transformation Plan (NITP) strives to mitigate the challenges and unlock the promise of the sector through five priority interventions: (1) Infrastructural and institutional upgrading and modernization of 1.1 million Ha of irrigated land, informed by successful pilots; (2) Development of 400,000 Ha of newly irrigated land, benefiting from new water storage facilities along the Atbara and Blue Nile rivers; (3) Improvement of water productivity, with at least 50% more crop per drop in both the existing and new irrigation schemes, through introduction of low to no-cost measures such as the optimization of irrigation duties and schedules to deliver immediate results without a long gestation period; (4) Strengthening of institutions and human resources capacity building for irrigation staff, farmers' representatives, and other relevant actors through short and long term trainings, internships, and secondments as well as on-the-job knowledge and experience exchanges; and (5) Contribution to the implementation of facilitative policies and transparent and participatory governance systems.

Collectively, these interventions are expected to transform the irrigation sector and deliver tangible results for the Sudanese people. Livelihood impacts include reduced poverty and improved food security for nearly seven million farming and herding community members, and nearly one-and-half million new employment opportunities, particularly for rural youth and women. On the human resources and institutional strengthening front, about 3,000 irrigation staff (50% of the Ministry workforce), roughly 500 young professionals, and 1,000 farmers' representatives will enhance their knowledge and skills in leadership, management, and the operational and practical aspects of irrigation development and management. Facilitative policies, governing rules, and enforcement mechanisms will create an enabling environment for these improvements.

National Water Supply Transformation Plan

The Sudan water supply sector has been facing major challenges that have contributed to deteriorating and poor services, elevated prevalence of water related mortalities and morbidities, and localised conflicts due to tension over finite water resources.

The challenges in the water supply sector can be categorized into three types of limitations:

1. Institutional: limited human resources; weak coordination (both vertical within subnational entities and horizontal with other sectors); unclear mandates, roles, and responsibilities; and no regulatory functions to ensure adequate water supply services
2. Technical: variable services and millions of citizens without adequate access to safely managed water supply services, lack of technical standards and guidelines, climate change and climate variability, and increased demand due to population growth and urbanization trends
3. Financial: limited investment and financing, limited reinforcement of transparency measures, limited focus on sustainability and cost recovery, low tariffs that do not adequately cover Operation and Maintenance (O&M) costs, and limited engagement and enabling environments for private sector participation.

As a result, some 18 million members of the rural communities, or about 63% of the country's nearly 30 million rural residents, depend on a water supply that is intermittent and unsafe due to contamination. Nearly 42% of Sudan's urban households with estimated 15 million residents do not have access to a water supply network, and those who have, suffer from poor quality and unreliable service. Many also resort to purchasing water from unregulated water tankers and vendors to augment their limited network supply, further endangering their health, lives, and livelihoods.

The National Water Supply Transformation Plan (NWS-TP) takes stock of these challenges and outlines the opportunities and potential impacts of the provision of water supply on health outcomes (reduction of health costs related to a lack of water and inadequate sanitation); education outcomes (improving school environment and contributing to a reduction in absentees and dropout rates among young girls); and economic outcomes (nurturing a healthy, fully contributing workforce; and productive livestock sector) and peace outcomes (building trust in historically marginalized



communities). In more specific terms, the plan endeavours to mobilise resources for the construction, upgrading, and modernisation of some 25,000 gender-sensitive and disabled-friendly basic and safely managed water supply facilities. These interventions are expected to generate about half million employment opportunities. The ultimate goal is for all Sudanese people in rural and urban areas, including nomadic communities and their livestock, to have affordable access to a safe water supply.

The NWS-TP also provides a framework for sector planning that aims to shift interventions from piecemeal ad hoc interventions that were primarily in the humanitarian sphere to a holistic development approach. It outlines implementation modalities, highlighting roles and responsibilities of sector actors and mechanisms for coordination to ensure alignment for sanitation and hygiene with relevant ministries (Ministry of Health, Ministry of Infrastructure and Transport). Addressing water supply for critical institutions such as schools and health facilities are discussed in the plan, and recommendations are outlined for effective and coordinated database management, monitoring and evaluation, and reporting and joint planning.

The National Water Resources Management Transformation Plan

Water Resources Management, as is currently practiced, cannot support strategic direction on what water needs to be allocated where and how, both for people's priorities and for the overall socioeconomic growth of the country. This new National Water Resources Management Transformation Plan (NWRM-TP) delineates how the country's future development and ambitious growth trajectories, which largely depend on how well its water resources are managed, will be unlocked. It focuses on the revitalization, enforcement, and development of new regulatory and facilitative policies, strategy frameworks, and roadmaps towards normative foundations during the transition period and beyond to 2031.

Putting water sector challenges in perspective, most water resources management challenges stem from a rigid exploitative legacy anchored in the assumption that water problems can be solved by supply driven, linear, normative engineering solutions. The need for participatory and accountable governance of water resources, largely overlooked in the past, is now explicitly addressed. Mindset changes and institutional transformations to streamline coordination, unravel complexity, and achieve broad societal partnerships to manage water resources offer immediate and long-term solutions.

The main internal challenges facing the Water Resources Management sub-sector include: the lack of investment in new data and integrated water resource development; ageing and partially functioning support facilities; non-responsive and non-aligned state and federal institutions and conflicting policies; limitations in accountability of governance (legal and institutional); and significant gaps in human resources and institutional capacity development. Externally, the challenges of climate change are real and need urgent attention, as does the challenge of responding to natural disasters (over 90 % are water related, including drought, flood, and tropical storms), with significant detrimental impact on societies and the Sudanese economy. In the past three decades, exacerbated by climate change, these inadequacies have resulted in poorly functioning water resource management systems and uninformed decision-making on irrigation, drinking water, and environmentally friendly water use, protection and development. Sudan has been unable to ensure broad societal water access and sustainable growth, or to limit the negative impacts of droughts or floods on the economy, environment, or society.

To overcome these challenges and harness the full potential of an improved national water sector (compliant with international conventions), this NWRM-TP promises three impacts:

1. Fulfilment of institutional reform ambitions, implementation of catchment plans, and empowerment of water councils
2. Standardization of oversight, facilitative means, and alignment of competencies and policies between federal and state levels
3. Coordination and quality assurance of data for monitoring, assessment, allocation, development, and planning of the water resources.

To achieve these impacts, the NWRM-TP embraces established IWRM principles, catchment-based, community-led water resources management practices, and multilevel water governance relevant to the context and specificities of Sudan.



Overall Implementation Approach

Detailed programmes and projects will operationalize the Sudan Water Sector Livelihoods Transforming Strategy (SWS-LTS). In a major departure from the past, a systemic approach will replace fragmented, ad-hoc interventions insufficiently informed by target beneficiary priorities. Data and careful diagnosis of problems across the water system spectrum will guide the design and implementation of programmes and projects. A detailed analysis will also be undertaken on the benefits and the unintended negative impacts on all users, including upstream and tail-end, small and large beneficiary groups, and marginal segments of the population, including youth and women. The programmes and projects will be mutually reliant; they may also be implemented in parallel and at any period within the 10-year lifespan of the SWS-LTS. That said, to deliver fast and visible results that correspond to needs and can be felt by the beneficiaries and the public at large, it may be useful to prioritise low-cost quick-win interventions. This could favour the upgrading and modernization of existing water facilities over starting with the long-term implementation and gestation cycles of new developments.

The formulation of the SWS-LTS has extensively engaged various national and international partners active and interested in the Sudan water sector. As the Strategy moves from vision to action on the ground, the Ministry will build upon the networks established and nurture transformative partnerships with relevant institutions that complement each other technically, bringing them together for effective resource mobilization. These institutions must share a common goal of realizing tangible impact on the ground to significantly enhance the lives and livelihoods of the vast agrarian population of Sudan. The SWS-LTS provides the framework and the means to communicate and engage with other sectors and Line-Ministries within the Sudanese Government as well as with other relevant organizations, including the private sector and farmer organizations, development and funding institutions, service providers, think-tanks, and academia.



4. SCOPE AND VISION

Purpose: The Sudan Water Sector Livelihoods Transforming Strategy strives to fulfil the aspiration of the deserving Sudanese people and deliver fast and visible results through expanding and improving the performance of irrigation schemes for a resilient irrigated agriculture in the country, servicing the population with reliable and accessible water supply and managing its water resources with the objective of satisfying the social, economic and environmental needs of the population.

Objective: This Livelihoods Transforming Strategy of the Sudan establishes the direction and priorities for water sector interventions in the coming 10-years up to 2031 in line with the general transformation of society. The Strategy describes the contribution that the Ministerial portfolio will make to resolve the pressing challenges in irrigated agricultural water use, drinking water supply and water resources management.

Vision: The aspiration of the Sudan Water Sector Livelihoods Transforming Strategy is that the MoIWR, aligned and compatible with efforts undertaken by other Cabinet Ministries, will be at the forefront of effective water use, water supply and water resource management. The Ministry will create value adding infrastructure, data and services while improving the utilisation of the available resources for a highly rewarding water sector that opens up many opportunities for the deserving People of Sudan: freedom from hunger, malnutrition and poverty; dignified and gainful employment; decent living standards for men, women and youth. The Strategy will be a major contributor to inclusive economic growth and a healthy environment.

The **vision** to transform livelihoods will move **into impact** on the ground in the decade 2021 – 2031 through three complementary anchoring pillars: (a) The National Irrigation Transformation Plan, (b) The National Water Supply Transformation Plan, and (c) The National Water Resources Management Transformation Plan.





5. ANCHORING PILLARS

5.1. National Irrigation Transformation Plan

5.1.1. Situation Analyses: Challenges and Opportunities

Sudan is blessed with nearly 84 million Ha of cultivable land and renewable water resources estimated at a total annual supply of 32 billion m^3 (20.5 billion m^3 from the Nile yield, 4.8 billion m^3 from renewable groundwaters, and 6.7 billion m^3 from seasonal streams outside the Nile system). This is in addition to adequate rain fall for rain-fed agriculture and range land, particularly in the southern parts of the country. Yet, over the past four decades, the contribution of the once versatile agriculture sector to the country's Gross Domestic Product (GDP) has declined from over 50% in the early 1960s to below 30% in 2019 (World Bank, 2020[1]). The consequences are visible: Sudan sits at the bottom end of the global food security index (93rd out of 113 countries), it is the 7th most vulnerable country to climate shocks and the 14th least prepared. Years of isolation have also left Sudanese irrigation professionals, farmers, and other stakeholders with limited opportunities for capacity development. Section 5.3 further elaborates on the Sudan water resources and their respective varied uses.

The seasonal and inter-seasonal variability of rainfall, which is already a major challenge in the country, is predicted to increase. The average temperature is also likely to increase, resulting in increased evapotranspiration. Both of these outcomes are a result of climate change. Together, they are expected to lead to the increased vulnerability of rain-fed agriculture and rangeland. Irrigation development based on adequate water management and supported with sufficient water storage facilities is considered to be among the most powerful mitigation measures against climate change. It provides more stable and reliable access to water, which is essential for the sustainable enhancement of productivity and reversal of the deteriorating trend in the agriculture sector.

[1] https://www.theglobaleconomy.com/Sudan/share_of_agriculture/

Although it occupies only about 10% of the total national cropped area, the irrigation sector contributes approximately 50% of the value of national agricultural products and provides gainful, decent employment that sustains over ten million livelihoods. Most of the important value chain crops such as sugar cane, wheat, and all vegetables and fruits are produced only through irrigated agriculture.

Unlocking an optimized, fully operational irrigation sector in Sudan is a significant challenge and a major opportunity. The impact would go beyond water use and would trigger a transformation of society. For example, the 2 million Ha irrigated in the four national large-scale irrigation schemes alone could, if properly performing, directly and indirectly create over 3 million jobs and contribute immensely to the improvement of food and nutrition security, raise national income and exports, and boost import-substitution. Improved performance of the irrigation sector is also expected to contribute to the achievement of two Sustainable Development Goals (SDGs) that are among the top priories of the Sudan: SDG (1) "Ensure zero hunger and food security for all" and SDG (8) "Promote sustainable economic growth, full and productive employment and decent work for all."

Some of the main challenges for an improved irrigation sector include the lack of investment in new irrigation developments, as well as inadequate, ageing, and non-functional irrigation facilities and non-responsive institutions. These inadequacies, combined with lack of proper governance structures and facilitative policies and institutional and human resources capacity, have resulted in a poorly performing irrigation sub-sector characterized by inefficient use of water and low cropping intensity and productivity. The resilience of most rural livelihoods is thus compromised.

Unbalanced socioeconomic development in different parts of Sudan is also a major challenge to address. Historically, investments in irrigation developments have prioritized the revenue-rich, easy to develop and use water resources available from the Nile and its tributaries. The other sources, such as groundwater and seasonal streams, have received much less attention because of their relatively costly and technically difficult development and exploitation. This has concentrated irrigation developments in a limited area of central Sudan, creating large socioeconomic disparities between different parts of the country and resulting in considerable social injustice for large segments of the population. To deal with this challenge, special attention will be given, whenever possible, to irrigation interventions that sustainably develop non-Nile water resources.

Box 1: Opportunities vs challenges

There is much potential to be harvested and water, not land, is the most limiting natural resource for expanding irrigated agriculture, as 85% of Sudan's 84 million Ha of arable land remains fallow. For instance, roughly only 50% of the estimated 1.2 million Ha currently equipped with irrigation infrastructure through large-scale national irrigation schemes (Gezira, Rahad, New Halfa and Suki) enters the cultivation cycle annually. Only about one-third of the 900,000 Ha equipped with irrigation infrastructure through the medium- and small-scale pump irrigation schemes along the Nile system is under cultivation annually. A similar picture is seen in the seasonal flood-based irrigation schemes (Gash, Tokar and Abu Habil), which offer large potential estimated at 500,000 Ha, but the actual cultivated area rarely exceeds 120,000 Ha annually. In spite of this, a large part of the Nile water goes unused, along with billions of m^3 from seasonal streams and renewable groundwater. An interactive water auditing system and real-time water balances (at different scales along sectors and value chains) requiring innovative, and transboundary water resources management will contribute to better identifying further opportunities.



Figure 1 Ageing main-canal regulator in the large-scale Gezira irrigation scheme needing urgent maintenance and upgrading to support improved irrigation water management and distribution (Credit: Professor Bart Schultz)

Box 2: Cautious optimism

The regulation of the flow of the Nile and its tributaries by the recently developed storage facilities creates considerable opportunities for irrigation expansion in Sudan. There are also some bright spots raising optimism that with effort, significant improvement is attainable. Pioneer farmers in the Gezira large-scale irrigation scheme achieved 6 ton/ha wheat productivity (2019/20 season). They introduced good field water management measures that mitigated the unreliability of irrigation supply and uneven water distribution in the field. In the Gash flood-based scheme, champions doubled the productivity of the major sorghum crop from 0.9 to 2.0 ton/ha while reducing water consumption by 30% (interventions piloted by the Ministry of Irrigation and Water Resources and development partner, MetaMeta - Netherlands). In Darfur, local irrigation institutions, with support from the United Nations Environmental Programme (UNEP), introduced floodwater harvesting, bank protection, and community managed soil fertility Improvement practices. These integrated interventions improved fodder and food production and contributed to greater harmony between the pastoral and agricultural communities.



Figure 2 Vibrant wheat harvest by some Gezira farmers through best irrigation water management and farming practices. Upscaling such bright spots is central to this Strategy (Credit: Wail Abdelgalil and Abu Obeida, MoIWR)

5.1.2. Transformative Packages

This National Irrigation Transformation Plan (NITP) represents a quantum leap in the development of irrigated agriculture and the corresponding delivery of services. It outlines the 10-year priorities of the irrigation sector, thus providing a common framework for all irrigation water management and development interventions. The NITP also provides the means to communicate with other sectors and Line-Ministries within the Sudanese Government as well as with other institutions that share similar interests, in particular, the private sector and farmers' organizations, multilateral development banks and Green Funds, bilateral aid organizations, UN organisations and diplomatic missions, service providers, think-tanks, and research and academia.

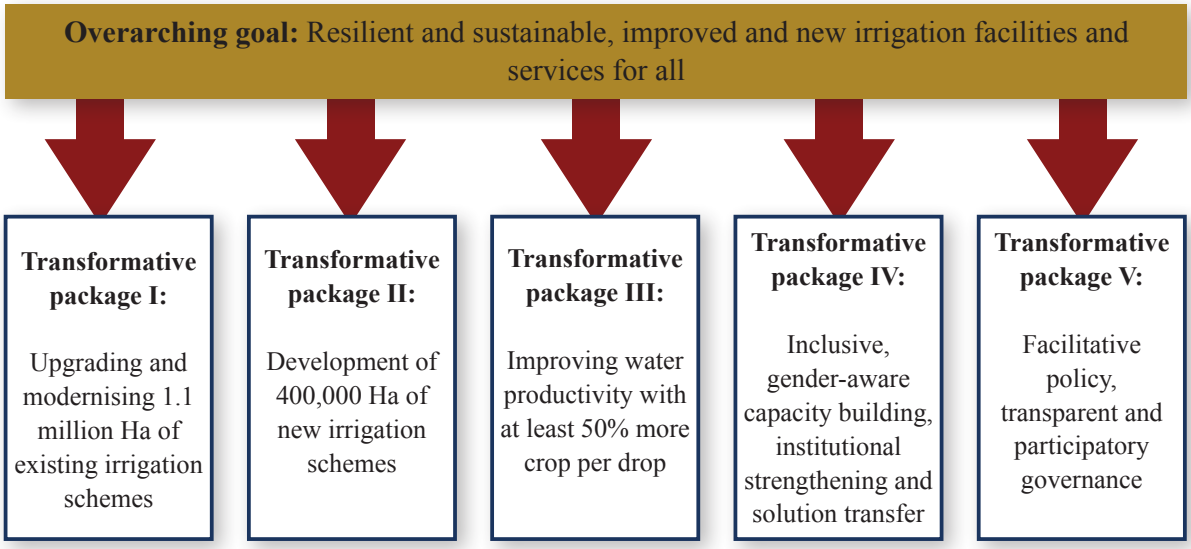


Figure 3 Framework for the National Irrigation Transformation Plan

Transformative Package (TP I): 1.1 Million Ha of Irrigation Schemes Upgraded and Modernized

This Transformative Package (TP) includes the sustainable upgrading and modernization of about 1.1 million Ha of irrigated land (400,000 Ha in large-scale existing national irrigation schemes, 300,000 Ha in medium-sized pump schemes, 300,000 Ha in seasonal flood-based irrigation schemes, and 100,000 Ha in small pump

schemes). This will be realized through improved infrastructure, proven best water management practices, and smart technologies fortified by competent institutions and facilitative policies.

These interventions are expected to increase productivity (kg/Ha) by at least 50% to improve food security among nearly 5.5 million farming and herding family members and create some 300,000 employment opportunities, particularly for rural youth and women. They are also expected to result in considerable water saving (see TP III) that can be used to increase cropping intensity by some 0.2 million Ha (see Table 1), leading to an additional 400,000 jobs and the livelihood enhancement of around 1 million rural farming people. This will also boost production for export. The potential here is significant, as each year, 60% of the estimated 2.6 million Ha of large, medium, and small-scale irrigation schemes currently equipped with infrastructure remains fallow (see box 1).



Figure 4 A sample of medium-sized pump schemes that will be rehabilitated (Credit: Yasir A. Mohamed, MoIWR)

The installation of solar pumps to upgrade and modernize irrigation systems that use groundwater for small-scale irrigation schemes will contribute to significant reductions of socioeconomic disparity. These upgrades will bring development programmes to marginal areas away from the Nile and the central part of Sudan—regions that have long benefitted from substantial irrigation investments.

Here and across TPs II and III (outlined) below, the participation of the private sector will be encouraged and facilitated. The private sector could play a pivotal role in a number of areas, including the supply of irrigation facilities (pipes, gates, pumps, solar panels, etc.); machinery and technical support for Operation and Maintenance (O&M); new irrigation development; farming inputs (fertilisers, seeds, etc.); and marketing value chains.

TP II: 400,000 Ha of Newly Developed Irrigation Schemes

Making use of additional water (see Box 2 on water audit and water balance) from the Blue Nile and Atbara River made available as a result of the new water storage developments, the 10-year NITP aims to expand the irrigated area in the country by 400,000 Ha through new private sector irrigation developments. This is expected to have the following major impacts: (a) create 800,000 employment opportunities for Sudanese people, particularly rural youth and women, (b) enhance food security and increase agricultural production for export, and (c) significantly reduce poverty among some 250,000 rural poor farming and herding families by increasing food, fodder, and domestic and livestock water supply. Care will be taken that new irrigation development does not lead to adverse socioeconomic disparities or exclusion.

TP III: Improving Water Productivity with 50% More Crop Per Drop

This TP aims at improving water productivity by at least 50% across the 1.1 Million Ha of existing irrigation systems through upgrading and modernization, and across the 0.4 million Ha that will be newly developed. An assessment of the Food and Agricultural Organization (FAO) WAPOR[2] database shows that Sudan has one of the lowest biomass outputs per volume of water used (Box 3). Experts believe that



Low-cost interventions to improve water distribution and productivity in Gash flood-based irrigation scheme (Credit: Amira Mekawi, HRC)

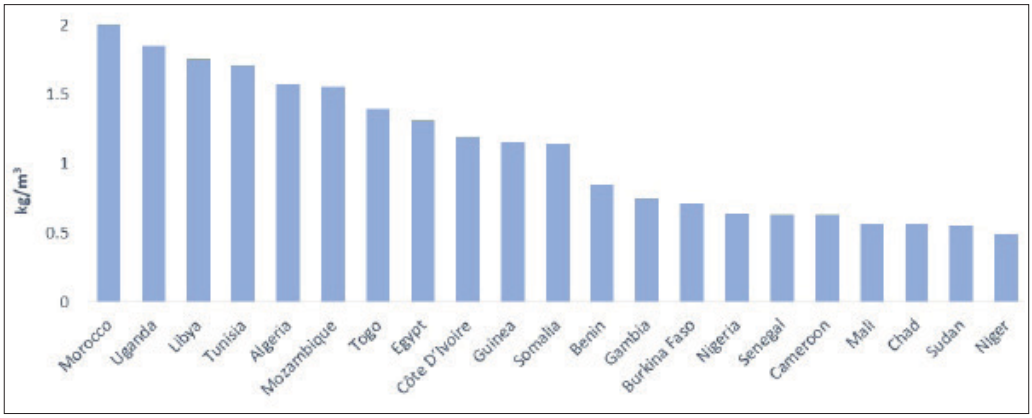
improving water productivity in irrigated agriculture by an average of 50% is feasible with 'low-to-no-cost' measures: improving water distribution rules and optimizing irrigation duties and water delivery schedules in terms of water volumes and irrigation intervals. In addition, there is considerable scope to better control leaks, improve drainage (including reusing drainage water), and introduce an array of smart measures that promote better water management at farmer field level. Such interventions often yield immediate results without a long gestation period. Moreover, improved water efficiency brings several other benefits: fewer diseases, less back breaking labour, and less salinity and water-logging. While improving water management and water productivity needs merits an independent TP in this plan, it must also be an integrated component of any upgrading, modernization, and/or new irrigation development program (TPs I & II respectively). Technologies such as remote sensing may be used following thorough discussion with irrigation systems operators and farmer representatives.

Improving 'productivity (kg/m^3 and kg/ha) and production (kg)', which are the central focus of the above three TPs, are influenced by several agricultural inputs and practices other than irrigation. These include land preparation, improved seeds, fertilisers, etc. Furthermore, institutional and organizational aspects of responsive, responsible, and transformative farmer organizations matter. For this reason, the NITP endeavours to facilitate collaboration with the Ministry of Agriculture and Natural Resources (MoANR) and several other institutions. That said, experience shows that irrigation, especially sustainable system O&M, is by far the most influential among these inputs to productivity. This is because improvement in the quality of irrigation services usually encourages and determines the level of improved investments in other agriculture inputs and services.

[2] FAO WAPOR refers to the FAO portal to monitor 'Water Productivity through Open access of Remotely sensed derived data' (WaPOR). This database provides access to 10 years of continuous observations over Africa and the Near East at three levels of spatial resolution (250 by 250 meters; 100 by 100 meters; 30 by 30 meters). It provides open area statistics and data downloads of key variables to estimate water and land productivity gaps in irrigated and rain-fed agriculture. (http://www.fao.org/in-action/remote-sensing-for-water-productivity/en/)

Finally, 'realizing sustainable irrigation schemes' is a shared objective of the three TPs outlined above. This requires enduring structures, organizations, and policy processes that have the capacity to function effectively over the long-term. To elaborate, the following are important: structures that are routinely maintained, and in the course of their lifetime upgraded and modernized or replaced; commitment of the farmers to take care of their share of O&M; regular updates to institutional capacities to respond to shifting needs and priorities; and irrigation policies that are comprehensive and adequately accommodate technical, social, environmental, and institutional dimensions of sustainability.

Box 3: WaPOR-based productivity of irrigated agriculture in Sudan and other African countries



TP IV: Inclusive, Gender-aware Capacity Building, Institutional Strengthening and Solution Transfer

A 'new approach' to capacity building that is inclusive, gender-aware, and solution-driven has been embraced by the Ministry of Irrigation and Water Resources (MoIWR) and is being operationalized by the Training and Capacity Building Directorate (TCBD). This new approach, cascading down all echelons and functions, is innovative by design —it will break the domination by powerful institutions and give equal skills and knowledge development opportunities to ground-level champions and institutions



(e.g., farmers and their organizations, extension service providers, field technicians and skilled labours, and largely forgotten organizations in fragile and resource stressed regions).

The TCBD, a product of the Ministry-level restructuring process, is promoting the 'new approach' to systematically address the huge institutional and individual know-how gaps on efficient irrigation water management and development for food security and improved livelihoods. In more specific terms, the main expected impacts are:

1. the training of a critical mass of professionals (about 20% of the 5,000-member workforce of the Ministry) by the end of the 2023 Transition Period and to upscale this to 50% by the end of 2031;
2. the strengthening of the institutional capacity of the major directorates of the MoIWR, which will cover:

- leadership capacity—the ability of senior leadership to inspire, prioritize, make informed decisions, and provide direction
- management capacity—to ensure that the senior management team is capable of setting realistic targets and ensuring efficient use of organizational resources
- technical capacity—to effectively plan, implement, monitor, and evaluate investment, research, and capacity development programmes and projects

3. the employment of 500 young water managers with updated knowledge of local techniques and opportunities for smart water use
4. 1,000 farmers' representatives who have benefited from targeted knowledge and experience sharing events
5. the translation of the six most promising completed irrigation improvement research outputs into impact on the ground and further scaled up.

In close collaboration with relevant partner institutions, the TCBD will also guide the mainstreaming of long-term capacity development programmes in key irrigation and water sector institutions and cultivate a critical mass of qualified trainers to ensure the continuity and sustainability of the programmes.

TP V: Paradigm Change: Facilitative Policy, Transparent and Participatory Governance

This facilitative policy with a participatory governance structure is being embraced by an interactive accelerated 'learning-by-doing' process by the MoIWR as the key vehicle to delivering results that respond to the urgent needs of farming communities. It is informed by the priorities of the water sector and other relevant institutions. The Ministry has implemented an aggressive agenda of regular field days and consultations with ground staff and grassroots farmers led by the Minister, Undersecretary, and other top irrigation officials. These initiatives have already made major strides in building trust between farmers and Ministry staff—a crucial element of social capital for the sustainability of upgrading and modernization programmes. Similarly, the Ministry is exploring effective incentive systems, such as decentralization of roles and responsibilities to lower echelon agencies. In the same spirit, the Ministry has organized productive and extensive engagements with national and international water sector institutions through numerous brainstorming sessions that are breaking the decades-long isolation of the various stakeholders in Sudan. Two large-scale conferences in December 2019 and February 2020 and a consultative workshop on 15 September 2020 conducted in preparation for the National Economic Forum stand out. These interactions helped identify the major challenges and the many opportunities that exist in the water sector in general and the irrigated agriculture in particular. These discussions helped to further define and consolidate the desired livelihood, food

security, and socioeconomic impacts of this NITP and the Water Sector Livelihoods Transforming Strategy (SWS-LTS) as whole.

The key expected impacts specific for this TP are: (a) the preparation of a facilitative policy following wide stakeholder consultations to create an enabling environment for irrigation management and development as well as research, capacity building, and institutional strengthening; (b) the revision and updating of laws, regulations, and enforcement mechanisms; and (c) the development of an all-inclusive participatory approach in which the roles and contributions of all relevant stakeholders are better defined as far as the financing and management of irrigation services are concerned.



Figure 5 Participatory governance in action: Continuous engagement among senior government officials, farmers and other stakeholders is critical to define priorities and identify actionable solutions (Credit: Wail Abdelgalil, MoIWR)

5.2. National Water Supply Transformation Plan

5.2.1. Situation Analysis: Challenges and Opportunities

Current Status

Sudan has a population of 44.2 million people with roughly 63 percent of the population residing in rural areas. The country's population is projected to increase to 64 million people by 2031. The country covers a vast geographic area with a landmass of 1.9 million km^2, bordering seven countries. The country is administratively divided into 18 states.

According to the Multiple Indicator Cluster Survey (MICS), 64 percent of rural populations and 78 percent of urban populations have access to improved water sources. There are wide variations in access to improved water supplies across Sudan's states, ranging from 94 percent to 28 percent, as highlighted in Figure 6. These averages mask disparities in the quality of services, as many of these statistics represent coverage and not necessarily access. In many areas, both rural and urban communities receive sporadic services, insufficient quantities of water, and water of poor quality (contamination). There is a clear correlation between poverty rates at state level and access to improved water supply. Poverty amplifies deprivations in access to improved water supply, with 46 percent access for the poorest quintile households and 96 percent access for the richest quintile households (MICS, 2014).

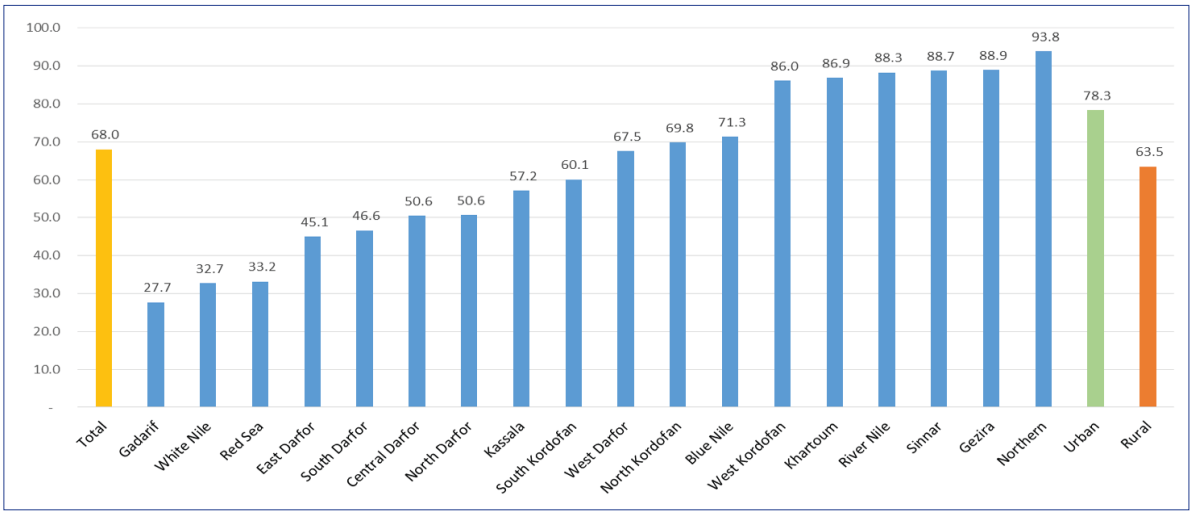


Figure 6 Access to water supply sources by state and rural/urban areas (Multiple Indicator Cluster Survey, 2014)

A National Sample Spatial Survey Method II (S3M II), carried out in 2018, shifted the indicators from "unimproved and improved" to global definitions of access, i.e., "BASIC"[3] and "SAFELY Managed"[4] water. The Survey highlights that Sudan has made reasonable progress in increasing access to BASIC water sources, increasing from 68 percent to 73.7 percent, of which 40.5 percent have access to household (HH) or compound network connected "BASIC" water supply. Sudan's HH or compound connected "BASIC" water supplies do not meet the requirements of "SAFELY Managed" water supplies, which are reliable supply and free from contamination.

Sudan has an estimated 35,716 water facilities (rural: 30,651, urban: 5,065) that produce around 2,810,248 m^3 of improved water supply per day (rural: 695,063 m^3, urban: 2,115,185 m^3). These facilities are mainly motorised groundwater facilities (water yards/mini water yards), hand pumps, improved Haffirs, water treatment plants, and slow sand filters. Yield and quantities of water produced from traditional structures, such as hand dug wells, are not monitored or quantified.

There are numerous caveats with existing data, particularly related to the functionality of schemes. Available sector data is used indicatively and requires further verification. The overall system functionality is around 73 percent. The highest system functionality level is in Khartoum State (95 percent), while the lowest is in Blue Nile State (45 percent). A breakdown of facilities, functionality, and production of rural/urban improved water facilities is provided in Table 1.



[3] Basic access refers to water from an improved water source with a collection time not more than 30 minutes for a round trip, including queuing.

[4] Safely managed access refers to water from improved water source located on premises, available when needed, and free of fecal and priority contamination.

Table 1 Overview of the good practices summarized in this publication

Area	Hand pumps		Water yards/ mini water yards		Improved Haffirs/Slow sand filters		Treatment plants/ compact units		Total BASIC water facilities		Total production (m^3/d)
	Total	Fn*	Total	Fn*	Total	Fn*	Total	Fn*	Total	Fn*	
Rural	19,348	66%	9,597	88%	1,623	54%	83	77%	30,651	72%	695,063
Urban	2,215	69%	2,742	90%	49	41%	59	92%	5,065	80%	2,115,185
Total	21,563	66%	12,339	88%	1,672	53%	142	83%	35,716	73%	2,810,248

* Functional

Pastoralist and livestock water supply

In addition to water supply for sedentary rural and urban communities, Sudan is home to sizeable nomadic and transhumant populations that are constantly moving along pastoralist routes that require targeted attention and coordination (e.g with the Ministry of Animal Resources and Fisheries) to provide water supply. Sudan is known to have one of the richest livestock populations in Africa. It is estimated that there are about 140 million heads of livestock comprised of camels, cattle, sheep, goats, and donkeys. Pastoralism and livestock development represent a critical form of livelihood income generation and contributes significantly to the country's Gross Domestic Product (GDP) through the export of live meat, slaughtered animals, and skins. The livestock sector is estimated to generate more than US$1billion on an annual basis and is estimated to provide employment opportunities for around 3 million people[5].

The movement of 96 percent of the estimated livestock populations is predominantly along the non-Nile geographic belt in an area that roughly covers 280 million feddans (1 feddan = 0.42 hectares). Pastoralists and livestock predominantly rely on non-Nile water sources, such as seasonal wadis, streams, water harvesting structures, and

[5] Mahmoud, Ali, UNESCO Chair for Water Resources. Integrated and Sustainable Management of Non-Nile Water Resources in Sudan Conference. November 21-23, 2017. Khartoum, Sudan

shallow groundwater wells. The movement of pastoralist populations is closely linked with the availability of natural pastures and water resources for their livestock.



Figure 7 Livestock sector is an important source of livelihood and a significant contributor to the Sudanese economy (Credit: Associate Prof. Abu Obeida, HRC).

Institutional water supply

As of 2019, there were a total of 20,440 schools and 6,504 health institutions in Sudan[6]. According to the annual Ministry of Education School Census, carried out for the 2018/2019 school year, 91 percent of schools have access to a water supply. However, disaggregated data indicates that over 50 percent of these schools rely on unimproved sources that are highly vulnerable to contamination. A similar trend is observed in health institutions, with rural institutions faring far worse than urban facilities. Data on access does not adequately convey the reliability and safety of the

[6] Data compiled from Sudan states government information and Federal Ministry of Health Annual School Census 2018/19.

water supply. In many institutions, water supply is intermittent with frequent water cuts and variable water quality (high turbidity, high mineral content, and bacteriological matter). Limited coordination between service providers (at state and local levels) and respective health and education sectors have contributed to challenges in the provision of required water supply services in these institutions.

Linkages of water supply with sanitation and hygiene

On average, 80 percent of the water supply provided for consumption is disposed of in various forms of water (grey and black water). The provision of water supply without due consideration and coordination for sanitation contributes to the contamination of water sources, adverse environmental impacts, and the proliferation of water-and-excreta-borne diseases. For illustrative purposes, access to sanitation is highlighted in the Sudan SDG 6 Plan as there is a correlation between a lack of water supply and poor sanitation. Sanitation promotion is a mandate of the federal and state level health sector, while sewerage is supervised by the Ministry of Infrastructure and Transport.

Access to sanitation at the household level is presented in Figure 8. Overall access to sanitation across Sudan is poor, with an average of 57 percent for urban areas and 22 percent for rural areas. There are wide disparities in sanitation coverage.

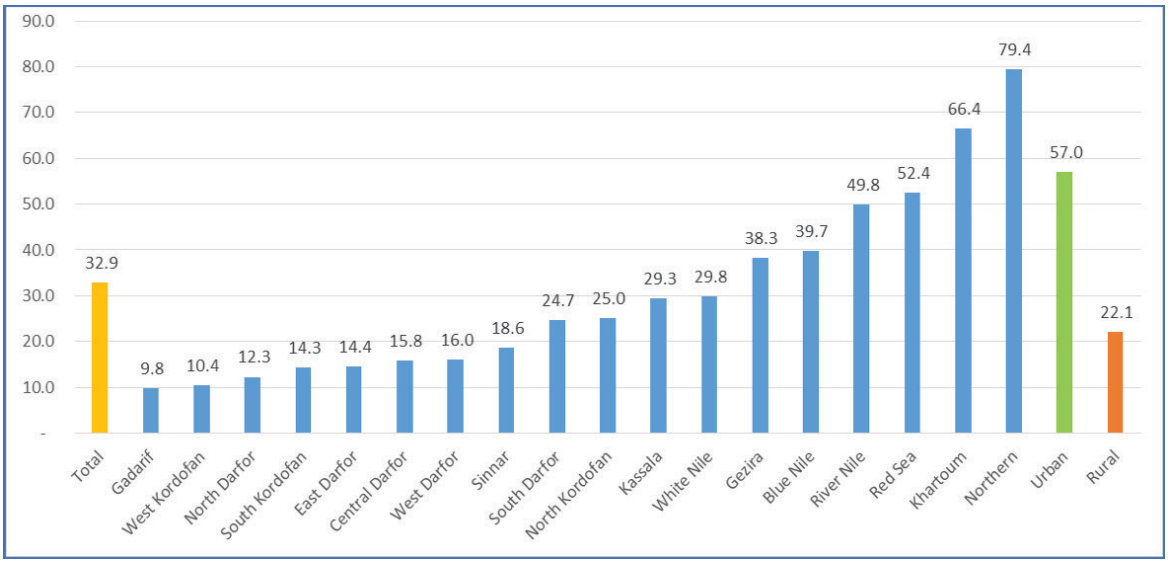


Figure 8 Access to sanitation disaggregated by state and rural/urban areas (Multiple Indicator Cluster Survey, 2014).

Challenges

The major development challenges complicating the provision of water supply for humans, livestock, and key institutions (such as schools and health facilities) are as summarised below:

- Inadequate access to water supply: Both basic and safely managed water facilities, which include infrastructure for water harvesting, extraction, storage, treatment, and transmission of water to points of use for households and livestock, are in short supply due to inadequate investment and maintenance. Closing the access gap is compounded by challenges of rapid urbanisation, which is outpacing the rate of service delivery. Population growth, especially in urban centers, constrains the provision of improved services, resulting in thinly stretched and inadequate services. This is reflected in limited water quantities, intermittent water supply, high water costs through vendors in urban outskirts, poor water quality, occasional outbreaks of water-related diseases, and time spent to fetch water at urban outskirts. Rapid urbanisation and conflict, which have forced the displacement of rural communities to semi-urban settlements, have strained service provision.
- Lack of enabling policy, institutional arrangements, and human resources for water supply: There is no up-to-date national water policy to guide the sector. Current policies are outdated and are not reflective of sector realities. The previous policy was prepared in 2006, but it was not formally endorsed. The lack of a clear roadmap for the management and development of the water supply sector in Sudan has contributed to fragmented and ad hoc implementation and management modalities and limited vision for unified sector targets and approaches. Further, the sector has weak and ineffective vertical (between federal, state, and community) and horizontal (between sectors) coordination mechanisms that have created inconsistencies, duplications, waste of resources and misinformation among sector professionals and stakeholders.
- Limited investment, financing, and internal revenue generation for cost recovery: Limited financial resources continue to strain the country's fiscal situation, requiring ad hoc prioritisation of recurrent and development expenditures. This has severely limited the government's ability to support the recovery and reconstruction of water supply facilities across the country from its own resources. On average, it costs 8.5 SDG to produce and deliver 1 m^3 of water for

an urban setting. Current urban water tariffs are, on average, 1.5 SDG/m³. Low tariffs, coupled with high running costs including electricity bills, imported goods (chemicals, pipes and fittings, spare parts for electromechanical equipment, etc.), hamper the sustainable delivery of water supply services. Revenues collected from relatively low tariff structures are not systematically earmarked to support the rehabilitation and expansion of water supply services. Poor financial transparency and accountability measures affect revenues collected from the water supply at the state and local level, which often enter the state treasury and are used to address emergencies and budget deficits in other sectors.

- Limited focus on the sustainability of service delivery: The sector has often prioritised investments in new infrastructure with limited support and orientation for the rehabilitation and optimisation of existing services. As a result, constructed water supply facilities fall into disrepair and rarely provide services for the intended life cycle. Limited provision of resources and budgets for O&M results in fragmented and piecemeal rehabilitation efforts with limited planning. Lack of clarity in institutional setups often lead to the inadequate handover of federally constructed projects to state or local counterparts. There are ongoing efforts to revise legal frameworks to formally establish and support community-led management structures that can play an active role in sustainability of rural schemes.
- Human Resource Development and Capacity Building: There is an acute shortage of staff with adequate skills, including technical and administration qualifications, to design, implement, and manage water supply services in the country. The water supply sector has experienced significant "brain drain," with the loss of numerous qualified technical cadres. Political interference and appointments have also contributed to an increase in staff turnover and a lack of institutional memory and capacity to guide the sector. As a result, the water supply sector today does not have sufficient technical capacity to attend to the increasing challenges ahead, and there is a disproportionate number of administrative staff and limited technical staff at all levels.
- Impact of climate change and climate variability: Extreme climatic variability with cyclical episodes of prolonged droughts and extreme floods, coupled with increasingly erratic distribution and intensity of rainfall, has a negative impact on the amount of surface and groundwater available for human and livestock consumption and productive purposes. These climatic phenomena complicate

the design and operation of water supply facilities that contribute to competition and conflict between farmers and pastoralists for scarce water resources. Desert encroachment also presents a challenge, resulting partly from deforestation activities and from climate change. This challenge is exacerbated by the absence of institutional arrangements and responsibilities for preparedness and responses to natural calamities and emergencies, resulting in weak and delayed interventions and the suffering of affected populations, including loss of life. The government has limited response capacity and has largely relied on external humanitarian responses, which have operated on limited budgets and in limited geographies.

- Limited and missed opportunities in the use and application of appropriate technology, research, and development and engagement of the private sector: The country's isolation and limited engagement with international good practices have limited the introduction and adoption of new technologies and approaches to improve water supply service delivery. Adoption of technologies like renewable energy, such as solar and wind, have been limited. Supply chains for introduced technologies are weak and result in disruptions in services due to the unavailability of spare parts and delays or restrictions in importing needed goods. It is worth mentioning that Sudan has faced severe fuel shortages that have negatively affected all norms of life, including provisions for the diesel driven machinery that operate water supply points. Links between academia, applied research, and operations are limited and are not widely promoted for addressing water supply challenges. The enabling environment for private sector participation in the supply chain, the introduction of technology, and innovative contracts for design, build, and operation are limited.
- Water quality and pollution: Most of the water supply from shallow groundwater sources and unprotected surface water sources that are prone to pollution and contamination by human activities, especially constructed pit latrines and sanitary disposal wells that tap into shallow aquifers in urban centers. Incidences of groundwater pollution have also been reported, with negative impacts on drinking water quality in urban areas with adjacent latrines and linked to water sources. In rural areas, water supply is impacted by other point source pollution sources, such as agricultural runoff, industrial waste, and waste from mining activities. Poor water quality has dire impacts on human and livestock health, leading to a series of chronic diseases; it is a leading contributor to malnutrition and stunting in children under five. This was evident during the large-scale

2016-2017 Acute Watery Diarrhea (AWD) outbreak that affected 36,460 persons and caused 818 deaths across Sudan (in all 18 states). A considerable number of the affected people were drinking water from bacteriologically contaminated "improved" water sources.

- Limited attention to the gender and inclusion aspects of water supply services: The design and operation of water supply facilities have included limited engagement and consideration for gender in decision making or design that is sensitive to disability and accessibility for all members of the community. This is a significant gap that needs to be urgently addressed.

Opportunities

The newly established Transitional Government presents a renewed opportunity for the country and the sector to review the existing situation and put in place an ambitious plan. There is an opportunity to capitalise on the political will for change to begin addressing the chronic challenges of this sector. The provision of water supply with strong coordination mechanisms for integrated delivery of sanitation and hygiene interventions has a series of positive impacts. These impacts can be considered opportunities to meet the NWS-TP's objectives.

Water supply and impacts on peace

Sudan's political transition presents an opportunity for the transitional government to lay the foundations for peace building. The recently signed peace agreements are also a positive step forward that can be leveraged. The provision of basic services such as water to post-conflict areas is a critical step in addressing the grievances of communities that have been disenfranchised and marginalised for decades. Access to a safely managed water supply by historically marginalised communities also presents an opportunity to rebuild the trust and social fabric between government and communities. Provision of water can also help to address the multi-faceted challenges faced by many communities across the country.

Water supply impacts on health

The provision of inadequate water supply in both quantity and quality has had a profound impact on the health outcomes of Sudanese citizens. Consumption of unsafe water supply directly contributes to high prevalence of diarrheic diseases that are some of the leading causes of death in Sudan. They also contribute to malnutrition and stunting in children. Figure 9 highlights the positive correlation between the provision of safe water and reduced levels of stunting across the various states of Sudan. The need to increase access to sufficient and quality water supplies is clear.

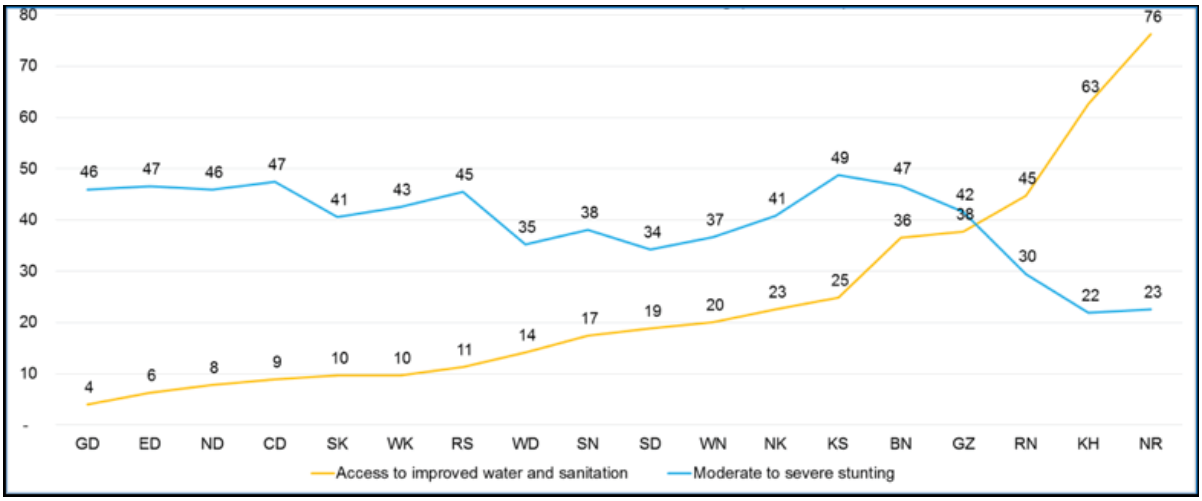


Figure 9 Sudan States' access to improved water and sanitation in relation to under 5 children stunting (MICS, 2014)

Water supply and impacts on education

Availability of safe water and coordination to provide adequate sanitation has been widely documented globally as contributing to improved school learning outcomes and attendance. Lack of water supply affects women and girls disproportionately, as they bear the burden of water collection over long distances, which has been associated with negative effects on school attendance. The transitional government in Sudan is planning for the provision of safe water supply in institutions such as schools and health centers to help amplify and improve literacy rates and make education more attractive.



Figure 10 Safe and reliable water supply is critical for brightening the future of children: they are the most vulnerable to water borne diseases (Credit: Salah Siddig, MoIWR).

Water supply and impacts on the economy

The provision of safe water has a series of positive impacts on the economy. Water supply for human consumption has contributed to positive health benefits and reduced costs for health care associated with water-related diseases. In addition to human consumption, provision of water supply for pastoralists and livestock also has the potential to support the livelihoods of millions of people and to contribute to economic benefits from the development of the livestock sector.

5.2.2. Transformative Packages

This National Water Supply Transformation Plan (NWS-TP) aims at three Transformative Packages (TPs) that can deliver sustainable, equitable, reliable, and affordable access to safe water, with due consideration for the environment and adequate links to sanitation and hygiene for rural, urban, and pastoralist communities and their livestock (Figure 11). It also outlines links with pertinent sectors and areas

where coordination is needed for integrated implementation of sanitation and hygiene interventions by the health sector, as well as the provision of water supply in schools and health facilities by the education and health sectors respectively. To effectively address chronic challenges faced by the sector, this plan underscores the need to revitalize the sector and reform institutional arrangements to effectively deliver proposed targets.

Both SDGs and the Sudan Quarter Century Strategy have set the target for full access to improved water supply and sanitation services at 150 and 50 liters per capita per day for urban and rural communities respectively, and at maximum walking distances of 100 m for urban communities and 500 m for rural communities, by 2031.

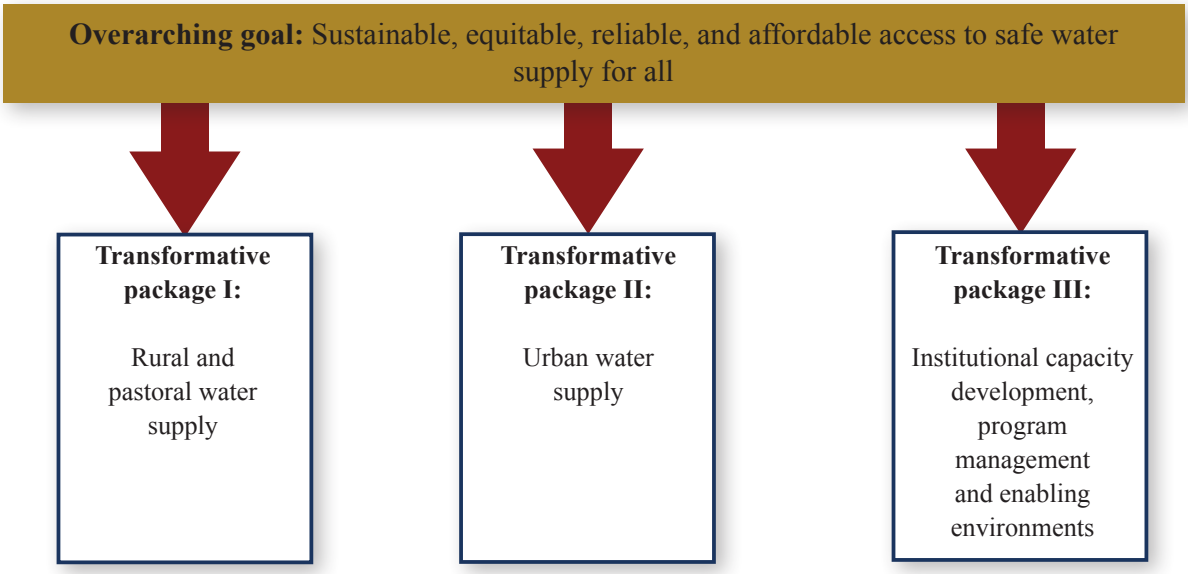


Figure 11 Framework for the National Water Supply Transformation Plan

Transformative Package (TP) I: Rural Water and Pastoralist Supply

Introduction

Nearly 70 percent of Sudan's population lives in rural areas, often in dispersed and isolated communities. As indicated, 63 percent of rural communities have access to a BASIC water supply that is often unreliable and unsafe due to contamination.

For rural water supply, the aim is to provide 50 liters per capita per day within the proximity of a water source not exceeding 500 m.[7] Steps to address the rural water supply will focus on: (i) preparation of a study and the design of new schemes; (ii) construction, rehabilitation, and expansion of existing systems; (iii) establishment of adequate O&M structures at all levels to ensure sustainability of water supply services; and (iv) strategic technical assistance to support rural water supply planning and capacity building. Construction and rehabilitation of water supply schemes will be based on a sector-approved menu of technology options that consider water quality standards, gender-informed design, climate adaptation strategies, and the scoping and financing of renewable energy sources, including non-carbon-based solutions. Technical assistance and capacity building interventions will focus on: (i) development of State and Mahalia level plans; (ii) capacity building to strengthen and develop State and Mahalia level capacities to plan, coordinate, implement, and manage water supply services jointly with core implementing sector partners such as health and education.

Planning and implementation of rural water supply is linked to implementation modalities (e.g., federally managed project, state-managed project, Mahalia-managed project, NGO-managed project, community self-supply project, etc). Regardless of the implementation modality, rural water supply facilities must adhere to the proposed planning, budgeting, and reporting modalities. Rural water supply facilities must also adhere to the framework of approved technical standards and take into consideration cost sharing policies.

Implementation and O&M modalities

The types of rural water supply implementation modalities include:

- **Federal or state managed water supply facility:** Federal or state level entities may design, appraise, finance, and commission water supply facilities in accordance with existing standards and menus of technological options. Federal

[7] Ministry of Water Resources and Electricity, 2014: Rural Water Supply – Action Plan, April 2014

or state level entities are required to provide needed capacity building to establish community level management structures that are capable of daily O&M and reporting as per the required standards. Sources of funding may include federal or state-level funds or external funding channeled through the Ministry of Finance and Economic Planning (MoFEP).

- **Mahalia managed facility:** Mahalia, or local level government entities, may be responsible for the design, appraisal, financing, and commissioning of water supply facilities in accordance with existing standards and menus of technological options. The Mahalia will play an oversight role and will be responsible for providing training and capacity building to establish community-level O&M arrangements for the established water facility that are capable of daily O&M and reporting as per the required standards. Sources of funding may include government grants for capital expenditure channeled from federal or state resources or collaboration with civil society groups and NGOs.
- **NGO-managed project:** An accredited NGO may design, appraise, finance, and commission water supply facilities in accordance with existing standards and menus of technological options. NGOs will also play a role in knowledge transfer, technology adoption, and institutional strengthening to enhance the capacities of communities and local government to design, implement, and manage water supply facilities. Financing for these facilities will come from resources mobilised by NGOs directly or through international donors.
- **Community or civil society managed project:** Water supply facilities that are designed and implemented through community cooperation or CSO engagement are yet another modality. Communities or CSOs are responsible for the design, appraisal, financing, and commissioning of water supply facilities in accordance with existing standards and menus of technological options. Communities and CSOs must inform and report to local government entities about the planning and operation of proposed water facilities to facilitate monitoring of functionality in the future. Financing of such facilities may be through community fundraising or CSO contributions. An adequate community level O&M mechanism must be established to ensure adequate daily management of proposed water supply facilities for continuity and sustainability of services.
- **Private sector project:** These are facilities financed by a private sector entity as part of corporate social responsibility efforts or the expansion of basic services in their area of operation to support nearby communities. These facilities may



be designed, constructed, and financed by a private sector actor and should conform to applicable standards. The private sector actor must engage with local governments to ensure some level of oversight and support the establishment and training of community-level O&M mechanisms.

Pastoralist and livestock water supply

Animal resources of Sudan present a critical source of livelihood for numerous communities across the country and are also a major contributor to the country's GDP. Nomadic communities across the country contribute to economic development and present a rich cultural heritage. Climate variability and climate change have adversely impacted nomadic communities and led to dramatic losses in livestock and livelihoods. These climatic changes have also contributed to shifts in nomadic movements, which have exacerbated tensions and conflicts over scarce resources between pastoralist communities and sedentary farming settlements. Given the unique movement and migration patterns of these communities, the development of water supplies for livestock and nomadic communities requires due attention.

Pastoralists generally rely on rivers, seasonal streams (wadis), haffirs, and wells to provide water supply for their livestock. The provision of water supplies for pastoralists and livestock will consider the following parameters: (i) maintaining and supporting social peace on the ground and engagement of all parties involved; (ii) coordination of water supply with availability of pasture lands; (iii) consideration of designated migration routes in collaboration with the Ministry of Livestock and Fisheries; and (iv) tailored O&M mechanisms that directly involve community management and local leadership structures.

Rural water supply technologies

Water supply technologies include: (1) Surface Water: river intakes, wadis and haffirs; (2) Groundwater: hand pumps, motorised pumps for deep wells, sub-surface dams, sand dams; (3) Sea Water: desalination and membrane treatment; and (4) Energy Sources: connections from the national grid, diesel operated pumps, solar driven pumps, and wind-operated pumps.

TP II: Urban Water Supply

Introduction

Although 58.3 percent of urban households have access to NETWORK water supply services with connections in their households, the reliability and quality of services is extremely poor. Many also resort to purchasing water from unregulated water tankers and vendors to augment their limited network supply. The quality of water supply is also increasingly a challenge.

Cities and towns in Sudan are categorised based on population and type (e.g., state capital, rural town, etc). Service level standards for urban settings aim to provide 150 liters per capita per day. There is a need to further define service level standards for urban water supply based on urban planning categorisation and designation to meet the needs of the now and the future.

Urban water supply implementation modalities

Urban water supply is managed by State Water Corporations (SWCs). These corporations operate as utilities and have the mandate to charge tariffs to cover O&M, depreciation costs, and contribute to capital expenditures. These corporations are expected to operate according to cost recovery principles and direct funds from collected tariffs and subsidies from federal and state governments towards maintaining and improving service delivery. The federal government is responsible for monitoring and regulatory oversight of state-level service providers. The federal level is also responsible for directing federally managed financial resources apportioned to state level water service providers.

The urban water supply component of this plan will contribute to increasing access to water supply services and to strengthening the capacity of town water boards and SWCs to effectively manage service delivery. Infrastructure investments in urban water supply will include: (i) the construction, rehabilitation, and optimisation of water production, treatment, and distribution systems; (ii) the design and implementation of operational efficiency improvements to reduce losses and save energy (e.g., reductions in pumping costs, use of renewable energy); (iii) the preparation of SWC water supply

business plans that consider demand, define climate adaptation strategies (including contingency planning), assess infrastructure needs, vet proposed tariffs, and highlight human resources needs; (iv) the establishment and/or strengthening of SWC water boards and water utilities to efficiently manage water resources and water supply assets and services; and (v) the preparation of feasibility and detailed design studies for water supply investments.

Urban water supply service providers, such as state water corporations, may contract the private sector to design, construct, and operate portions of their systems under various arrangements and service contracts. Although provision of urban water supply is a public service, portions of the service delivery may be contracted out to private operators to enhance service efficiency, accountability, reliability, and sustainability.

Sustainability of service delivery

Capital expenditures for water supply service delivery are financed through a combination of federal and state financial resources. The design and implementation of new water supply treatment and distribution facilities, or the expansion of existing facilitates, is implemented through a combination of federal and state human and technical resources. To ensure the sustainability of urban water supply services, this plan aims to ensure all investments in urban water supply facilities adhere to the following guidelines:

- **Selection of appropriate technologies and adherence to technical standards:** Investments in new and existing water supply facilities must adhere to feasibility and detailed design studies that are adequately vetted and appraised for the following parameters: appropriate site selection, water resource sustainability, climatic and geological considerations, existing and future demands, treatment and distribution technologies, etc. Sector standards to orient the design and study of water supply infrastructure should be updated to provide a framework and standardised provision of water supply facilities.
- **Adequate governance and institutional arrangements:** Urban water supply services must be administered and led by an incorporated entity, such as SWCs. The composition of the service provider must include adequate management and technical personnel to plan and operate water supply services. The water

supply service provider must also include a board that is accountable to the state government, which can provide decision-making support mechanisms. State water corporations must maintain ring-fenced financial management systems to ensure transparency and that revenues collected are adequately re-invested in maintaining and expanding water supply services in the designated areas. Ideally, in addition to an approved corporate structure, each service provider must prepare adequate master plans to orient short, medium, long term interventions; invest in adequate systems, such as enterprise resource software to adequately mange aspects such as billing, operations (treatment, distribution system, pumps, etc.), human resources, and asset management.

- **Planning:** Urban water supply service providers, such as SWCs, must prepare adequate planning documents that lay out the vision, mission, and future scope of service delivery for a 5 to 10-year period. Planning documents must include elements such as a strategy for service delivery continuity, future expansion and rehabilitation, institutional capacity building, and a strategy for tariff setting. Planning documents must be approved by state level governance or a board that provides decision making oversight for the service provider.
- **Tariff setting and cost recovery:** As part of service delivery provision, SWCs must prepare a strategy for tariff setting that is affordable to consumers and provides enough resources for cost recovery and try to balance consumer affordability and O&M of water supply systems.
- **Environmental and Social Impact Assessments:** All new expansion or rehabilitation projects for water supply facilities must adequately identify and recommend mitigation measures for environmental and social risks that may be associated with the project. Pertinent Environmental and Social Impact Assessments or similar assessments must be conducted during the feasibility study of the particular investment.
- **Project management and supervision:** All civil works for water supply facilities must be professionally supervised to ensure adequate contract management and follow up during construction.
- **Customer service:** Service providers must provide adequate and transparent mechanisms to address customer queries and develop systems to facilitate consumer feedback.

TP III: Institutional Capacity Development, Program Management, and Enabling Environments

To address the systematic and widespread gaps in capacities and to put in place an adequate modality to manage the provision of water supply across the country, this plan aims to support sector reform, improvement of skills, and strengthening of institutions that plan, implement, manage, and monitor service provision.

Structuring an enabling environment

To achieve the objectives set forth by this plan, the sector needs to structure an enabling environment to address the systemic challenges caused by decades of neglect and mismanagement. To create a conducive environment that supports sustainable and efficient water supply service delivery for all segments of the population, the plan recommends implementation of the following actions:

1. Embark on holistic sector reform (legal and institutional) to establish a strong federal entity (e.g., reinstate the National Water Corporation (NWC) and clearly define mandates, roles, and responsibilities of sector actors at federal, state, Mahalia (sub-state), and community levels:

- Revise and endorse an updated policy that includes clear mandates and a vertical regulatory relationship at federal, state, Mahalia, and community levels
- Review, revise, or adopt legislation and proclamations to develop and implement the policy framework
- Establish clear engagement mechanisms with SWCs to foster stronger sub-national coordination and implementation
- Strengthen the institutional setup and identify capacity gaps
- Appoint relevant young professionals at national and sub-national levels to help run the machinery of the water supply sub-sector.

2. Create and operationalise regular national and state water sector coordination platforms to orient and coordinate developmental and humanitarian activities
3. Develop state plans that are strongly linked to the SDGs and this NWS-TP following comprehensive participatory and engaging processes to solicit and optimize political support and consistency in water supply sector planning and management

4. Establish mechanisms to attract and retain young professionals and new talent for the sector
5. Establish mechanisms to facilitate and scale up private sector participation in the development of water supply infrastructure and management of water supply services
6. Increase the role of the private sector in O&M and in the adoption and knowledge transfer of new technologies
7. Develop supply chains for water supply equipment and goods
8. Adopt, implement, and monitor universal effective and transparent fund utilisation for financial resources with the required level of governance and Value for Money approaches that focus on innovative sector fund use options, such as cost recovery
9. Ensure universal water quality and water safety monitoring, surveillance, and water safety planning are set up for the provision of quality water supplies
10. Conduct focused research and development and expand solar and other innovative affordable technology options and management strategies.

Capacity development strategy

To effectively implement proposed interventions, a minimum amount of staffing is required at various levels. A capacity assessment is required to determine the gaps and skills requirement at each level to support the development of the Capacity Development Strategy. The assessment will be carried out in collaboration with MoIWR Capacity Building Directorate. This assessment will address the following gaps, among others:

- **Technical** – design, construction, and O&M of water supply facilities
- **Institutional** – strengthening of program implementation, strengthening of service providers (SWCs, Community Committees, etc.)
- **Social development and community mobilisation** – communication and awareness raising as well as provision of training and capacity building of community-based management entities
- **Procurement and contract management** – to prepare and manage tendering of civil works and consultancies, contract management to ensure adequate follow up during construction and handover of infrastructure

- **Program management** – to strengthen planning, budgeting, and monitoring and evaluation.

A Capacity Development Strategy will first require a comprehensive training needs assessment across the board, based on clearly defined roles and responsibilities of sector personnel. Next, a training provision assessment will be required, covering an inventory of existing institutions and the training they offer, identifying gaps that need to be filled, and proposing appropriate training mechanisms (locally and abroad). Training will be provided in a cascaded approach and structured to ensure capacities gained are transferred to local implementing entities. Guidelines, manuals, and other training materials will need to be reviewed and revised accordingly. These materials may include design standards, O&M, among others.

Knowledge exchange and transfer

To further enhance knowledge exchange and transfer, the Capacity Development Strategy will also include a set of recommendations to strategically engage the private sector. To build capacities of the local private sector and service providers, the Capacity Development Strategy will aim to lay the foundations that will support the transfer of knowledge from the international private sector. Potential areas of knowledge exchange and transfer include capacity to:

- Assess and design new water supply infrastructure (treatment, distribution, etc.)
- Construct and project manage complex civil works
- Operate water supply infrastructure
- Increase efficiency in water supply service delivery (e.g., reduction in non-revenue water, asset management, automation of systems, etc.).

Research strategy

The NWS-TP is prioritising research to promote innovation and knowledge management for improved service delivery. It is also intended to serve as a link between practitioners and researchers in various academic institutions to orient operational research. The research strategy should focus on identified weaknesses

and challenges for which existing solutions or capacities are not easily identified. The research strategy should be based on international and local collaboration with relevant partners. Research should be needs based and action driven, aiming for concrete solutions to concrete sector problems. Applied research is the theme of this transformation plan.

Coordination with sanitation and hygiene

The provision of water supply alone will not yield the intended impacts of the improved health and wellbeing of communities across the country. The proposed plan to improve water supply will need to be coordinated with activities to improve sanitation and hygiene. The mandates for sanitation and hygiene are divided among several federal and state level sectors. The Water and Environmental Sanitation (WES) Program, housed in MoIWR, will play a role in coordinating Water Supply, Sanitation, and Hygiene (WASH) activities across the Ministry of Health (MoH) and the Ministry of Education (MoE) to support the delivery of integrated and coordinated water and sanitation services as well as hygiene knowledge in schools and health facilities.

Ministry of Health – The MoH and its state and local level entities, in collaboration with the Water and Environmental Sanitation Program (WES), are responsible for sanitation and hygiene promotional materials and outreach. This includes awareness raising campaigns on activities related to safe water use (at access points and at the household level), construction and management of improved household sanitation infrastructure (design of latrines), and the design and dissemination of appropriate Behaviour Change Communication (BCC) materials. The MoH will be responsible for developing standard guidelines for water supply and sanitation facilities in health centers and hospitals and for following up on the implementation of these activities.

Ministry of Infrastructure and Transport – The Ministry of Infrastructure and Transport, at the federal level and through its state level entities, is responsible for sanitation services provided through sewerage. The Ministry is mandated to provide oversight for public and private operators for fecal sludge management. Entities pertaining to this sector also design and operate separate treatment facilities that receive fecal sludge from latrines and septic tanks through vacuum trucks and that treat the waste to ensure that it does not harm the health of communities and the

environment. This sector is also responsible for setting the standards and guidelines for wastewater and fecal sludge treatment and regulation of all actors engaged in these activities. At state level, these ministries provide oversight for the SWCs.

Coordination for institutional water supply

This strategy aims to coordinate with the MoE and the MoH to ensure water supply and sanitation facilities are provided based on jointly prepared technical standards and guidelines. Water supply interventions (to be supported by the MoIWR) require close collaboration and joint implementation of sanitation and hygiene activities (to be implemented by MoE and MoH) to achieve intended impacts.

The MoE, through state and Mahalia level offices, will be responsible for the prioritisation and implementation of sanitation and hygiene activities in their respective schools. The MoH, through its state and Mahalia level entities, will be responsible for the design and implementation of sanitation and hygiene activities in their respective health facilities. Both the MoE and the MoH should prepare minimum packages and standards for water supply and sanitation services to ensure standardisation of interventions across the country. Alongside the technical standards, appropriate guidelines, manuals, and materials should be prepared to accompany the implementation of the proposed activities.

5.3. Water Resources Management Transformation Plan

5.3.1. Situation Analysis: Challenges and Opportunities

Water Resources and Their Use

Rainfall, the Nile River, wadis (seasonal rivers), and groundwater are Sudan's main water sources. Annual average rainfall ranges from 50 mm in the northernmost parts of the country to 700 mm in the South-East and South-West, with an overall average of about 250 mm/year. Since the average per capita water availability is below 1000 m^3/

person/year, Sudan is classified as a water scarce country. Rainfall is highly variable in space and time, and in areas away from the Nile, available water is limited along the wadis and existing aquifers; the uneven distribution of water resources is significant.

Some 90% of total agriculture in Sudan is rain-fed, whereas nearly 10% is irrigated. As discussed in section 5.1, however, the irrigated agriculture is the major pathway to increased agriculture production and productivity, food and nutrition security and employment opportunities.

The transboundary Nile River is the major source of water for domestic drinking water, irrigation, and industrial and hydropower purposes in areas along the river and its tributaries, known as the "Nile system." The average annual flow of the Nile, as recorded at Aswan in southern Egypt, is 84 Billion m^3. This volume is shared by Egypt (55.5 Billion m^3) and Sudan (20.5 m^3) according to the 1959 Nile Waters Agreement between the two countries.

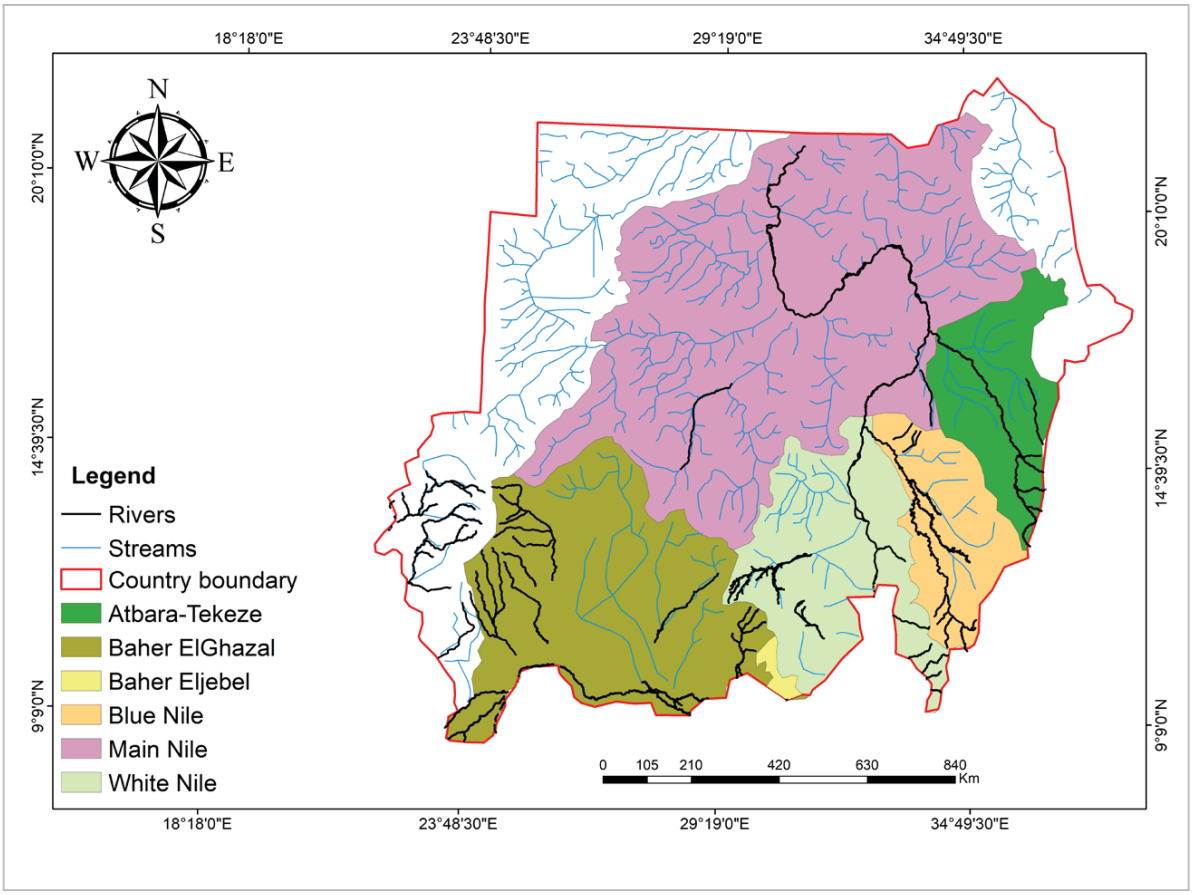


Figure 12 Major water catchments of Sudan



There are a number of dams on the Nile in Sudan. The Sennar Dam on the Blue Nile provides water for the Al-Jazīrah plain at the time of year when the water level of the Blue Nile is low. It also produces hydroelectric power. Another dam, at Jabal al-Awliyāʾ on the White Nile, was built in 1937 to increase the water available to Egypt during the period of low water (January to June); it is not intended to provide irrigation water for Sudan. Other dams—including one on the Atbara at Khashm al-Qirbah (completed in 1964) and the Al-Ruṣayriṣ Dam on the Blue Nile (1966)—have enabled Sudan to take maximum advantage of its allocation of waters from Lake Nasser.

The country's major groundwater aquifers fall under four main categories: the largest transboundary Nubian sandstone aquifer, the Um Ruawaba formation, recent alluvial deposits, and the cracks and joints of the basement complex. These aquifers often provide good quality water, which usually does not need treatment or purification. The Nubian Sandstone Aquifer System (NSAS) is the world's largest transboundary aquifer, known as a fossil water aquifer system. It is located underground in the eastern end of the Sahara Desert and spans the political boundaries of four countries in northeast Africa. NSAS covers a land area spanning just over 2 million km^2, including northwestern Sudan, northeastern Chad, southeastern Libya, and most of Egypt. Containing an estimated 150,000 km^3 of groundwater, the significance of the NSAS as a potential water resource for future development programs in these countries is extraordinary. The NSAS renewable groundwater estimate in Sudan is 4 Billion m^3.

The groundwater resources, together with the seasonal rivers, are substantial at over 11 billion m^3. Despite their huge potential, they have largely been passed over in policy, investment, and research for development initiatives. Much attention so far has been on the Nile's water resources. As a first step towards optimal use of groundwater and seasonal water resources we need to strengthen the monitoring system by installing monitoring devices in observation wells and stream gauges to support hydrological studies, e.g., the monitoring of the flow of wadis and khors (creeks). This needs to be followed by targeted financial resources for research to understand the behaviour of the water resource systems and to identify the most profitable investment portfolios from socioeconomic and environmental perspectives based on whole catchments.

Water Data

Whether at basin, national, or transboundary level, easy access to information on the status and evolution of water resources and uses is one of the keys to successful water policy implementation. However, necessary data and information are usually fragmented, dispersed, and heterogeneous, and accessing data is often difficult to organize for numerous reasons (e.g., multiplicity of data producers, inconsistency of data and information). As a result, the data products of various actors are under-utilised, and the capacities for producing the information required for efficient water policy implementation are often very limited.

On one hand, the MoIWR is responsible for most of the needed water data for decision-making. On the other hand, most data on water is produced by other institutions: water quality data is produced by health-related institutions; groundwater data is produced by geological and mining institutions and the energy sector; data on agricultural water uses is produced by irrigation system managers and the Ministry of Agriculture; statistics on population growth and urban characteristics are managed by statistics institutes; etc.

Box 4: Access to Information Law, 2015 (https://www.moj.gov.sd/sudanlaws/#/reader/chapter/362)

"All citizens have the right to access information from any governmental entities and public or private companies which are partially owned by government, etc.".

With this multiplicity of topics and data producers, there is often little agreement regarding data exchange. As such, each institution produces data for its own purposes without necessarily considering the need for integrated and comprehensive datasets. Major gaps in time series or in geographical coverage are caused by the lack of monitoring and the means to ensure regular checking and maintenance of monitoring equipment, and by delays in the replacement of faulty parts or even the payment of

salaries and fees to the monitoring staff, which results in many stations being out of service. With changing climatic trends, the need for high spatial and temporal resolution is absolute for robust decision-making. Satellite imagery and digital technologies have proven importance in various water management applications, such as agriculture water use management, flood and drought early warning systems, and disaster risk reduction as well as in operational water management in structures like dams and in enhancing citizen participation in various activities, including monitoring.

There is a lack of legislative and institutional frameworks for organizing access and dissemination of water-related information, such as relevant agreements or protocols between the partners or institutions governing the process (or between countries for transboundary basins). While data produced from public funds should be freely accessible, data institutions need to raise funds to establish their data infrastructure. This is the funding modality of the main National Meteorology Station housed in the MoIWR. In addition, institutionally, the two most relevant sections in the MoIWR are the Groundwater and Wadis Department (GWWD), responsible for exploration, assessment, and evaluation of wadis and groundwater resources, and the Nile Water Directorate (NWD), responsible for the establishment and operation of all hydrometric and sediment discharge monitoring stations on the Nile tributaries in Sudan. The NWD runs a Flood Early Warning System (FEWS) on the Blue Nile and Atbara rivers. The performance of these key agencies is found wanting, as demonstrated by their response capacity during the 2020 floods (and ensuing State of Emergency). The Nile River is reasonably monitored by telemetric weather stations, while most of the local streams (wadis) are not regularly monitored.

Capacity Building and Research and Development

The general lack of capacity and resources to design, organize, and implement water policies, and to facilitate and oversee compliance with regulations enforcing these policies, has regularly been identified as a major issue hampering the delivery of water management, irrigation, and water supply services. Many attempts have been made to enhance the capacity of the water sector to deliver, but the institutional capacity to adapt and provide sound leadership focused on improving performance has been limited.

There are two related objectives of capacity development in this programme: 1) understanding the obstacles that prevent the people, organizations, or any other elements of an institutional framework from fully realizing their development goals; and 2) identifying the applicable mechanisms in overcoming these challenges and ultimately achieving better and more sustainable results for the water sector.

Change management in connecting supportive institutions (water resources management) to operational institutions, i.e. irrigation and water supply, will lead to the re-skilling of agencies and staff. The organizational culture of the 'old' MoIWR has suffered from lack of transparency, acutely centralized decision-making, and inequity in the distribution of career development opportunities. A large part of the administration was sidelined, while ad-hoc parallel bodies were created to fulfil the ministry's mandate. Such irregularities have replaced highly qualified individuals with those with little career ambition, questionable morals, and low work ethic. Visionary leadership and facilitative change management will be required to change the prevailing culture of inequitable remuneration and related benefits.

Research and Development (R&D) is the responsibility of the MoIWR which is underfunded. Despite the presence of many specialized research bodies belonging to and affiliated with the MoIWR, they have shown little or no leverage for impact due to the lack of coordination and competition for limited financial sources. Absolute and relative data on R&D investments in the water sector are unavailable. However, with agriculture being the largest water consumer a proxy of agricultural R&D spending in 2012 is appropriate to paint the big picture of the fully insufficient attention to water-related R&D investments in Sudan.

Complementarities and integration of Capacity Building (CB) initiatives with R&D are crucial. Since CB, including re-skilling and hand-over of intangible knowledge, is required at various administrative levels (trans-national, national, sub-national) and for different target populations (senior level, planning and implementation level, and the public at large), using of a variety of means (i.e., partnerships as well as North/South twinning modalities and networking arrangements) will be necessary.

Networking is aimed at reinforcing capacity and avoiding fragmentation of efforts by fostering collaboration, sharing of resources (human, technical, institutional), and creating a culture of discussion and communication among all affected parties.




TOSHIBA

Networking requires cooperative mechanisms among education and training institutions and the public and private sector, as required. Partnership arrangements aim at complementing efforts while matching the strengths and weaknesses of the partners. It is expected that major actors in these partnerships will be universities, the private sector, government, civil society, and local communities.

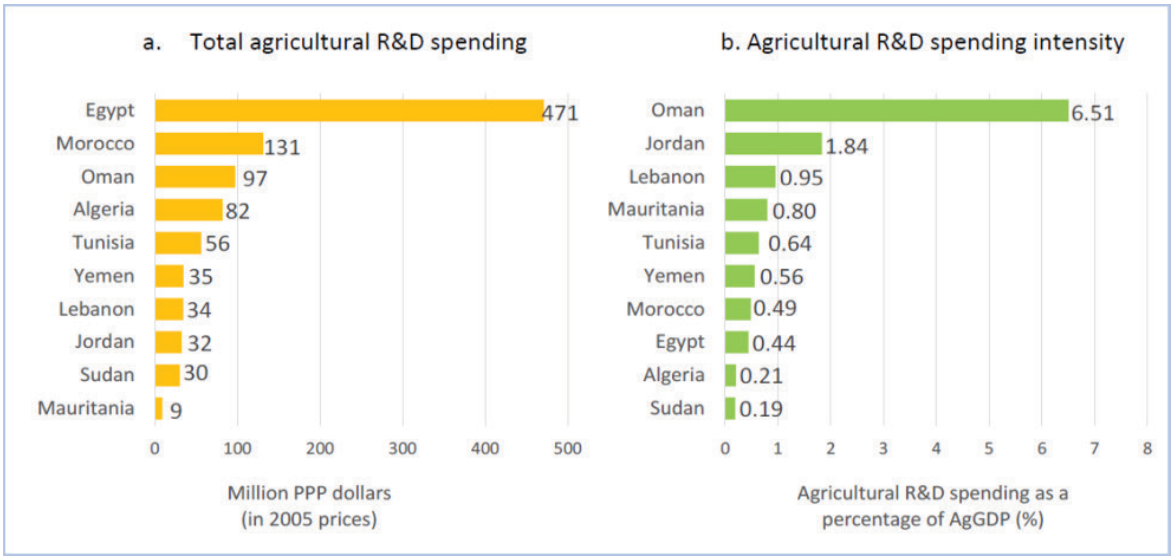


Figure 13 Absolute and relative agricultural Research and Development (R&D) spending levels (https://www.ifpri.org/blog/agricultural-rd-capacity-arab-world-positive-progress-challenges-remain)

Water, Climate Change, Disasters, Food Security, and Peace

The impacts of climate change, including natural disasters, are felt in the hydrological cycle, and their frequency and magnitude are expected to increase in the coming years. The vast majority of natural disasters (over 90 %) are water related, including droughts, floods, and tropical storms, with significant impact on societies and the economy.

Sudan is among the countries with the largest number of internally displaced persons (IDPs), though internal displacement has decreased in recent years[8]. In addition, Sudan harbours regional refugees, e.g., from Ethiopia and Eritrea. Displacement can be trigged by three levels of conflict: internal (tribal), federal, or regional. Internal

conflicts include interethnic clashes over natural resources such as land, water, and crops. Such conflicts triggered nearly 10,000 new displacements in East and Central Darfur and White Nile State in May and June of 2019. At the federal level, Sudan is generally very arid, and large parts of the country are considered drought prone. This has had devastating humanitarian consequences, because more than two-third of people live in rural areas and are largely dependent on rain-fed subsistence agriculture and animal husbandry for their livelihoods. These climatic conditions have overlapped with conflict and economic and political instability to create extremely high levels of food insecurity.

Darfur, South Kordofan, and Blue Nile states face conflicts relating to natural resources and conflicts relating to political tensions. Water conflicts, especially those between nomads and settled farmers, are increasing because of climate change, a lack of inclusive governance, and the allocation of limited water and natural resources.

The dependency on water originating outside the country is high, and suitable management of the Grand Ethiopian Renaissance Dam (GERD) will be vital to ensuring that Sudan's water demands are met. It is in particular critical that there is an agreed operational arrangement of the Dam to avoid disruptions of water supply for domestic, livestock and irrigated agriculture sectors.

Policies and Institutional Reforms

Some of the obstacles hindering the effective management of water resources in Sudan are found in an incoherent, non-inclusive, non-accountable, and fragmented national water policy with concomitant gaps in water legislation and poor enforcement. The lack of clarity and coordination about roles and responsibilities between sectors and across geographic scales is prevalent, hampering the optimal use of limited resources for facilitating and regulating the sector. This is most evident in the management of water facilities, whether for drinking water or irrigation. The functionality of small

[8] https://www.bpb.de/gesellschaft/migration/laenderprofile/307860/internal-displacement-in-sudan

dams, haffirs, and water yards often deteriorate because of the lack of clear policies for identifying the responsible entities for operations and maintenance (O&M). The involvement of beneficiaries during the project life cycle is often missing, with the federal MoIWR overseeing construction, handing operations over to states after completion. There are legal provisions for states to collect O&M fees, and the opportunity for Community Based Management (CBM) is currently gaining traction with a CBM strategy currently being finalized. It is important to note that CBM will only be successful if the handed over infrastructure is in good shape and if there is continuous technical support and accountability oversight from the respective State Water Corporations (SWC).While the federal government ensures the participation of the states in the management of projects, the state organs exercise powers in accordance with the federal plans, policies, and legislation in relation to water resources management, water supply, and irrigation.

Water use charges are currently collected from the irrigation, energy, and water supply services. The main challenges faced are the low charges and limited revenue collection. For the water supply services, the main constraint is the political interference that prevents real cost recovery to enhance the services. Water pricing is a promising solution for several of the main water challenges in Sudan, but getting it right is often complex. This is due to the various pricing tools that are available, the multiple objectives they serve, and the variety of water uses for which they can be implemented. Also, given the fundamental public interest in water resources management, access to drinking water and water for economic development, pricing, and regulatory instruments need to be considered together. The cost recovery experience and mechanisms put in place in the drinking water, irrigation, and electricity service delivery, could lend lessons learnt to help introduce water management services. A range of policy instruments can be considered, e.g., tariffs for water supply and sanitation, abstraction charges, pollution taxes, and value capture relevant to use mechanisms. Improving willingness to pay for water management and water services requires clear explanations of how revenues collected are used for stated goals that benefit users. A water pricing policy is envisaged in which all water services are governed by the same principles and the whole water value chain is used optimally.

Public participation and transparency in decision-making is not featured, nor does it refer to the role of the states in managing water resources. There is no emphasis on water management as a service, no mention of gender provisions, and no definition of water use.

Federal Systems and Decentralization

Due regard must be given to resource limitations and increased competition for water resulting from Sudan's drive towards development and the implications of climate change. IWRM is a systematic process for sustainable development, allocation, and monitoring of water resource use in the context of social, economic, and environmental objectives. Its integrated management means that all water uses are considered together. It also advocates for the creation of an enabling environment, including legal reforms. It is therefore pertinent to ensure the integration of water-related legal frameworks that promote cross-sector coordination, building on existing structures where possible. Public institutional arrangements at federal and state levels need to be integrated, efficient, and transparent whilst avoiding duplication of functions and responsibilities.

There is a need to strengthen the National Council for Water Resources (NCWR) and other coordination mechanisms and to build on what is available, such as state-level water coordination councils and the potential for transboundary coordination mechanisms, such as the Countries Coordination Framework Agreement. The need for an Inclusive National Water Allocation Plan (NWAP), in which water allocation priorities are defined and established in a short to medium time horizon taking climate change implications into account, is recommended. Catchment plans (and considering sub-catchments as planning units) and state-level water plans need to be in line with this NWAP. The plan will also cover aspects such as water investments, assessments, special projects of strategic federal nature, international agreements, transboundary commissions, etc. Final endorsement of the National Water Policy/Strategy and the NWAP by the NCWR will be some of the plan's main responsibilities.

Facilitative Regulatory Oversight

As custodian of water resources, the government has identified MoIWR as the executive body that will act as regulator. A dedicated, ring-fenced government-supported, competent, and well-resourced facilitative regulating agency, possibly within the MoIWR, will need to be identified to develop policies and regulations around water use, control, protection, development, and management.

Box 5:

"Existing regulatory frameworks for water governance fall far behind to contributing to the development of robust institutional building as they suffer from critical gaps, contradictions and inconsistencies. Law enforcement mechanisms are not in place and concrete and socially recognisable water policy and strategic frameworks are lacking". **Sudan Transitional Government urgent needs document**.

Water Resources Planning and Development

The fragmentation of water management across institutions has contributed to overlapping responsibilities and has constrained the effective implementation of water management functions. The coordination of all uses requires a strategic water planning framework that identifies priority allocations, defines priority water infrastructure targeting cross-state water sources, defines the economic value of the resource, declares pro-poor equity national provisions, and offers the latest authentic government-approved water resources assessments.

Furthermore, Water Resources Management planning allows for optimal use of a limited resource equitably and sustainably for all uses, including agriculture, navigation, fisheries, tourism, energy production, mining, etc. The focus for the short to medium term is the development of water resources to harness under-utilised water resources to sustainably replenish haffirs and shallow wells for drinking water, supplying water to support more than one crop in a year, which is the current norm now, generating energy where applicable, and creating habitats for special and unique fauna and flora, including fish. All this can be possible if water harvesting and storage facilities are established on suitable sites taking all environmental considerations into account. Storage, in this context, refers to the entire storage spectrum: catchment management enhancing blue and green water in soils, haffirs, barrages; water harvesting (small scale); managed recharge (sand dams, etc.); conjunctive surface-groundwater storage; and multipurpose dams of varying sizes.

The limited investments in the past have not adequately developed the available resources to meet current and future demands. The lack of an ambitious water master plan is particularly glaring now that the country is embarking on a development trajectory. The modest, incremental thinking of meeting water challenges by installing more haffirs and boreholes or water yards, which was perpetuated because of a lack of government investment, should be transformed into a 'can do' approach in which citizens benefiting from these developments receive services based on cost recovery. This implies a serious shift in citizen behaviour. Awareness raising campaigns about citizens' rights and obligations will need to accompany such developments. Special provisions are needed for households that are unable to pay for services, such as special coupons, social grants, stepped tariffs, and/or a free basic allowance. There is also a need to encourage and support the use of renewable energy in water resources development.

Water Resources Allocations and Protection

The process of allocating or sharing water among users or consumers based on a set of principles defined in a water policy or strategy statement supporting developmental trajectory is missing. Water resource allocation is a decision-making process involving scientific assessments of demand and supply that allows for the identification and analyses of water resources in respect of: location (where it can be taken from and sometimes where it can be used), time (when water can be abstracted), purpose (what it can be used for and sometimes how it should be used), user (who can abstract it and who can use it). Prioritizing and allocating water has serious and direct implications for sustainable development. Big business investments in agriculture, industry, or mining can be at risk if allocation decisions are not scientifically supported.

Supply/demand studies rely on various models that use water-related data collected from the field or remotely sensed from satellites. Catchment-based assessments need to be run on a regular basis to provide consistent and coherent information for the economic sectors of government. These assessments are normally carried out routinely using various decision support platforms and represent a core function of the MoIWR. Building appropriate information technologies and human resource capacity to run these technologies is critical for sustainable development. Universities and research institutions play an important role in advancing the science and innovations.

Efficiencies in administering allocation decisions can hinder or enhance development. This includes transparency in allocation decisions and flexibility that aids in promoting development options. The accountable administration that makes these decisions would need to maintain impartiality to investors and uphold clear policy positions for the equitable and sustainable distribution of water. Monitoring, verification, and enforcement of license or permit conditions is a major responsibility of catchment or state-level regulators.

Most permit conditions will include water quality provisions. In addition to soil erosion that results in siltation and destabilization of wadi morphology, there is the problem of water quality deterioration in haffirs and water yards that lack separation between human and animal water consumption. The safety of water for human consumption also deteriorates in the months following the rainy season. Other sources of pollution that need to be regulated include increases in agricultural inputs – agricultural runoff, source pollution from industries and mining, and groundwater contamination through unmanaged/poorly constructed septic tanks/sanitation facilities.

License conditions will give specific instructions and place limits on various water uses, such as mining, which is on the increase. From a policy perspective, there is a need to include environmental and resource costs associated with damage or negative impact on the aquatic environment in accordance with the polluter-pays principle for all water pollution of diffuse or point sources.

5.3.2. Transformative Packages

The scope of the National Water Resources Management Transformation Plan (NWRM-TP), which fully acknowledges the role of water in the overall development in the country, is to establish/transform long term systems/mechanisms needed for the proper management of water resources. This can be achieved by addressing critical challenges and opportunities to ensure sustainable management in the country. The Transformative Packages (TPs) outlined in Figure 14 are aimed at addressing the challenges outlined above to enhance the management of water resources in Sudan.

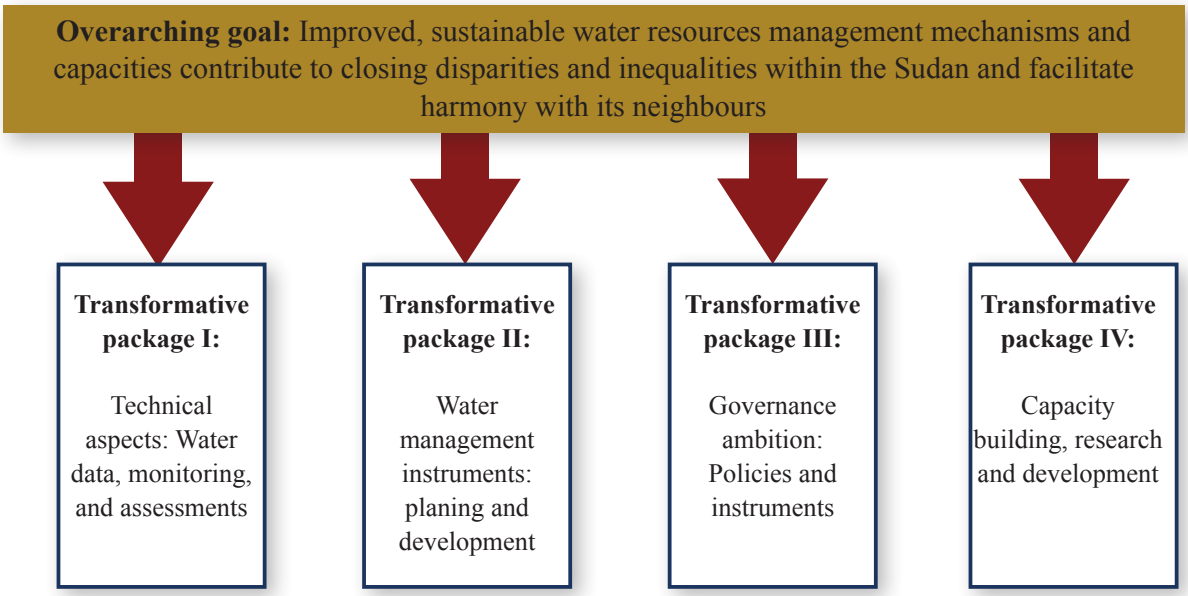


Figure 14 Framework of the National Water Resources Management Transformation Plan

To achieve its intended impacts, the NWRM-TP is informed by established common IWRM principles, catchment-based, community-led water resources management practices, and multilevel Water Governance relevant to the context and specificities of Sudan. The expected impacts of the four priority TPs outlined in Figure 14, are:

1. The institutional and policy reform ambitions, catchment plans, and water councils are implemented.
2. Government oversight and facilitative means are standardized and aligned between the state and federal levels.
3. The data for assessments, allocations, development, and planning are coordinated.

The priority action across the four TPs are characterized by cross-fitting approaches:

- Addressing institutional, individual, and societal capacity development needs, research, and innovation
- Monitoring and information management of resources and their uses, ecosystems are functioning
- Public participation and decisions based on an understanding of the intersectional impacts of decision-making (e.g., based on gender, disability, and tribal and/or ethnic dimensions).

Transformative Package (TP I): Technical Aspects - Water data, Monitoring, Assessments

This Transformative Package (TP) makes use of the defined challenges in this document's sections on water resources and their use, water data, climate change disasters, and peace, respectively.

The program will include a comprehensive water quality and quantity data programmer that aims to address coverage gaps and sustainability provisions, enabling community involvement through catchment-based institutions.

From a hardware perspective, this TP will focus on enhancing and standardizing existing information technology systems used in the Nile to upscale to all other catchments. These improvements will enable MoIWR to run regular assessments using the various model parameters and inputs in a coherent and continuous manner to determine national water supply and demand and current and future projections for allocations, and to guide development decisions. Delivery will be in partnership with the Meteorological Department and others.

Water allocation decisions relating to the economic sectors such as irrigated agriculture, water supply, energy, mining, or health will incorporate risk analyses. Considerations of the adequate measures to reduce and manage risks will form the core of the MoIWR regulatory strategy. In order to synthesize this diverse information and to compare and evaluate alternatives, a planning process will benefit from using modelling and decision-making tools such as GIS and/or Decision Support Systems.

For consistency and structured approaches, the development of a national map to guide the optimal use of potential water resources and recharge zoning will allow for alignment in decision-making. Stringent water restrictions implemented by the MoIWR will also encourage residents to dramatically reduce water consumption. Monitoring and regulation of water allocations and licensed users will regularly be verified using technological advancements such as satellite images.

Compliance monitoring will also make use of local users organized in catchment-based structures to help enhance water use. For example, CBM structures responsible for the O&M of infrastructure can act as whistle blowers to local authorities. Operationalization of the various regulations for water withdrawals from surface water,

groundwater, or the Nile basin will be enacted. Enhancing community awareness of these regulations will contribute a great deal to implementation and enforcement, such as the current radio programme and outreach undertaken by the GWWD. Legal provisions for surveillance access and spot fines, etc. will be put in place.

A key impact of this TP is 'Improved data management and sharing, monitoring and assessment practices, and local users organised in strengthened catchment-based structures for enhanced compliance.'

TP II: Management Instruments - Planning and Development

This TP reflects the challenges outlined above on water resources planning and development, water resources allocations, and water pricing/costing while balancing use and protection for sustainability. This is one of the major TPs that deals with the management instruments that are essential to enhancing water resources management decisions. Management instruments are specific methods that enable decision-making based on rational and informed choices, bringing together data, perspectives, and knowledge from a range of disciplines such as hydrology, hydraulics, environmental sciences, system engineering, legal sciences, sociology, and economics.

National Water Allocation Plans (NWAPs) aimed at catalyzing national development agendas are developed in a widely consultative and facilitative way. Water allocations are a means of controlling water use; they are developmental tools with a protection/sustainability dimension. Accordingly, NWAPs would comply with the aspirations of SDG 6 (ensure availability and sustainable management of water and sanitation for all), SDG 1 (ensure zero hunger and food security for all), and SDG 8 (promote sustainable economic growth, full and productive employment, and decent work for all). The plans will vary based on priority water resource concerns, such as disaster risk reduction provisions, including early warning systems; risk to, and migration of, vulnerable communities during extreme events and disaster mitigation interventions; conflict mitigation and prevention needs; agricultural productivity in agricultural zones; pollution control and mitigation; and transboundary water diplomacy provisions.

All plans will include water conservation provisions for future generations and gender specific provisions. Similarly, and reflecting broader aspirations towards sustainability of quality services, cost recovery aspects would be considered based on social equity, ecological sustainability, revenue collection, financial affordability, and willingness to pay.

For water resources planning, the development options are not confined to the water sector itself, but are based on scenarios for development in relation to other sectors that may have an impact on water resources (e.g., water demand or water quality).

A key impact of this TP is 'widely consulted National Water Allocation Plan informed by state and community water needs and priorities; complaint with SDGs 1, 6 and 8.'

TP III: Governance Ambitions - Policy and Institutional Reforms

This WRM TP addresses policy and institutional reform, the federal system and decentralization, and regulatory oversight challenges. Given the importance of coordination among all key players, the MoIWR, under its reform agenda, will coordinate and consult with the NCWR. The NCWR includes high-level members of the political leadership and state representation from multiple relevant sectors (such as agriculture, energy, environmental protection, and mining). The NCWR currently has a mandate to endorse and approve policy for water resources as a long-term federal plan for the optimal and balanced use of water resources and to determine priorities. The strength of the NCWR is in its membership, which is assumed to ensure high-level coordination and alignment between sectors and states in water use and protection. These relationships transcend water boundaries and contribute to achieving balance in the water/food/health/energy nexus.

In line with institutional reform, catchment-level councils at the state level regulate the use of wadis (such as spate irrigation). This includes coordinating and prioritizing investments in stressed upstream/downstream water dynamic areas, such as in Abu Habil between North and South Kordofan or in Wadi Elku between North and South Darfur. These areas experience regular conflicts arising from competition over the limited available resources.

This TP aims to coordinate water resources management through the establishment of at least five state-level water coordinating councils, such that there is harmony and synchronization between all key players and no tensions in implementing and managing federally-funded water projects. Moreover, a comprehensive review and update of water legislation will address gaps, remove irregularities, and improve enforcement, potentially through the revival of the NCWR and with the support of state-level coordinating councils.

As the custodians of water resources, the MoIWR is mandated by government to pursue the facilitative and empowering fulfilment of functions at all levels, delivering value, affordability, and inclusivity in WRM services. Regulations based on affiliative oversight principles of incentivizing rather than penalizing federal to state relations are central to this mandate. The prevailing weak regulations will be improved to better control the various uses and water allocations; facilitate the participation and support of users, including women; protect water resources from all sources of pollution; and address disaster risk management at various levels.

A key impact of this TP is 'revived and strengthened water councils at national, state, catchment, and community levels to manage water resources and create an accurate national water policy with corresponding facilitative and regulatory oversight.'

TP IV: Capacity Building, Research and Development

The program under this TP aims to elaborate on the needed and agreed performance of organizations, individuals, and society regarding water resources management. Assessing current performance will further identify capacity development gaps that will require systemic programming and new enabling policies, agencies, and financial sourcing.

Initially, the focus will be on raising the efficiency and enhancing the delivery of the mandate, by analyzing human resources gaps and growth incentive systems as well as establishing a Performance Management System (PMS). A dedicated set of activities will be organized for individual capacity development, including sharing

of knowledge and enhancing multi-disciplinarily. Since the majority of Sudan's population is made up of youth, special youth programs will be introduced to trigger youth interest and engagement in water services such as manufacturing, construction, and employment. Lastly, at the societal level, awareness raising and documenting of indigenous knowledge will be an integral part of the science. R&D interventions will identify and foster partnerships and investigate the R&D space for alignment and removal of redundancies.

A key impact of this TP is 'strengthened water sector institutions engaging staff and youth, and successfully identifying, designing, and implementing priority water resources management and development programmes.'





6. CROSS CUTTING ISSUES

6.1. Water Quality

The Sudan Water Sector Livelihoods Transforming Strategy (SWS-LTS) aims to coordinate with the Higher Council for Environment, the MoANR and the Ministry of Infrastructure and Transport (fecal sludge management) to address aspects of water quality and water resources contamination. Design and planning for water supply will require due attention to the water quality of identified water resources. Efforts to strengthen the water quality labs of SWCs is yet another strategic approach to ensuring that water supply is regularly monitored. For irrigated agriculture, coordination with MoANR is required to provide awareness on pesticides and fertilizer application to reduce contamination.

6.2. Climate Change and Variability

As discussed in earlier sections, the planning and management of water supply services and irrigation water management will be reviewed in the context of vulnerability to climate change and climate variability. Water resources management interventions will pay due attention to monitoring and forecasting climate variability and development of applicable management plans. The design and management of irrigation schemes will take into consideration climate variability in its water use efficiency interventions. Approaches such as conjunctive use and contingency plans to address water supply in the context of drought or floods will be developed to embed resilience to climate change in the plan's interventions.

6.3. Gender, People with Special Needs, and Inclusion

To tackle aspects of gender inequality, the Livelihoods Transforming Strategy aims to address the equal representation of women and girls in consultative processes during design and implementation and to ensure adequate and meaningful representation of

women in local management structures. Further, the design and implementation of water resources management, irrigation water management and water supply services will begin to address issues related to people with special needs (disabilities) through the revision of national standards and guidelines for the construction of facilities. Revising design schemes to ensure accessibility for people with disabilities is an initial strategic action. In addition, this strategy aims to address broader issues of inclusion to ensure that vulnerable groups are adequately included in consultations and that their needs are incorporated into the design and operation of irrigation and water supply schemes.

6.4. Refugees and Displaced Peoples

Sudan has faced decades of conflicts that have created massive displacements internally, while conflicts in neighbouring countries have resulted in an influx of refugees. This strategy aims to address the needs of host communities and Internally Displaced People (IDPs) in the construction and design of water supply and irrigation schemes to mitigate potential conflict. This will be realised through coordination with humanitarian actors and adequate consultations to reflect the needs of both refugees and host communities.



7. ACCOUNTABILITY AND TRANSPARENCY IN DELIVERABLES AND IMPACT BY 2031

Within a 10-year period, the ambition of the Sudan Water Sector Livelihoods Transforming Strategy (SWS-LTS) is to contribute to the following three priorities of the MoIWR: 1) all Sudanese people in rural and urban areas, including nomadic communities and their livestock, have reliable, adequate, and affordable access to a safe water supply; 2) improved livelihoods and food security for nearly seven million rural farming community members; and 3) the creation of dignified and rewarding employment opportunities for about two million Sudanese people, particularly rural youth and women. These three priorities are very much aligned with SDGs 1,6, and 8.

The total ten-year budget including 10% management costs is estimated at nearly $US 8.6 Billion. Accountability and transparency are supported by clearly stating ambitions. The specific outputs and impacts across the three Anchoring Pillars, along with their budgets, are summarized below.

Anchoring Pillar I: National Irrigation Transformation Plan

Output	Expected Impact by 2031	2023 Transition Period Targets	Budget in Million $US
Transformative Package (TP) I.1: Upgrade and modernize large-scale irrigation schemes: 400,000 Ha (out of a total of 1.2 million Ha) are sustainably upgraded with adequate irrigation facilities, sufficient institutional capacity, and a supportive policy framework	i) Create about 200,000 new employment opportunities for Sudanese people, particularly rural youth and women. ii) Enhance food and nutrition security and livelihoods of about 2 million farming family members. iii) Increase production for export and foreign currency earning. The upgrading and modernization work is also expected to inform the new irrigation developments	100,000 Ha in Gezira and another 20,000 Ha in each of Suki and Rahad schemes rehabilitated: nearly 60,000 employment opportunities generated and livelihood of 0.6 million farmers and their family members improved With support from the Food and Agricultural Organization (FAO), the Ministry of Irrigation and Water Resources (MoIWR) is implementing action research to identify and implement water productivity improvement interventions in the Gezira irrigation scheme	**300**

Transformative Package (TP) I.1: Upgrade and modernize large-scale irrigation schemes: 400,000 Ha (out of a total of 1.2 million Ha) are sustainably upgraded with adequate irrigation facilities, sufficient institutional capacity, and a supportive policy framework	i) Create some 100,000 employment opportunities for Sudanese people particularly rural youth and women. ii) Enhance food and nutrition security for roughly 1.5 million farming family members. iii) Increase production for export and foreign currency earning	Upgrading and modernization of 100,000 Ha of the medium-size pump schemes is expected to create some 35,000 employment opportunities, and 0.5 million Sudanese rural poor and farming household members will enjoy better livelihoods Upgrading and modernization of medium-sized pump irrigation is included in development programmes that the MoIWR has shared with interested donors including the World Bank (WB)	**100**
TP I.3: Modernize small-scale pump irrigation schemes: 100,000 Ha (out of a total of 300,000 Ha) benefit from smart irrigation technologies (e.g., solar pumps, precision irrigation) and a robust operation and maintenance support mechanism	i) Create some 25,000 employment opportunities for Sudanese people. ii) Provide better income and livelihood security for about 0.5 million farmers and their family members through affordable and reliable irrigation supplies. ii) Expand groundwater use for small-scale irrigation, particularly in areas away from the Nile. This will help mitigate the challenge of unbalanced development	Interventions implemented across 20,000 Ha are anticipated to improve livelihoods of 100,000 farming community members There is high interest in these schemes, and some joint project proposals with the water supply sector have already been discussed with interested donors including United States Agency for International Development (USAID) and United Nations Children's Fund (UNICEF)	**125**
TP I.4: Upgrade and modernize seasonal flood-based irrigation schemes: Improved water harvesting, and water management practices introduced in 300,000 Ha (out of an estimated total of 500,000 Ha)	i) Significant reduction in poverty among nearly 1.5 million rural poor farming and pastoral farmers and their families. ii) Address the challenges of unbalanced development through building irrigation facilities in less marginal areas	An estimated 150,000 Ha upgraded, resulting in nearly 0.75 million rural poor farmers and pastoralists and their families having improved and resilient livelihoods. There are two up-scalable solutions in Wadi El Ku in Darfur and Gash scheme in Kassala (see Box 2)	**100**

TP I.5: Improve cropping intensity: In close coordination with agricultural authorities and farmers' organizations, increase the cropping intensity in existing large-scale irrigation schemes in the summer and winter seasons by 25% and 35% (88,000 and 118,000 Ha) respectively, taking 2018/19 cropped areas as the benchmark	i) Enhance production for food security and export by increasing the cropped area by around 200,000 Ha in the existing large-scale irrigation scheme. ii) Create about 400,000 employment opportunities and improve livelihoods of about 1 million Sudanese farming family members.	80,000 Ha of cropped area increase in large-scale irrigation schemes. This is expected to create about 160,000 new jobs and enhance the livelihoods of some 0.6 million farming family members. There is already a plan and a commitment by the MoIWR to increase the wheat cropped area in the Gezira irrigation scheme by about 150,000 ha in 2021.	**16**
TP II: Construct new irrigation developments: Use available water from the Nile to begin 400,000 Ha (250,000 Ha from the Blue Nile and 150,000 Ha from Atbara River) of new irrigation developments	i) This new development (400,000 Ha) will mainly be the result of the efforts of investors; thus the main impact will be on employment creation estimated at about 800,000 new jobs based on the conservative estimate of 2 job opportunities per Ha. ii) Roughly 50,000 Ha of this area is expected to be distributed to local small farmers, contributing to the enhanced food and nutrition security of about 0.25 million rural farming family members. iii) Increased production for export and foreign currency earning	100,000 Ha new irrigation development: a) 200,000 employment opportunities mainly in Roseires irrigation scheme where there is already a ready-to-go design and plan, and b) improved availability of fodder and water supply for livestock in neighbouring areas	**1200**

TP III: Improve water productivity: Increase the output per volume of water used by at least 50% in existing and newly developed irrigation schemes	i) Throughout the irrigated crop land production system, the options for low-to-no-cost improved water management measures have been systematically analyzed and discussed, leading overall to 50% more crop per drop across the existing 1.1 million Ha and the 400,000 Ha of new irrigation schemes. This contributed to the 20 to 30% crop intensification discussed above ii) 250 new young water managers updated with local techniques and opportunities for smart water use	i) In 300,000 Ha of existing irrigation schemes across all systems, low-to-no cost improved water management measures have been introduced, leading to an overall rise in the water productivity of 50% more crop per drop. ii)100 new young water managers trained and equipped to manage water productivity raising measures. This effort has already started with the FAO-funded irrigation water management and productivity improvement project in the Gezira Irrigation Scheme	**15**
TP IV.1: Build capacity: All major irrigation departments of the MoIWR and other actors in the operation of irrigation management (including farmers, pastoralists, and agricultural managers) to benefit from developed and operational capacity development programmes that address current knowledge and skills gaps and future needs	i) Strengthened institutions across the MoIWR supporting the upgrading, modernization, and management of irrigation systems and providing better quality, cost-effective services to farmers ii) 50% of the 5,000 staff of the MoIWR, including 250 young professionals will have improved knowledge and skills. iii)1,000 farmers and pastoralists have benefited from horizontal learning and exchange programmes	i) Capacity of three key irrigation institutions strengthened in several areas, including: effective leadership and organizational management, fostering partnerships and improving performance, cultivating a motivated and effective workforce, initiating and implementing organizational restructuring ii) 20% of the 5,000 MoIWR staff, including 100 young professionals responsible for irrigation management and development, have improved their knowledge and skills. iii) At least 250 farmers and pastoralists have benefited from horizontal learning and exchange programmes	**16**

TP IV.2: Solution Transfer: At least six of the most promising completed research activities are translated into impact on the ground. Four new research initiatives on priority themes will be developed and implemented	i) Provide new solutions that can enrich and fast-track the upgrading and modernization of irrigation systems ii) They will serve as a vehicle to sharpen the know-how of many young professionals who will be actively engaged in research activities alongside their senior colleagues	Three promising research activities will be translated into investment programmes. Among others, some quick wins here are the successful field research pilots in Gash and Wadi El Ku seasonal flood-based irrigation schemes	**2**
TP V: Policies, Governance, and Transparency; Facilitative policies anchored in an inclusive and engaging governance system will be prepared to guide realisation of the above outlined TP	i) Clear policies to guide plans and decision making developed, approved, and adopted. ii) Revised and updated laws, regulations, and enforcement mechanisms are in place. iii) Enhanced well-defined roles for all stakeholders, including farmers and service providers involved in the irrigated agriculture business.	i) Irrigation and drainage law revised. ii) Draft Sudan water policy prepared and subjected to wide stakeholder consultation before its approval by the legislative body.	**1**
Total budget			**1900**

Anchoring Pillar II: National Water Supply Transformation Plan

Output	Expected Impact by 2031	2023 Transition Period Targets	Budget in Million $US
Transformative Package (TP I): Rural and Pastoralist Water Supply	Reach 100 percent access to water supply in rural and pastoralist areas based on population growth projections. The tentative mix of schemes are: • Water yards: 3,412 • Mini water yards: 4,360 • Hand pumps, wells: 10,825 • Haffir/dam w/treatment: 274 • Household or compound networks: 3,10751	Targeted results for transitional period: • Water yards: 682 • Mini water yards: 872 • Hand pumps: 3,274 • Haffir/dam w/treatment: 74 • Household or compound networks: 621,502	**2100**
TP II: Urban Water Supply	Reach 100 percent access to water supply in urban areas: • Water yards: 4,353 • Mini water yards: 4,360 • Hand pumps, protected wells: 10,825 • Haffir/dam w/treatment: 274 • Treatment plant/compact unit: 176 • Household networks: 3,107513	Expected results during transitional period: • Water yards: 871 • Mini water yards: 426 • Hand pumps, protected wells: 10 • Haffir/dam w/treatment: 35.2 • Treatment plant/compact unit: 35 • Household networks: 749,701	**3600**
TP III: Institutional Capacity Development, Program Management, and Enabling Environment	To support: • Establishment of enabling environment (sector reform, endorsement of policy, legal aspects such as laws and proclamations for water supply) • Training of sector specialists, contracting of sector staff at all levels (federal, state, mahalia, and community) • Preparation of applicable guidelines, manuals, and associated dissemination and outreach • Community mobilization and establishment of community management structures		**183**
Total budget			**5883**

Anchoring Pillar III: National Water Resources Management Transformation Plan

Output	Expected Impact by 2031	2023 Transition Period Targets	Budget in Million $US
Transformative Package (TP) I: Good quality water data that is better managed, shared, and applied	• Comprehensive water quality and quantity data program established • Quality data used for current and future projections for allocations and development decisions • Risk analysis incorporated in MoIWR regulatory strategy • Residents encouraged to dramatically reduce water consumption • Curb water over-abstractions and instill effluent quality control	• 5 catchment-based institutions strengthened • Smart IT used in the Nile up-scaled to all major catchments • Key water allocation decisions include risk analysis • National Map for potential water resource use and recharge zoning • At least one major non-Nile (seasonal river) has an adequate monitoring station and is managed by a competent institution • Field offices of the Nile water monitoring stations are better equipped with improved technologies and better skilled personnel	**20**
TP II: Water resources management instruments are operational	• Multi-sector development scenario Water Allocation Plans (WAPs) guide the allocation, control, use, development, and protection of water resources at national, state, catchment-based, community levels • Ministry-wide framework for cost/benefit sharing among varied water users and uses is consultatively developed	• WAPs incorporate disaster risk reduction provisions, and transboundary water governance aspects are rolled out • At least 5 state-level and another 5 catchment-level WAPs are introduced • Framework for cost/benefit sharing among varied water users and uses is implemented at pilot scales in the 5 selected catchments	**4.5**

TP III: Facilitative governance and policies	• Revive and strengthen the National Council for Water Resources (NCWR) to assess water resources and create an accurate national water policy • Introduce and improve state and catchment-level governance and conflict management mechanisms, particularly in fragile water-stressed basins	• NCWR mandate, governance, staffing, and structure • Draft National Water Policy • 5 state-level Water Coordinating Councils established, including in tension areas • Governance mechanism introduced in the Darfur and Gash water-stressed basins	**3.5**
TP IV: Increased efficiency, delivery of mandate, and performance of organizations, individuals, and society regarding Water Resources Management (WRM)	• Performance Management System introduced across MoIWR at all levels, including knowledge sharing and enhancing multi-disciplinarily • Special youth programs piloted and mainstreamed upon proven effectiveness • Priority research programs that address major water resources management and development issues identified, implemented, and up scaled	• Institution-wide review to identify knowledge gaps and options for closure • 75% of senior staff of all key institutions active in water resources management and development have improved leadership and management capacity • 50% of the technical staff of all key institutions have improved skills and know-how on water resources management • Two major studies completed, and their findings translated into decision-informing policy briefs • Societal awareness campaigns implemented	**5.5**
Total budget			**33.5**

* These budget numbers are tentative, and concern only identified priorities. The overall WRM budget should correspond to 3-5% of the Irrigation and Water Supply Investments.

8. ENABLERS AND THEMATIC GUIDING PRINCIPLES

The following overall approach and thematic principles will guide the formulation of specific projects to realise the above outlined outputs and impacts.

8.1. Overall Approach

Prioritise implementing quick-wins interventions that are critical to performance and that respond to the urgent need of the Sudanese people to achieve impact on the ground as integral components of long-term irrigation, water supply and water resources management and development programmes that are well-thought through and have measures built-in to mitigate unintended negative consequences.

Put the Water Sector Livelihoods Transforming Strategy to the service of the rural farming communities and urban population where needed and democratise access to water resources for all, in its productive sense for agriculture and livestock, in its social sense of creating harmony and cohesion, and in its environmental sense of doing no harm by seeking synergies and complementarities.

8.2. Thematic Guiding Principles

Facilitative policies with fair regulatory framework: The presence of such a policy within the MoIWR is critical to strengthening the responsible States' capacity to manage their resources and to level the legal, technical, and information playing fields. Without institutionalization and alignment of the various roles played in the effective management, use, development and protection of irrigation, water supply and water resource management facilities; transformative development will not be feasible.

Impactful allocation of financial resources: To address the most critical needs and support the prioritisation of geographic areas that need investment the most, planning will be carried out in a parallel process of 'bottom-up' and 'top-down' approaches:

1. **Top down**–The national level has to put the following parameters and criteria in place to support states and localities to prioritise geographic areas in a phased approach that is commensurate to the available funding and sector absorption capacities:

- Proportion of inadequately developed irrigation, water supply and water resources management facilities and insufficiently served population
- Poverty, food insecurity and high unemployment rates
- Vulnerability to climate shocks — extreme droughts and floods
- High prevalence of water-and-excreta-borne diseases
- Limited resources or funding provided in last 5 years
- Not served by any other funding source (e.g., NGO or externally financed program).

2. **Bottom up** – Based on the selection and prioritisation criteria set forth at the national level, states will be provided with guidance and resource availability. Accordingly, each state must work closely with each locality to identify communities that meet the above-mentioned prioritisation parameters. As resources become available, states and localities can continue to expand their scope and propose new areas as part of an annual planning exercise.

Efficient resource utilisation and risk mitigate: To achieve this, several measures will be introduced including developing joint financing agreements; designing program financing to optimise the flow of funds at all levels as well as mechanisms for earmarked funds to be used for dedicated purposes; ensuring provision of matching funds from states/communities for water supply schemes as well as states/irrigation water users are provided as per the budget cycle; establishing a national governance body to ensure adequate allocation of budgets in line with pragmatic plans and sector absorption capacity.

Systemic approach: Transformative interventions need to be informed by data and careful diagnosis of problems across the water system spectrum. They should also take stock of detailed analyses of the benefits to and the unintended negative impacts

on all uses (upstream and tail-end, small and large farmers, marginal segments of population, servicing youth and women).

Actionable solutions: These are solutions to overcome critical situations, with the highest implementation probability and the highest promise for a positive and wide impact on the ground.

Recognise farmers, herders, producers and all other water users as solution providers, not just a target group: These stakeholders are also being at the forefront of innovation, knowledge exchange and learning. Farmers are reservoirs of local knowledge, harnessed through constant strive to address their problems: many have applied such local knowledge to a greater effect. Water users know where system deficiencies hurt most and how to remedy these. Artisans, producers and traders hold the knowledge, and are willing to share, how to make their value-chain more 'water-resilient', especially in view of climate change unpredictability and weather vagaries.

Capacity building, learning and knowledge sharing embraced as the regular order of business: Facilitate solution-oriented research with dedicated room for innovation and experimentation. Regularly update the knowledge and skills of the MoIWR workforce and mainstream capacity building in all departments and agencies. The newly established Training and Capacity Building Directorate (TCBD) has a crucial role to play here: It can support the design and piloting of the capacity building programmes, create incubators of innovation as well as nurturing qualified local trainers.





Handing over the baton: engaging young professionals in flow measurements to better inform decision making in water allocation and distribution (Credit: MoIWR).

9. IMPLEMENTATION ARRANGEMENTS

9.1. Implementation Approach

The specific deliverables and impacts of the Sudan Water Sector Livelihoods Transforming Strategy (SWS-LTS) will be addressed by time and resource-bound, synergetic performance-based projects. Accountability and transparency to the public are key characteristics. The projects may be mutually reliant on one another and/or may be implemented in parallel and at any period within the ten-year lifespan of the Strategy. That said, to deliver fast and visible results that correspond to needs yet can be felt by the beneficiaries and the public at large, it may be useful to start with low-cost quick-win projects. This could favour upgrading and modernisation of existing irrigation and water supply schemes, and water resources management instruments over starting long implementation and gestation cycles of new developments.

9.2. Management Structure

The Ministry of Irrigation and Water Resources (MoIWR) has the overall implementation responsibility and is ultimately accountable for the quality of all deliverables. To implement the proposed TPs and activities outlined in the SWS-LTS, the following bodies will be strengthened or established:

▪ **Strategic governance and oversight** – led by ministers (and can be represented by undersecretaries) of participating sectors to review program scope, approve plans and budgets, and provide strategic orientation for implementation. The composition of the governance and oversight Steering Committees (SCs) may vary for irrigation, water supply and water resources management programmes. The membership and specific responsibilities of the SCs will be determined following thorough consultation with all relevant government bodies and the respective donors and implementing partners.

▪ **Coordination** – a dedicated unit or team of personnel will be responsible for coordinating and planning support at all levels of government to ensure active participation of various stakeholders form relevant line ministries, institutions, state

and local level representatives including beneficiary consumer groups as well as engagement of research and private sector.

▪ **Implementation** – dedicated personnel at federal, state, Mahalia, and community levels to support the design, supervise construction, and manage irrigation, water supply and water resources management interventions. The implementing units will work in tandem with relevant MoIWR directorates and agencies to ensure smooth implementation of proposed interventions and institutionalisation of capacity. The implementation structures for irrigation, water supply and water resources management programmes and projects may be different. They will, however, all include a mix of program management, technical staff, procurement & contract management, financial management, monitoring and evaluation, IT and communication and as needed, environmental and social development experts.

Accordingly, a detailed framework for the program's planning, financial management, budgeting, and budget preparation as well as procurement and contract management will be further outlined to ensure that adequate and transparent implementation modalities are in place and tailored to specific water supply, irrigation and water resources management programmes.

9.3. Monitoring and Evaluation, Knowledge Management, Networking and Innovation

The purpose of the monitoring and evaluation is to: 1) ensure the production of quality deliverables, 2) learn and ensure that ongoing activities are responsive to what is working and what is not, and 3) maximise eventual impact on the cost-effectiveness and sustainability of the proposed interventions.

A detailed programme and project level monitoring and evaluation plan will be developed. Performance indicators will be identified to measure the level of contribution of the project output to its expected outcome and impact. Each indicator will be identified with baseline and target to be achieved at each key milestone and at the end of the project completion. Periodic project monitoring reports and project completion report will be the source of data for the level of achievement in each indicator.

Key in monitoring and networking are to promote internal learning and knowledge management amongst partner organisations across regions and thus being able to move away from monitoring and evaluation as only a management tool, but also as a process in which partners help to define the indicators to measure progress and impact in their own context. Therefore, additionally, a monitoring protocol will be developed to enable internal learning and capture innovation throughout the life of the projects and/or its coherent programmes and thus the Transformative Packages of the Strategy.

The Sudan Water Sector Livelihoods Transforming Strategy as whole will be evaluated against the progress made towards achieving the desired impacts, minimally every two and half years, through an independent ad-hoc evaluation committee. The composition and TOR of the committee will be determined by the SPIU and subsequently approved by its Steering Committee.

9.4. Resources Mobilisation - Financing the Water Sector Strategy

In water development programs, the government, communities, and other stakeholders shall cover capital investment costs, while beneficiary consumer groups will be responsible for O&M costs through the introduction of appropriate tariff systems.

The Government of Sudan's financial contributions come from the national, state, Mahalia, or town level budgets. City administrations also provide funding for water supply and sanitation investments and O&M costs. For irrigation and WRM, water use fees should cover aspects of O&M.

External Financing includes contributions from development partners and donors. These funds will be channeled through MoFEP to implementing agencies based on program-designated implementation modalities and flows of funds.

State Water Corporation Revenue or Irrigation Scheme Boards – Residents of towns and cities where SWCs are active will provide contributions from water supply tariffs while irrigation water users contributing to scheme boards or associations will provide contributions from irrigation fees. In order to receive additional financial support from government funds, tariffs for irrigation and water supply should ensure affordability for consumers.

Non-Governmental Organizations and Civil Society Organizations – NGOs invest in and implement selected water supply, irrigation and water resources management interventions. Although funding from these actors may not flow through government funding channels, resources from these organizations should be consolidated in resource mapping plans.

Private Sector – There is currently limited private sector financing for the sector, but there is scope to increase private sector financing and engagement in expansion of infrastructure, O&M as well as supply of goods and services.

Communities are expected to make in-kind or financial contributions to support the construction of rural water supply facilities and small-scale irrigation schemes where no formal tariff structures are in place.

The RM mobilization effort will be guided by three practical steps: (1) Identify potential resource partners, their geographical and thematic interests, and funding modalities. This is a continuous process and requires regular updating of the details and specificities of the resource partners. (2) Engage the most promising resource partners by seizing every opportunity to communicate the varied components of the Strategy and its detailed projects and programmes for which resources are sought. (3) Build trust—manage joint projects and programmes professionally, provide regular feedback on the progress of work, report results in a timely manner according to the agreed framework, and always acknowledge partners' contributions.



10. STRATEGIC PLANNING HISTORY

This 10-year SWS-LTS is the first of its kind that comprehensively addresses the critical challenges and harnesses the opportunities that exist at this point in time to allow for a firm futuristic demand for systemic long-term mechanisms for sustainable transformation of the Sudan water sector.

The SWS-LTS drafting process took place between May and December 2020. It followed a systemic and deliberate approach. First, the critical challenges that should be addressed and the opportunities that need to be harnessed were exhaustively discussed and documented through brainstorm sessions and consultative workshops. These events were widely attended by the leadership and representatives of the MoIWR and other Sudanese Ministries, UN organizations and NGOs, private sector and farmers' associations as well as varied funding, development, research, capacity building and service providing stakeholders active in the irrigation and water sectors in Sudan. They laid the foundation for designing impactful interventions that respond to the shared priorities of the MoIWR and its partners. The resulting draft was then subject to extensive internal and external reviews. This enriched the content and sharpened the focus of the SWS-LTS, which was further consolidated in a final all-inclusive stakeholder validation workshop.





In the decade 2021-2031, this Sudan Water Sector Livelihoods Transforming Strategy aims at unlocking an optimized, fully operational water sector in Sudan to trigger a transformation of society and deliver enhanced food security and dignified and rewarding employment for some nine million farming community members. The strategy also aspires to provide all Sudanese with safe, adequate and accessible water supply services. These priorities are very much akin to the focus of the Sustainable Development Goals 1, 6 and 8.

To deliver fast and sustainable impact, the Strategy provides the means to foster transformative partnerships with other Line-Ministries within the Sudanese Government as well as with other institutions that share similar interests, in particular, the private sector and beneficiary groups' organizations, multilateral development banks and Green Funds, bilateral aid and UN organisations and diplomatic missions, service providers, think-tanks, and research and academia.