

Policy brief

THE BENEFITS OF TRANSBOUNDARY WATER COOPERATION IN THE NORTH WESTERN SAHARA AQUIFER SYSTEM BASIN



supported by



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Water Convention



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INTRODUCTION

Transboundary waters create social, economic, environmental and political inter-dependencies that make cooperation a precondition to sustainable development and peace. There is a long history of cooperation between Algeria, Libya and Tunisia in the knowledge and management of transboundary water resources of the North Western Sahara Aquifer System (NWSAS). The NWSAS countries are among the pioneer States in terms of cooperation on a transboundary aquifer. However, due to the pressure from a continually increasing demand on such resources, and in a context where the impacts of climate change on water resources are likely to intensify, urgent action is needed.

This policy brief aims to inspire additional cooperative actions among decision makers to improve the sustainable development of the NWSAS basin to the benefit of the three riparian countries, and therefore to support the achievement of the Sustainable Development Goals.

This policy brief consolidates:

- The main achievements, impacts and benefits generated so far by transboundary water cooperation in the NWSAS, in particular through the work of the Consultation Mechanism;
- The added-value of implementing a water-food-energy-ecosystems nexus approach to transboundary water cooperation, and the possible additional benefits it could generate in the basin;
- Prospective opportunities and benefits from strengthening transboundary water cooperation in the NWSAS.

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Design and layout by Clara Schnack. Photos from Depositphotos Inc.

LIST OF ACRONYMS

CM	Consultation Mechanism
GWP-Med	Global Water Partnership Mediterranean
IC	Intercalary Continental
NWSAS	North Western Sahara Aquifer System
OSS	Sahara and Sahel Observatory
TC	Terminal Complex
UNECE	United Nations Economic Commission for Europe



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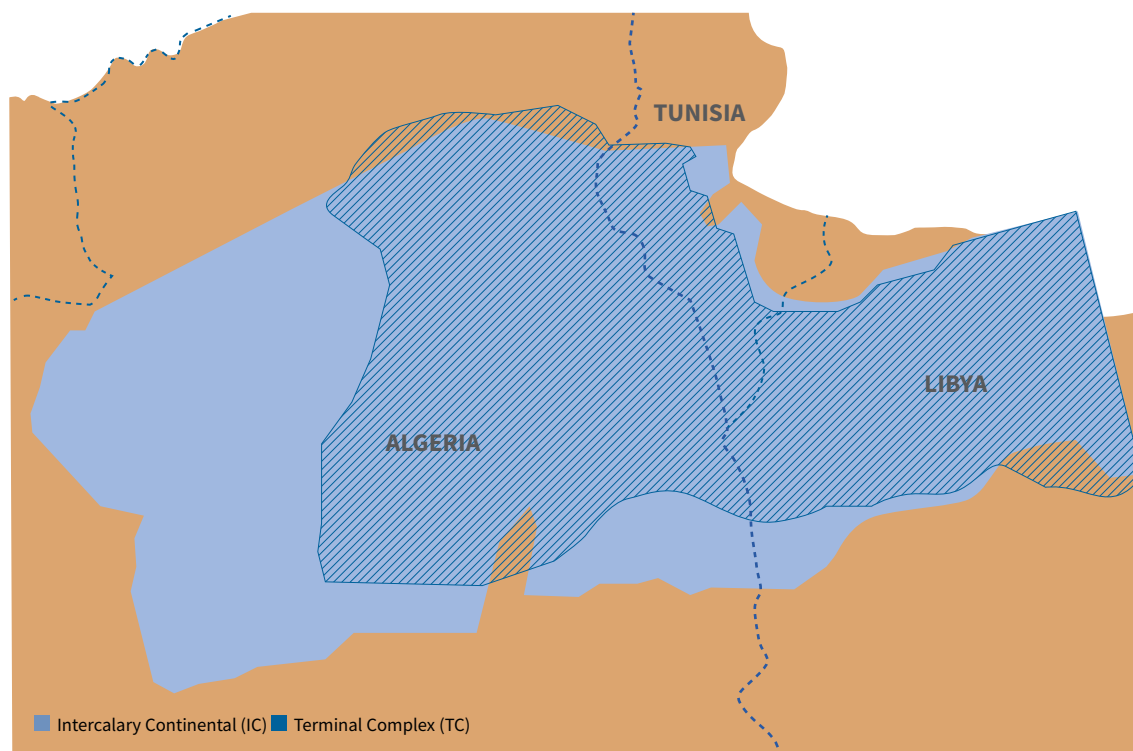
1. SETTING THE STAGE



1.1 The North Western Sahara Aquifer System (NWSAS)

The NWSAS is one of the two major North African transboundary groundwater basins. It comprises of two sandstone formations - the Terminal Complex (TC) aquifer and Intercalary Continental (IC) aquifer (cf. Figure 1) and covers approximately an area of 1 million km² shared by Algeria, Libya and Tunisia. The NWSAS has an estimated groundwater reserve of 60,000 billion m³, essentially non-renewable in a human timescale. Located in the North Africa desert region with an arid-to-Saharan climate, it receives weak recharge, approximately 1 billion m³ annually by infiltrations from the runoffs from the Saharan Atlas piedmont plains in Algeria, the Dahar in Tunisia and the Djebel Nafusa in Libya.

Figure 1. Extension of the NWSAS

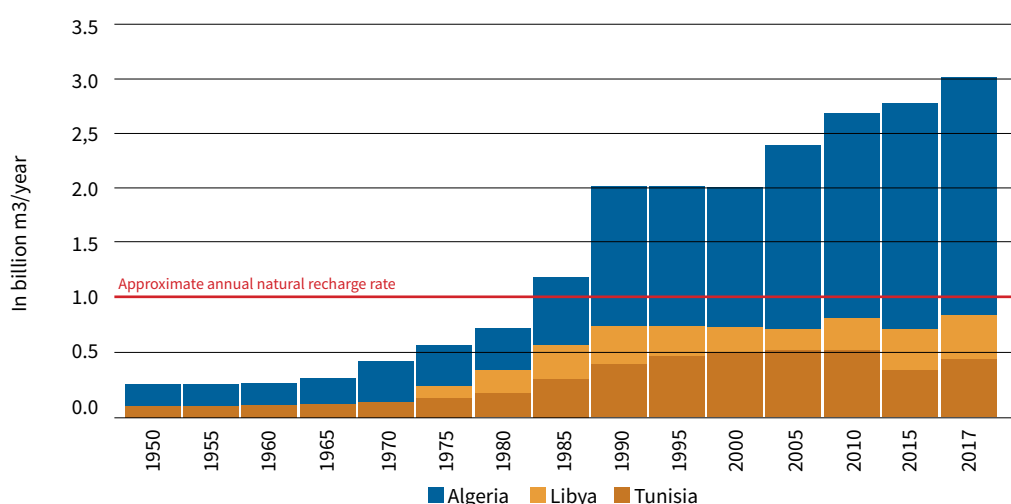


Source: Adapted from CM

1.2 Main water uses and dependent sectors in the NWSAS basin

The NWSAS basin strongly depends on the NWSAS groundwater resources. These groundwater resources serve as a major source of water for irrigated agricultural and livestock breeding, for rural and urban drinking water supply, as well as for industrial and tourism activities in the region, therefore contributing to its socio-economic development. These resources are also highly important for the preservation of the environment. An estimated 4.6 million people directly or indirectly depend on the aquifer resources for their livelihoods and well-being (2.04 million in Algeria, 1.48 million in Libya, 0.7 million in Tunisia in 2012). With the increasing population growth and urbanization, as well as the accelerated economic activities, water abstraction in the NWSAS basin increased from an estimated 0.75 billion m³ in 1980 to 3.1 billion m³ in 2017 (cf. Figure 2), which is three times more than the estimated natural recharge rate of 1 billion m³ per year.

Figure 2. Annual water withdrawals from the NWSAS by the three countries (1950-2017)

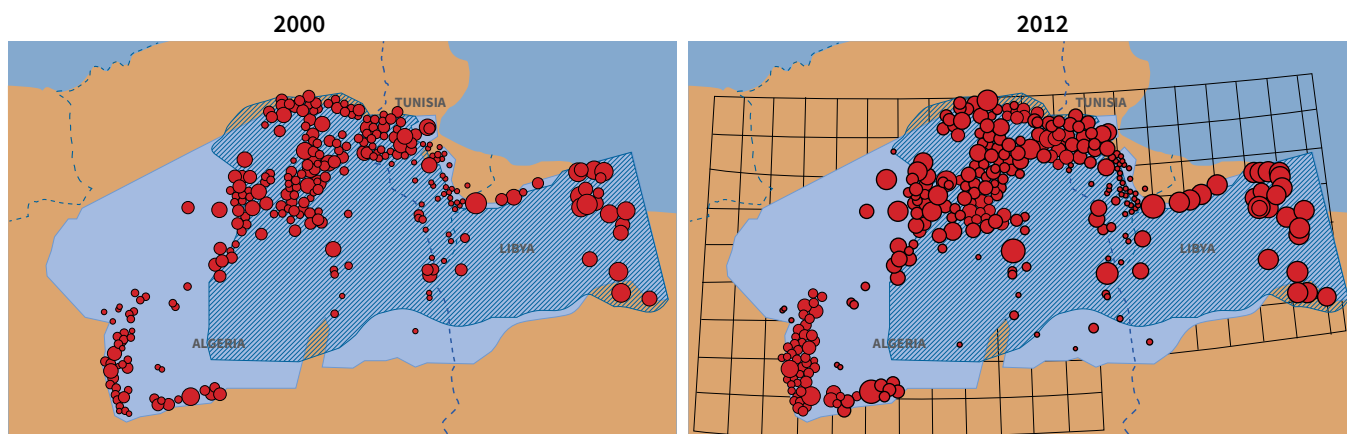


Source: CM. 2019.

The NWSAS water resources are under the pressure of a continuously increasing demand by the various economic sectors. The total national water withdrawal for all sectors was 10.46 billion m³ for Algeria and 4.87 billion m³ for Tunisia (AquaStat), and 4.71 billion m³ for Libya in 2017. While the agricultural sector represents the first consumer of water resources in all three countries (representing 80 per cent of the total demand in Libya and Tunisia, and between 50 and 60 per cent in Algeria), the drinking water, industry and tourism sectors are also significant consumers. In the NWSAS basin, the water demand for agricultural purposes also represents the highest share of the overall water demand, with an irrigated area in the NWSAS basin of around 260,000 ha (170,000 ha in Algeria, 50,000 ha in Libya and 40,000 in Tunisia).

Over the last decades, the steadily growing water abstraction resulted in the overexploitation and depletion of the resource and the degradation of water and soil quality. The number of boreholes in the basin has increased substantially from an estimated 9,000 in 2000 to 17,400 in 2018 (cf. Figure 3). Due to the current level of overexploitation, these shared water resources are under pressure of qualitative and quantitative challenges, such as increase in groundwater salinity, reduction of artesian pressure, depletion of natural outlets with the drying-up of the springs, shallow wells, traditional water catchment and distribution systems (Foggaras) and the decrease in piezometric levels reaching more than -2 meters / year in some areas. In addition, the irrigation (and drainage) practices and the high mineralization of the groundwater contributes to an increasing salinization of soils, which results in lower agricultural yields, hence a decrease of farmers' revenues.

Figure 3. Evolution of the distribution of operational wells



Source: CM, 2019

These combined challenges convert into potential risks in the NWSAS region and beyond, such as possible:

- **Hydro-economic impact:** high resource mobilization costs (energy bill of water pumping for higher volumes from deep IC and TC aquifers), need for desalination treatment of brackish water and need for higher energy production;
- **Socio-economic impact:** decrease in agriculture yields, increase in production costs for the population depending on agriculture, threat to food security, possible impact on regional stability; and,
- **Environmental impact:** pressure on the hydrodynamic balance of the IC and TC aquifers and the hydro-ecological equilibrium in the SASS basin.

1.3 From a project-based to a sustainable transboundary water cooperation platform in the NWSAS basin

Cooperation from the late 1990's until today evolved from cooperation on a project-by-project basis to a permanent transboundary concertation platform demonstrating numerous successful interventions (cf. Table 1). The three riparian countries of the NWSAS basin have committed to a joint process of knowledge exchange and cooperation to rationally manage the NWSAS resources. Cooperation among the countries on water resources management dates back as far as the 1960's, intensified from the late 1990's, when countries cooperated under two major international projects (SASS I from 1999-2002 and SASS II from 2003-2006). Such cooperation was formalized through the 2006 Declaration of the Water Ministers of the 3 countries, on a tri partite NWSAS Consultation Mechanism as the joint body for transboundary water cooperation between the three countries and common objectives, followed by the definition in 2007 of the structure of the CM. By this time, the three parties had already succeeded in establishing a common database, hydro-geological model and monitoring network to evaluate the status of the resource.

Table 1. Progressive strengthening of cooperation in the NWSAS

1960's	Initiation of cooperation
1968-1972	ERESS ¹ project engaging Algeria and Tunisia, recommending the setting-up of a joint Algerian-Tunisian commission or body to compare and coordinate the exploitation of groundwater in areas where there is a risk of interference (Souf in Algeria and Djerid in Tunisia)
1999-2002	SASS I Project for knowledge improvement (geologic and hydrogeologic studies; creation of a common database on wells; development of a mathematical management model for the simulations of impacts of water withdrawals on the resource)
2002	Rome workshop: Agreement of the establishment of a Consultation Mechanism to “coordinate, promote and facilitate the rational and concerted management of the NWSAS water resources”
2003-2006	SASS II Project for a consultation mechanism (local mathematical sub-models for Biskra and the Djelfa; diagnosis of agricultural practices in the SASS; setting up of an institutional consultation mechanism)
2005	Algiers workshop: Stakeholders from Ministries of water, environment and agriculture and NGO representatives drafting a Ministerial Declaration
2006	Signature of the Ministerial Declaration by the 3 countries, establishing an autonomous “Permanent Consultation Mechanism for the NWSAS” with the mandate to: <ul style="list-style-type: none"> - Produce indicators on the water resource and demand - Elaborate water resources management scenarios for the development of the basin - Reinforce and update the common database through data and information exchange - Develop and manage common monitoring networks of the aquifer system.
2007	Definition of the structure of the Consultation Mechanism
2008	Launching of the Consultation Mechanism
2010-2015	SASS III Project “Operational recommendations for the sustainable management of the NWSAS” (Socio-economic analysis of irrigated agriculture; development of a hydro-economic model; demonstration pilot agricultural projects)
2012-2019	WACDEP ² project for climate change impacts evaluation and transboundary cooperation enhancement
2016-2019	Water Matchmaker project including Nexus assessment, assessment of the benefits of cooperation and transboundary cooperation enhancement

The provision of critical information for hydrogeological planning, the development of technical capacity, knowledge exchange on irrigation practices and a deepening of mutual trust can be counted among the successes of transboundary water cooperation in the NWSAS basin so far.

Recommendations issued by recent processes offer opportunities to greatly enhance previous and current benefits of transboundary water cooperation. In 2016, a study on options regarding enhanced transboundary water cooperation arrangements in the NWSAS and related organizational schemes³ was initiated. At the same time, opportunities of applying a water-food-energy-ecosystems nexus approach⁴ to enhance coherent policies and coordinated action towards sustainable management in the NWSAS basin were discussed. Both processes, carried out in coordination with the three countries and the NWSAS CM, provide recommendations that can be translated into concrete measures to coordinate the management of the water resources and build synergies with other related sectors, and to contribute to economic development, regional economic cooperation, environmental protection as well as social and political stability in the region.

¹ The project Study of the Water Resources of the Northern Sahara” (Etude des Ressources en Eau du Sahara Septentrional - ERESS) was supported by UNESCO

² The project Water, Climate and Development for Africa (WACDEP) was a programme of the African Ministers’ Council on Water (AMCOW) and was implemented in North Africa by GWP-Med.

³ The study on options regarding enhanced transboundary water cooperation arrangements in the NWSAS was conducted in the framework of the WACDEP project and of the Water Matchmaker project, carried out by GWP-Med and the OSS.

⁴ The assessment of the Nexus in the NWSAS was conducted by UNECE, GWP-Med and OSS in the framework of the Water Matchmaker project. It followed a participatory methodology for assessing intersectoral links, trade-offs and benefits in transboundary basins developed under the Water Convention. The process comprised stakeholders’ workshops in 2017 and 2019.

2. ACHIEVEMENTS AND REALIZED BENEFITS OF TRANSBOUNDARY WATER COOPERATION FOR NWSAS COUNTRIES

2.1 Why identifying and communicating the benefits of transboundary water cooperation?

While the NWSAS is at the forefront of cooperating on the management of transboundary groundwater resources, the **benefits generated by transboundary cooperation in the NWSAS, both in terms of process and outcomes on development, have not been systematically analyzed.**

Transboundary water cooperation has the potential to generate many significant benefits for cooperating countries, such as accelerated economic growth, improved human well-being, enhanced environmental sustainability and increased political stability. *The Policy Guidance Note on the Benefits of Transboundary Water Cooperation – Identification, Assessment and Communication* developed under the Water Convention offers guidance about how to carry out benefit assessments, to help riparian countries move from perception to facts regarding what they can gain from strengthening cooperation about their shared waters. The NWSAS is one of the four transboundary basins where the Policy Guidance Note has been applied.

Identifying, assessing and communicating the numerous benefits of transboundary water cooperation can foster cooperation. It helps to:

- Fully realize the potential benefits of cooperation and identify common interests;
- Provide fact-based arguments for finding windows of opportunities to develop stronger cooperation (moving from perception to facts);
- Broaden the scope of cooperation by defining a “benefit cluster”;
- Attract financial resources to implement water cooperation solutions.

The benefit identification in the NWSAS followed a participatory methodology. It builds on the outcomes of discussions held during national consultation workshops⁵ for Libya and Tunisia in 2019, desktop review and analysis, input from several interviews with stakeholders and experts. At the country workshops, the participants were asked to identify benefits for their own country, but also to identify benefits for other countries. A draft annotated outline of the policy brief was presented for comments at a basin workshop⁶ in June 2019 and further consulted with representatives of the three riparian countries in September – October 2019. The final draft was then circulated for comments by water management authorities of the three countries in July 2020. This policy brief was developed in parallel to the assessment of the

⁵ More information on the national workshops is available respectively:

- for Libya (1-2 April 2019, Hammamet, Tunisia): <http://www.unece.org/index.php?id=51679>;

- for Tunisia (3-4 April 2019, Hammamet, Tunisia): <http://www.unece.org/index.php?id=51681>.

⁶ More information on the basin workshop “Assessing the Water-Energy-Food-Ecosystems Nexus in the NWSAS basin” (18 - 19 June 2019, Hammamet, Tunisia) is available from <http://www.unece.org/index.php?id=51813>.

water-food-energy-ecosystems nexus in the NWSAS, which helped to substantiate the intersectoral aspects relevant for benefits of broader cooperation beyond sharing water.

2.2 Achievements of the process of transboundary water cooperation in the NWSAS

During the last decades, great progress was achieved. It includes:

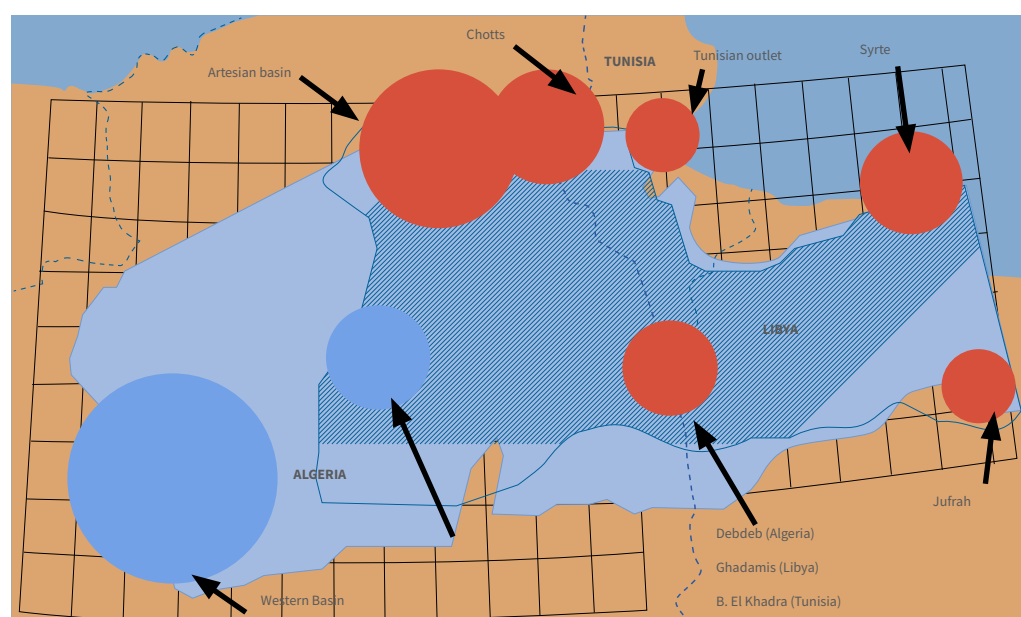
Institutional achievements

- The countries have created and established a tripartite Consultation Mechanism headed on a biannual rotating basis and a framework for further cooperation with the 2006 Ministerial declaration.
- Its Permanent Technical Committee holds regular annual meetings.
- Its Coordination Unit has been continuously working to ensure implementation of the Consultation Mechanism's mandate since its establishment.

Informational and technical achievements

- Consensus on the state of the resource has been established.
- Common challenges and solutions in water management have been identified.
- Knowledge and data exchange and data standardization have been achieved.
- Repeated tripartite technical trainings and workshops were held and technical capacity enhanced.
- A common database and Information System were developed
- A model was developed, including local sub-models for cross border, which allows, for example, to simulate the potential impact of agricultural development and water transfer.
- Vulnerable and high potential abstraction zones as well as status and location of high salinity have been mapped (cf. Figure 4).
- Several hydrological, socio-economic and ecological studies (e.g. inventory and analysis of vulnerable wetland ecosystems) were undertaken.
- Recommendations on irrigation practices were generated and disseminated through pilot projects (under SASS III).
- Provisional simulations of the exploitation of the resource are elaborated according to the evolution of the state of the NWSAS aquifers.

Figure 4. Risk map with vulnerable (red) and high potential (blue) abstraction zones



Source: CM, 2012

Financial achievements

- The provision of staff and resources by the countries has secured the work of the Consultation Mechanism.
- Thanks to their cooperation and institutional achievements, countries have succeeded in cooperatively leveraging several successive donor grants to acquire a deeper knowledge of the basin water resources and their uses, as well as to better protect and sustainably manage the aquifer and related ecosystems.⁷

2.3 Governance benefits of the transboundary water cooperation process in the NWSAS

The transboundary water cooperation process generated important benefits in terms of improving both domestic and transboundary water governance. The successive projects in the NWSAS basin have brought together experts from the three countries, deepening existing and building additional *technical and scientific capacity* and inspiring collaboration on new areas of research. Data exchange and standardization as well as several trainings have substantially enhanced skills and capacity of participating technical staff.

The cooperation process has also generated applicable knowledge for the management of the basin. It has pooled and created useful data and information on the status and trends of water resources, as well as environmental and socio-economic aspects, which are being used to *inform development and planning in the basin area*, both at national and transboundary levels. It has also raised awareness on environmental challenges and spurred water management activities.

The institutional framework for cooperation, which the establishment of the Consultation Mechanism, constitutes a solid basis for *concerted transboundary water management*, identification of additional areas of collaboration, improvement of stakeholders' coordination and better-informed water-related policies development (cf Box 1).

Box 1. Impacts of cooperation in the NWSAS – Concrete examples of informed water-related policies

- The database and the model are used by countries to estimate water potential but also to simulate the expected impact of any possible new drilling or agricultural project.
- Information on deteriorated and abandoned boreholes has allowed addressing the leakage and reducing water wastage.
- As a result of better information on the resource, countries refrain from drilling near vulnerable zones, as e.g. chotts.
- In response to the SASS III project's pilots on irrigation practices, the use of desalinated water for irrigation has been incorporated in the strategy of the Tunisian provinces of Gabes and Medinine. In the Ouargla district in Algeria the project results have influenced the regional government's approach to drainage of irrigated lands in their planned expansion of irrigated perimeters. In general, the project influenced awareness and attitudes at local and regional levels.
- In In-Salah, Tamanrasset, Algeria, the agricultural enhancement area was positioned in Western erg as recommended by the NWSAS study.
- The Rjim Maatoug irrigation perimeter was planned based on the NWSAS model.
- The Djeffara Study (sub-model) led to consideration of alternative water sources for the region in Libya.
- The National Plan for Agricultural Development (PNDA) in Algeria sets out new orientations for the pricing of drinking water and encourages water-saving modes of irrigation.

⁷ The projects were: the NWSAS project phases I + II (1999 – 2005) "Protection of the North West Sahara Aquifer System and Related Humid Zones and Ecosystems", funded by IFAD, FAO, DDC Switzerland (Phase I until 2002) and GEF, FFEM and SDC Switzerland (Phase II until 2005); the SASS III project (2009 – 2014) "Reducing risks to the sustainable management of the North West Sahara Aquifer System (NWSAS)", funded by GEF, AWF and FFEM; the project "Water, Climate and Development project (WACDEP)" (2012-2019), funded by ADA, DANIDA and DFID; as well as the project "Making water cooperation happen in the Mediterranean" (aka the Water Matchmaker project) (2016-2020), funded by Sida.

2.4 Sustainable development benefits achieved through transboundary water cooperation in the NWSAS

Transboundary cooperation on the NWSAS basin has already generated numerous benefits by contributing to social and economic development, environmental protection as well as peace and stability (cf. Table 2), therefore playing a key role in achieving Sustainable Development Goals (SDGs), and SDG 6 on water in particular.

Table 2. Benefits of transboundary water cooperation identified in the NWSAS

Economic benefits	Environmental benefits
<ul style="list-style-type: none"> • Increased income for farmers • Better planning of development projects • Reduced costs of groundwater over-exploitation • Reduced costs for generation of knowledge, planning and capacity building 	<ul style="list-style-type: none"> • Reduced drilling activity in vulnerable zones • Preservation of sensitive wetland ecosystems
Social benefits	Peace and security benefits
<ul style="list-style-type: none"> • Enhanced water security • Increased resilience of local communities • Poverty reduction • Reduced (rural-urban) displacement 	<ul style="list-style-type: none"> • Positive basin identity • Sense of common ownership • Mutual trust • Reduced potential sources of conflict and increased stability • Viable basis for broader political cooperation beyond water management

Economic benefits

Increased income for farmers through higher water productivity

Where irrigation practices and water productivity are improved, as in e.g. in the SASS III pilots, a higher income for farmers is possible and over-exploitation can be prevented. Improving the efficiency of the irrigation system has the potential to save up to 47% of the water abstraction in the NWSAS area⁸, therefore decreasing the energy demand for pumping groundwater.

Avoided cost of misplanning for development projects

Water scarcity can severely impede successful implementation of development and infrastructure projects. Development planning without the information from the database and model on vulnerable and potential zones would risk stranded and misguided investments. Hence, cooperation and information sharing supported successful planning efforts.

Avoided costs of over-exploitation of groundwater

Over-exploitation can lead to substantive costs. Rising energy demand for pumping or desalination resulting from it is likely to increase costs for water mobilization, which can in turn put economic and social systems at risks. Not only resource dependent business can leave the region but resulting loss of income and job opportunity can spur rural-urban displacement. Hence, in cases where the Information System and the overall NWSAS cooperation have prevented over-exploitation, farmers, dependent business and administrations benefit economically.

Reduced costs for generation of knowledge, planning and capacity building for water management

⁸ See Reconciling resource uses: Assessment of the water-food-energy-ecosystems nexus in the North Western Sahara Aquifer System - Part A "Nexus Challenges and Solutions" (UNECE, GWP Mediterranean, OSS, 2020)

The cooperative effort has enabled an efficient use of resources for knowledge and data management, capacity building, research and resource planning. The costs for these activities would have been substantially higher if each country had pursued them independently. This is especially the case for the setup and maintenance of the common Information System, for which cost savings are high compared to the maintenance of three independent systems.

Social benefits

Enhanced water security enabled by the Information System as well as higher water productivity through improved irrigation practices and higher agricultural production *increase the resilience of local communities* to basin challenges including climate change. This *reduced poverty risks* as well as *(rural-urban) displacement*.

Environmental benefits


The inventory and analysis of vulnerable wetland ecosystems, as well as joint research and pilot projects have raised awareness among administration at national, regional and local levels as well as among the population about the sensitivity of ecosystems and for the need to sustainably manage the NWSAS basin resources. This is the basis for *preservation of these ecosystems*. The map on vulnerable and high potential zones (e.g. chotts) has *reduced drilling activity in vulnerable zones*.

Peace and security benefits

The transboundary cooperation among countries contributes to a *positive basin identity*. Countries have established consensus on the status of the resource and identified common challenges and solutions. Data exchange and continuous meetings create a *sense of common ownership* and an atmosphere of *mutual trust*. Water security is enhanced through joint management efforts. Countries positively experienced that their shared effort has reaped joint achievements. All these aspects *reduce potential sources of conflict, enable stability* and create a *viable basis for broader political cooperation beyond water management*.

Transboundary water cooperation and management in the NWSAS benefited all groups of the society. Specific beneficiaries of the NWSAS cooperation include:

- *National water and planning authorities* benefit from enhanced availability of information and planning capacity.
- The *rural and urban population* in the NWSAS benefits from fresh water supply security.
- *Farmers and businesses* benefit from enhanced water productivity.
- The *whole region* benefits from socio-economic improvements related to avoided costs of over-exploitation, efficient water use and productivity and related improved living conditions, contributing to the achievement of development objectives.



3. A NEXUS APPROACH APPLIED TO TRANSBOUNDARY COOPERATION: AN OPPORTUNITY FOR THE NWSAS

3.1 Towards sustainable management in the basin through a Nexus approach

The NWSAS degradation (water depletion, salinization, loss of artesianism) and its consequences (soil degradation, reduction of agriculture productivity, increase in energy demand for water pumping and demineralization) compromise development in the basin.

A **Nexus approach** to transboundary cooperation offers the opportunity to explore the interactions between water, energy, food and water-related ecosystems and understand intersectoral resource management issues at national and basin level. It **helps to identify beneficial synergies and implementable solutions, increase coherence of management and avoid unintended trade-offs between sectors**. This is crucial to enhance water, energy and food security whilst also preserving ecosystems and their functions.

An assessment of the water-food-energy-ecosystems nexus in the NWSAS was carried out in 2017-2020 to strengthen the knowledge base with solid technical work and multi-stakeholder consultation and to contribute to and **inform policy processes that aim to the long-term sustainable management of the NWSAS** and the enhancement of transboundary cooperation, also across sectors.

Through this process, three main **priority areas of intervention** in the water, food, and energy sectors were identified by the three countries to address the challenge of the NWSAS degradation:

1. Curb the depletion of groundwater resources and rationalize water use as a response to the degradation of groundwater and its increased scarcity.
2. Modernize and increase the value and sustainability of agriculture as a response to the vulnerability and unsustainability of agriculture.
3. Promote the use of renewable energy in agriculture as a response to increasing energy demand for irrigation and water scarcity, and in order to improve rural access to electricity in general.

A **package of 15 high-priority and implementable Nexus solutions** was jointly identified by countries as an outcome of the NWSAS Nexus assessment⁹. These solutions span from (1) governance and international cooperation, to (2) economic and policy instruments, and (3) infrastructure and innovation.

⁹ See Reconciling resource uses: Assessment of the water-food-energy-ecosystems Nexus in the North Western Sahara Aquifer System, Part A “Nexus Challenges and Solutions” (UNECE, GWP Mediterranean, OSS, 2020)

3.2 Benefits of implementing a Nexus approach at the NWSAS level

Riparian countries in the NWSAS basin already reaped many benefits from transboundary water cooperation. Taking a Nexus approach and **implementing the Nexus solutions** at different levels (local, national and transboundary) through cooperation and coordination, **will help realize an even broader range of benefits of cooperation across different sectors**, including regional economic cooperation benefits. The anticipated benefits of implementing a Nexus approach to cooperation in the basin are described below (cf. Table 3).

Table 3. Benefits of implementing a Nexus approach in the NWSAS

Economic benefits	Social and environmental benefits
<ul style="list-style-type: none"> • Reduction of economic risks related to climate change impacts through enhanced adaptation capacity • Improved water productivity • Added value of agricultural products • Avoided costs of over-exploitation of water and soil • Availability of water for economic sectors ensured • Reduction of costs for concerted action on innovation, notably on for sustainable farming and irrigation practices 	<ul style="list-style-type: none"> • Enhanced climate change resilience • Reduced poverty • Preservation of ecosystems • Enhanced capacity of farmers to manage resources, improve resilience, and increase productivity of agriculture • Higher incomes for farmers • Connection of communities in different countries through joint projects
Regional economic cooperation benefits	Peace and security benefits
<ul style="list-style-type: none"> • Impulses for regional trade and commerce based on shared objectives and complementarities • Investments facilitated, including through harmonized policies • Innovation spurred by cooperation • Impulses for economic growth through concerted action on Nexus solutions 	<ul style="list-style-type: none"> • Stronger basin identity through concerted implementation of Nexus actions • Mutual trust thanks to transparency and enhanced knowledge of the natural resources • Support for positive relationships through regional trade and cooperation • Reduction of conflict potential through reduced resources scarcity

3.3 How transboundary water cooperation supports the implementation of Nexus solutions

In general, all **Nexus solutions can be enhanced by successful transboundary water cooperation**. For example, the successful implementation of the following selected solutions would depend on and benefit from transboundary cooperation.

Upscaling the use of non-conventional water resources for the sustainable use of NWSAS water resources

Nexus solution 5: Upscale the use of non-conventional water resources through desalination and wastewater and drainage water treatment

Actions to implement this solution include research and diagnosis (inventory of existing water reuse initiatives, mapping of water reuse potential, assessment of agricultural drainage water, inventory of crop species suitable for treated wastewater irrigation); policy development (coordinated intervention and financing strategy), investment (facilitation of water and energy sectors partnerships, development of solar treatment and demineralization units), and awareness-raising and capacity building (promotion of adapted crops, improved agricultural practices and drainage).

The cooperation platform offered by the NWSAS Consultation Mechanism could provide a venue to coordinate action in transboundary areas of the basin and to facilitate the exchange of knowledge and experience related to non-conventional water use across the countries.

Deploying renewable energy for irrigated agriculture and economic development

Nexus solution 7: Develop a sustainable program for diversified, multi-purpose renewable energy and sustainably upscale of small-scale solar irrigation.

Actions to implement this solution include the development of support schemes for farmers for solar-powered irrigation, safeguards against over exploitation diversification of renewable sources – beyond solar, but also modern biomass from agriculture, geothermal, etc. –, restructuring of fossil fuel subsidies, and mutual learning and exchange on practices of implementation of renewable energies.


The history of successful cooperation for the management of transboundary waters in the NWSAS has paved the way for strengthening collaboration and coordination of other sectors, building on existing trustful relationship. It can support awareness on the potential of renewable energy, energy efficiency and rational use of water resources in the region. Regional exchange of lessons learned and experiences can spur policy innovation. The coordination of renewable energy policies at transboundary level can help maximizing the benefits of their deployment in the NWSAS basin, for example by creating a reliable environment for investments, while protecting groundwater. Further, a concerted effort at basin scale can drive down the costs of renewable energies. All of these aspects are enabled by transboundary water cooperation.

Valorising local products for sustainable development of the oases in the NWSAS region

Nexus solution 10: Valorise local products and strengthen programs for a more balanced diet while involving young people and women in economic and social development of the oases.

Actions to implement this solution include the strengthening of the value chains of local products from traditional agriculture in oases and the building of strategic partnerships.

The fact that traditional agriculture in the NWSAS region is a common feature of the three countries and the basin identity already created through the long-established transboundary water cooperation would facilitate the valorisation of local products on export markets. For example, the deglet nour variety of dates could be labelled as NWSAS/Saharan production, instead of being sold as a national product. Developing such initiative can build on existing cooperation and even strengthen international cooperation in border regions of the aquifer providing, at the same time, benefits of cooperation in the NWSAS basin beyond water management. Regional origin-linked products, such as handicraft and commercial products, can be promoted on the international market.



4. POTENTIAL BENEFITS OF FURTHER STRENGTHENING TRANSBOUNDARY WATER COOPERATION IN THE NWSAS BASIN

Improved transboundary water cooperation in the NWSAS could generate additional benefits for the NWSAS basin countries. Opportunities for a possible enhancement of transboundary water cooperation arrangements in the basin and related organizational schemes, including through the Consultation Mechanism, have been considered by the basin countries. **Possible avenues that could be considered for achieving a strengthened cooperation and reaping additional benefits of joint action include:**

- **Enhanced quality and availability of information and data to better inform decision-making process.**

Concerted action to improve the groundwater model as well as data input and management will allow for more reliable information on the status of the resource, including on abstraction levels, sustainable yield, water demand by sectors and economic implications. Additional joint economic and environmental studies can complement the knowledge base. The shared monitoring of the resource can continue to further enhance trust, update the knowledge related to common challenges and opportunities, and reduce the cost of maintaining the information system. It is a central precondition to enable economically and environmentally sound decision making.

- **Enhanced control over the resource to secure long-term water availability and economic development.**

Only a close cooperation between the three riparian countries can enable coordinated actions for environmentally, socially and economically sound abstraction of the NWSAS water resources. Coordinated procedures at the basin level can guide the concerted management of the resource, avoid tensions related to resources allocation, and ensure long-term water availability for a sustainable socio-economic development of the three countries.

- **Concerted implementation of Nexus solutions to stimulate economic growth throughout the region.**

Applying a Nexus approach, engaging a broader set of actors and sectors in the basin resources manage-



ment, has the potential to reinforce the cooperation, both at national and transboundary levels. If this is supported by national policies to enable e.g.

the promotion of renewable energy, climate resilient agriculture and water-efficient

irrigation practices, this can spur a strong impulse for economic growth throughout the region.

Regionally coordinated environmental policies and smart policy design can attract and guide public and private investment in the three countries.

- **Mutual learning on cross-sectoral challenges to build capacity, drive innovation and increase climate change resilience.** Drawing lessons from the experiences of the riparian countries in order to resolve common challenges related to natural resources scarcity, security, food safety and climate change can enhance technical capacity, governance and stimulate innovation. It can contribute to enhanced climate change resilience in the countries. Joint projects for innovation strengthen mutual trust, enhance the problem-solving capacity of each country and bring communities closer together.
- **Outreach activities on the efficient use of water and natural resources to support economic growth.** The Consultation Mechanism can further engage in outreach and capacity building activities, disseminating collaboratively developed knowledge products designed to support farmers, economic sectors and the broader public in implementing efficient irrigation and farming practices, better managing scarce resources, deploying renewable energy where appropriate, adapting to climate change impacts, and conserving ecosystems. This can contribute to economically and environmentally sound resources use. Additional mechanisms to ensure the continuous engagement of stakeholders across various sectors could be implemented.
- **Closer relationship between communities in the basin to support regional trade and political stability.** The involvement of local communities, which will be the beneficiaries of many of the economic, social and environmental benefits generated by cooperation in the basin, is key for sustainable transboundary cooperation. A common basin identity, and sense for common challenges and opportunities, are powerful safeguards against tensions and contribute to ensure political stability. The continuous and intensified collaboration of countries for the management of natural resources can in turn facilitate commercial and trade exchange between countries.

REFERENCES

CM (2019). Gestion concertée du Système Aquifère transfrontalier du Sahara Septentrional-SASS. Le Mécanisme de Concertation. Presentation by Taibi, R. at the National Consultation workshop for Tunisia: Assessing the water-food-energy-ecosystems nexus in the North-Western Sahara Aquifer, 3 - 4 April 2019, Hammamet, Tunisia.

Mamou, A., Besbes, M., Abdous, B., Latreche, D.J., Fezzani, C. (2006). North-Western Sahara Aquifer System (NWSAS), Foster, S., Loucks, D.P (eds.). Non-renewable groundwater resources. A guide to socially-sustainable management for water-policy makers.

OSS (2008). The North-Western Sahara Aquifer System (NWSAS). Concerted management of a transboundary water basin. Synthesis Collection.

OSS (2015). For a Better Valorization of Irrigation Water in the SASS Basin: Diagnosis and Recommendations.

Schmidt, O. (2016). The North-Western Sahara Aquifer System (NWSAS). A case study for the research project “Transboundary water management in Africa”.

UNECE (2015). Policy Guidance Note on the benefits of transboundary water cooperation: Identification, assessment and communication.

UNECE (2018). A Nexus approach to transboundary cooperation: The experience of the Water Convention.

UNECE, GWP Mediterranean, OSS (2020). Reconciling resource uses: Assessment of the water-food-energy-ecosystems Nexus in the North Western Sahara Aquifer System.

UNEP (2015). Terminal Evaluation UNEP/GEF Project entitled “Reducing Risks to Sustainable Management of the North-Western Sahara Aquifer System (NWSAS)”.



