



Report of the Roundtable of experts on transboundary collaboration around the Senegal-Mauritanian Aquifer Basin

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Geneva Water Hub

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Executive Summary

Water management is a major challenge in West Africa. In order to address this challenge, it is important to provide the needed attention and resources for the management and preservation of groundwater as it constitutes major water reserves in the region.

In response to a request put forward by the Riparian countries to initiate a transboundary collaboration regarding within the Senegal-Mauritanian Aquifer Basin (SMAB), the Secretariat of the Water Convention, hosted by UNECE, and the Geneva Water Hub jointly organised a roundtable in Geneva on the 6th and 7th of February 2019, that included representatives of the four countries of the SMAB, the OMVS and OMVG as well as technical and financial partners, namely: AfDB, BGR, GWH, IAEA, IGRAC, SDC, State of Geneva, UNECE and UNESCO. This roundtable provided an exchange and preliminary assessment of the current cumulative status of knowledge related to the SMAB between the various national authorities in charge of water resource management. It has also explored the potential role for Transboundary Basin Organisations in the co-ordinated management of this aquifer system, based primarily on the experiences of the OMVS in the field of groundwater monitoring. The roundtable also allowed to share information regarding past and future activities of technical and financial partners in the region.

Experts of the roundtable agreed upon the need to reinforce the institutional and technical framework of cooperation for the joint management of the aquifer system that constitutes a strategic resource for the region, in particular taking into account climate change. The roundtable also concluded on the need to develop a joint management mandate of the SMAB, involving both OMVS and OMVG, with the aim to promote the joint management of the shared groundwater and surface water in the region. This institutional setting may build upon similar experiences implemented in Africa and in Europe.

In order to establish a co-ordinated management of the SMAB, it is important to clarify the added benefit of cooperation for each party. A preliminary joint identification of economic, social and environmental advantages, as well as in terms of peace and security, has been conducted during this round table. In particular, it has been emphasized that a sustainable management of the SMAB is a strategic axis in ensuring water security of major cities and the development of rural economy in the region.

Accordingly, the roundtable has provided operational recommendations in the following three fields:

- 1) Protection and integrated, sustainable management of the resource;
- 2) Governance for coordination and cooperation;
- 3) Financing mechanisms, particularly for the monitoring of the SMAB.

This report summarizes the exchanges and recommendations produced during the roundtable that fostered a strong convergence of the various visions on the co-ordinated management of the SMAB. The joint commitment expressed throughout this roundtable defines the first steps of a transboundary cooperation that – given a strong political support – will fully contribute to promoting resilience, sustainable development and stability in the region through the strategic management of the SMAB. Such a joint management will profile the region as a world leader on the vital topic of transboundary groundwater management.

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1. Introduction

This report, prepared by the Geneva Water Hub, documents the exchanges held during the "Round table on transboundary cooperation around the Senegal-Mauritanian Aquifer Basin" (SMAB), as well as recommendations resulting from it. This event was held in Geneva on February 6 and 7, 2019.

The report is a compilation of:

- Data and information presented by all basin's riparian states, institutions and experts, present at the meeting;
- Suggestions for options aiming for the cooperative and sustainable management of the SMAB, and based on the roundtable discussions;
- A study prepared by the Dropstone consulting agency, upon the request of the Geneva Water Hub. This study aimed at reviewing existing knowledge on the SMAB and was based on a rapid analysis of grey and scientific literature.

The various presentations shown during the roundtable are available on the following link: <https://www.unece.org/index.php?id=51172>

The roundtable was jointly organized by the Geneva Water Hub, a specialized centre for hydro-diplomacy attached to the University of Geneva, and the Secretariat of the Convention on the Protection and Use of Transboundary Watercourses and International Lakes (Water Convention) hosted by UNECE.

This roundtable was convened on the basis of the request from Senegal in the frame of the 8th Meeting of Parties to the Water Convention (Astana, 10-12 October 2018) to inscribe in the 2019-2021 programme of work of the Convention the support to the transboundary cooperation on this aquifer. This request received support from other countries attending the Meeting of Parties (Mauritania, The Gambia). This initiative also owes its impetus to the encounter between two representatives of the ministries in charge of water respectively of Mauritania and Senegal at the occasion of the international seminar organised in Geneva on the 29th of November 2018 in the frame of the celebrations of 40 years of the transboundary cooperation treaty between France and Switzerland on the Geneva Aquifer.

The roundtable aimed at:

- Providing representatives of ministries in charge of water in the four riparian countries and of Transboundary Basin Organisations (TBO), with an opportunity to assess the state of knowledge available on the complex system of the SMAB;
- Highlighting benefits of cooperation around this basin, as well as opportunities for technical and financial collaboration;
- Identifying ways to improve collaboration of different actors around the sustainable management of SMAB's resources.

The roundtable brought together representatives of the four riparian countries of the SMAB, namely, The Gambia, Guinea-Bissau, Mauritania and Senegal, formally appointed by Water Ministers of these countries. Representatives of institutional actors from within the region such as OMVS, OMVG as well as the following technical and financial partners: IAEA, ADB, BGR, State of Geneva, SDC, IGRAC and UNESCO, were also present.

2. Snapshot of the current situation

2.1. General hydrogeological information

The aquifer system of the Mauritania-Senegal-Gambia-Guinea-Guinea-Bissau basin, known in the hydrogeological literature as the Senegal-Mauritanian Aquifer Basin (SMAB), is limited to the east and south-east by the Mauritanides chain and to the south, by the Bové Basin. Its maximum length is 1,300 km (Mauritania, Guinea-Bissau) and it reaches a maximum width of about 550 km at the latitude of Dakar.

The SMAB system covers a total area of approximately 350,000 km² and borders the Atlantic coast along 1,400 km to the west. About 115,000 km² of this aquifer is in Mauritania, 195,000 km² in Senegal, 11,295 km² in the Gambia (totality of the country) and 20,000 km² in Guinea-Bissau.

The aquifer system is multi-layered and consists of three main aquifers containing underground water: i) the superficial aquifer system which covers -often intermittently- the whole basin, ii) the intermediate aquifer system, which includes Eocene and Paleocene formations, and iii) the deep aquifer system mainly dating from the Maastrichtian. The latter covers almost the entire sedimentary basin and has a variable hydrogeological potential. It is the only common transboundary aquifer shared by Senegal, the Gambia, Mauritania and Guinea-Bissau. The Maastrichtian aquifer is found at varying depths in different countries, and is locally at the outcrop in Guinea Bissau.

The hydrogeological potential of the Maastrichtian layer varies: in the north towards Mauritania, it is not really exploited for example, because its water is of very poor quality (low hydraulic conductivity due to the presence of important clay levels, and high salinity). In Senegal, it is the main source of groundwater supply in the country.

Recharge at the edge of the aquifer by rainwater, in particular at the outcrop of the Maastrichtian in Guinea-Bissau, is poorly known. The current state of knowledge does not allow to determine the water renewal levels in this part of the SMAB. The largest recharge zone is located south-east of the aquifer, at the edge of the Precambrian basement.

The Senegal River mainly supplies the surface aquifers (alluvium), which can percolate to the Maastrichtian. However, the analysis of the isotopic elements shows that the water of the continuous aquifer is very old (several hundreds of thousands of years). It is therefore mainly constituted of fossil water, which is practically not renewed.

However, with the development of irrigated agriculture in the Senegal basin, especially rice cultivation, we are witnessing the deep percolation of surface water towards the aquifers. In addition, rising rates of mineralization during high water, as well as mining and traditional gold washing activities, contribute to the degradation of water quality.

Already in 1984, more than a hundred oil wells had been drilled, on land as well as at sea, crossing the subsurface series over sometimes several thousand meters.

The most advanced knowledge of the hydrogeology of SMAB is first and foremost in Senegal. This country is also the largest user and the largest part of the aquifer is below its territory. Mauritania uses it partially and the underground dynamics are also known. Knowledge is lesser in The Gambia and Guinea-Bissau.

The following section presents in a non-exhaustive manner, the hydrogeological elements relevant to the understanding of cooperation dynamics around the SMAB. Differences between the levels of information produced under each sub-section refers in part, to the uneven level of knowledge currently available on this system, in each of these countries.

Map of the SMAB created by the Geneva Water Hub



(sources : Hydrosheds, BGR Hannover / UNESCO, Paris 2008, United Nations Geospatial Information Section, Natural Earth)

2.2. Hydrogeological information by country:

2.2.1. The Gambia

The majority of the Gambia includes the Gambia River Floodplain, which originates in Guinea before crossing Senegal and Gambia where it flows into the Atlantic Ocean. The country is indeed generally very flat, ranging from 0 to < 100 m above sea level.

The Gambia is located on the uppermost formations of one of the continent's main sedimentary basins, the Mauritania-Senegal-Gambia-Guinea-Bissau-Guinea Basin (MSGGGB). It consists of two main aquifer systems, a quaternary shallow sandstone aquifer (SSA) and a Cretaceous-Tertiary deep sandstone aquifer (DSA), located at a depth of more than 250 meters. These aquifers are isolated from one another by a layer of clay. In some locations, the SSA is in the form of distinct units of phreatic or semi-confined aquifers (SCA). The phreatic aquifer is between 4 and 30 meters deep, while the SCA is between 30 and 50 meters deep.

According to the literature, the Gambia uses only its surface aquifer (SSA) water for its drinking water needs and not the surface water of the Gambia River. According to the Department of Water Resources, there are currently 207 boreholes equipped with hand pumps, 260 boreholes with solar drainage, 84 boreholes with electromechanical pumps, and 1,634 wells equipped with hand pumps. The recharge of the superficial aquifer by infiltration of rainwater remains for the moment, more important than the quantity of water taken for the population's needs.

The Cretaceous-Tertiary in which the Transboundary Aquifer (DSA) is located is apparently not used for the country's water needs. Groundwater is fossil. Only 12% of this water resource (80,000 m³), located in the east of the country, is considered drinkable.

In 2014, the Department of Water Resources set up a network of 38 boreholes to control the groundwater level and the quality of groundwater. They are distributed throughout the Gambia and are equipped with automatic data loggers. Recorded observations of groundwater levels are collected every three months and data is stored in the GeOdin database of the Department of Water Resources.

However, monitoring capacity in the Gambia remains limited. It does not provide comprehensive data on both the quantity and quality of the water. Lack of data therefore poses problems for good water resource management, such as prioritisation of actions and investments. It may complicate the introduction of integrated water management principles.

According to the Gambian representatives at the roundtable, the assessment of anthropogenic pressures on water is lacking, as is the data on the quality of water resources. However, the collection, compilation, analysis and dissemination of data from all sources are essential to demonstrate the benefits of water-related investments to governments, donors and private investors.

2.2.2. Guinea-Bissau

The water resources of the Republic of Guinea-Bissau are poorly known in general and are divided into 3 categories: rainwater (45,000 millions m³ estimated reserve), surface water (13,820 millions m³ estimated reserve) and groundwater (1,756 millions m³, estimated reserve). Only 15% of surface water is exploited while groundwater uses account for 85% of total uses.

The internal runoff resources are abundant, but poorly distributed, with 90% of it flowing over six months, and only distributed over the eastern half of the country.

Surface waters constitute a large reservoir. The hydrographic network of the Republic of Guinea-Bissau is dense and highly developed. It is dependent on large rivers.

Groundwater can be grouped into two main hydrogeological units: the Paleozoic / Precambrian basement in the eastern part of the country and the sedimentary basin in the west. The latter consists of several aquifers that are from top to bottom: the superficial aquifer of the plio-quaternary, aquifers of the Tertiary formations (Miocene, Oligocene and Paleo-Eocene) and the deep aquifer of the Maastrichtian.

The renewable water reserve of the surface water table is estimated at a few hundred million cubic meters per year: however, the exploitation flows are low and the water is often of poor quality (intrusion of saline water, pollution at the area).

The Maastrichtian aquifer, shared with Senegal, is the most exploited, with extractions of 13.2 hm³ / year. This aquifer (sub)outcrops on the eastern part increases towards the west in thickness and depth. The flow obtained per water point for the sub-catchment area (areas west of Bafatá, east of Oio, east of Quinara and west of Tombali, Bolama) is between 5 and 50 L / s with drilling depth of 150 m. For the rest of the regions, 20-50 L / s can be obtained with drilling depths of 200-250 m (west of Oio, Bissau). Groundwater generally has a salinity of less than 0.5 g / L.

This aquifer can have a thickness of up to 500 m and contains as a whole the best productivities. It is fed from its base by rainwater. The flow direction seems to be towards the west or the north-west, but it must be confirmed as few works make it possible to take precise measurements. When close to the surface, this aquifer is widely exploited by many wells and boreholes, particularly in the center of the country. Towards the west, some boreholes are established to depths of 260 m.

Deep aquifers, still poorly known, are only partially exploitable and constitute a renewable resource of the order of 10 to 30 million cubic meters per year.

According to the hydrogeological synthesis and according to data of the piezometric measurements on several works since 1968, one observes a regular decrease of the level of the water of the order 0,1 to 0,5 m / year in the captive zone depending to the depth of the catchment.

The recharge is not evaluated. In the rainwater catchment area, annual fluctuations in the water table are observed in the order of 2.5 m / year. Like the Géba watershed managed as a shared resource, the Maastrichtian aquifer is considered as a future challenge, to be shared with neighbouring countries, Senegal in particular.

According to UNDP's inventory database (2002) and Hydrogeological Synthesis, the piezometric network consists of about 100 poorly identified field structures with field accuracy problems. A piezometric network of 44 piezometers representative of the recharge / discharge of the three major aquifers in the Republic of Guinea-Bissau has been set up. It covers, among others, the Maastrichtian partially.

Although of variable quality depending on the areas, authorities recommend the use of the aquifer's resources for water supply of semi-urban and urban centres, as well as for irrigation. Authorisations of future operations will have to take into account already existing uses and abstractions as well as the risks of saline intrusion.

2.2.3. Mauritania

The area of the Mauritanian territory covering the Senegal-Mauritanian aquifer is estimated at 111,000 km². It is bordered to the west by the Atlantic Ocean and to the east by the Mauritanides arc. The groundwater resources of the Mauritanian part are contained in the following aquifers: the Boulenoir aquifer (3,000 km²), the Benichab aquifer (1,200km²) and the Trarza aquifer (20,000 km²) which accumulate water reserves estimated at 50 to 120 billion km³. These aquifers are located in the Quaternary and Continental Terminal layers.

Their salinities are relatively low, except for one single well (Touguène). The deep waters of Bennichaab are mild with salinities less than 0.35 g / L. Tritium activities confirm the recharge of this deep aquifer by surface water. Further north, the Boulenoir region is characterized by waters that are relatively more loaded with dissolved salts with salinities between 0.35 g / L and 0.7 g / L.

A piezometric monitoring network at the level of Idini and Boulenoir, as well as the piezometric network on the alluvial water of the Senegal River, enables the collection of data necessary for the management of resources in the region. Nevertheless, a more complete and regular follow-up is necessary.

The main extractions taken in Mauritania are intended for:

- Drinking water and mineral water;
- Agriculture and livestock farming;

- Ecology and the environment (in protected areas).

The deep aquifer on the Mauritanian territory contains very poor quality water, unlike the case in the three other states where β constitutes a major source for water supply.

2.2.4. Senegal

Hydrogeological studies of Senegal, group different geological formations into four main aquifer systems: the superficial aquifer system encompassing Continental Terminal, Oligocene and Quaternary formations; the semi-deep aquifer system of the Eocene and Paleocene formations; the deep aquifer system of the Maastrichtian, Campanian and Lower Senonian formations and the aquifer system of the base.

The Maastrichtian aquifer in Senegal is an immense reservoir with resources estimated at between 300 and 400 billion cubic meters with a renewable potential estimated at 200 million cubic meters per year. The recharge comes from direct infiltration of rainwater or indirect infiltration of river water.

The salinity of natural origin in the Maastrichtian aquifer is increasing from east to west and from west to east from the two recharge zones identified (eastern Senegal and the river to the east, and horst of NDiass to the west), with an intermediate zone showing values higher than the norms of potability. The geographical limit of the saline groundwater in the central part of the Maastrichtian aquifer could be defined by using the Cl and Br contents as tracers.

The Fluorine contents vary substantially in the same direction as the electrical conductivities or the values of 5mg / L, higher than the WHO recommendation of 1.5 mg / L, are recorded in the centre of the basin at the level of the salted central band. These relatively high values are of natural origin.

The Maastrichtian aquifer has relatively high iron contents, often responsible for the reddish colour of the water distributed. These high levels are noted in the north-east and west and south-west of the country

Over-exploitation of groundwater is identified in the western part of the deep aquifer in Senegal (depletion, degradation of quality). A groundwater transfer project from east to west is currently under study. The drastic lowering of the water table in western Senegal and the increase in salinity pose serious problems for Dakar's water supply.

About 60% of Dakar's drinking water is supplied by groundwater, obtained from the intermediate and deeper aquifers of the Cretaceous-Tertiary. The surface waters of the Senegal River feed Lake Guiers, which produces 40% of the water resources of the capital Dakar.

Various water abstraction schemes are intended for urban and rural water supply, for mining and other private sector activities (agriculture, livestock, industry) representing respectively 45.9; 36.1; 8.5 and 9.5% of the total withdrawals.

Distribution of different types of uses

Uses	Flow in m3/an	Flow in %
Urban hydraulic	81 518 630	45,9
Rural hydraulic	64 140 387	36,1
Mining	15 171 097	8,5
Other private sector	16 803 104	9,5
Total	177 633 217	

Source DGPRES Sénégal 2018

Data shows that in 2008 there were at least 7,000 sampling points in Senegal's groundwater aquifers, both large boreholes and hand-dug, with information on geological logs for about 1,400 boreholes. Water abstractions are mainly concentrated in the central and western areas of the country.

A fossil freshwater pocket has been found near Louga in Senegal. It is under study and could be used to supply the city of Dakar.

2.3. Institutional tools available to support transboundary cooperation

There is no formal agreement between the four countries for an integrated management of the SMAB, nor is there any agreement related to the exchange of data on the aquifer's quantitative and qualitative evolution.

Two Transboundary Basin Organisations (TBOs) exist for the management of shared rivers located in this region: The Organisation for the Development of the Senegal River (OMVS), of whom Guinea, Mali, Mauritania and Senegal are members and the Organisation for the Development of the Gambia River (OMVG), which membership comprises Guinea, Guinea-Bissau, Senegal and The Gambia. Since there is no accurate overlapping between the countries sharing the SMAB and countries sharing these two transboundary watershed, the SMAB constitutes a link between these two watersheds.

Both TBOs were invited to share their knowledge of groundwater issues in the region as well as their respective visions on the roles they could play in supporting riparian countries to achieve a cooperative management of the SMAB.

2.3.1. OMVS' contributions in relation to possible tracks of cooperation on the SMAB:

Hydrogeology in the Senegal River Basin is characterized by the existence of several groundwater layers corresponding to different geological formations established respectively in the Primary, end of the Secondary, Tertiary and Quaternary Eras.

- The Maastrichtian aquifer, located in the entire Senegal-Mauritanian basin. The Senegal River basin is (or has been), according to some experts, a feeding zone for the aquifer from the river;
- The Eocene aquifer, located in the Senegal-Mauritanian Sedimentary Basin ("BSSM") in Mauritania (Brakna water table) and in Senegal: The supply of this aquifer is dependent on rainwater, river water (infiltration following floods) or water from the Maastrichtian aquifer by upward leakage ("drainance ascendante");
- The Continental Terminal (CT) aquifer, identified on the right bank (Trarza aquifer) and on the left bank (Ferlo aquifer): This aquifer seems to be fed only by river floods;
- The Quaternary aquifer or alluvial aquifer, corresponding to the river's major bed: Piezometric studies have shown that alluvial aquifers are alternately fed and drained by the river;

- Basement aquifers, identified in the Senegal River basin in eastern Senegal, Mali and Guinea.

Although its mandate focuses specifically on the Senegal River Basin's surface waters, the OMVS conducted a study to understand the impact of two of its water infrastructures on the groundwater of the region, namely the Diama and Manantali dams. This study shows that the effects of the management of the Senegal River on groundwater are mainly visible on the alluvial aquifer. The main hydrological change, however, is attributable to the drought, which has greatly limited the water slide and therefore the aquifers' refills. On the other hand, the development of irrigated perimeters, and particularly rice-growing areas -which remain in water for several months- favours the deep percolation of surface water towards the aquifers. The assessment of the current state of knowledge shows the absence of any negative effect of the surface water management of the Senegal River on groundwater dynamics. One exception has been found in the Delta zone, where hydromorphism¹ occurs, as a result of irrigation and drainage activities from Diam dam, in parallel to a rise of saline levels downward to the dam (most probably related to the reduction of the superficial groundwater recharge that enables the below salty groundwater to be lift up). The percolation of irrigation water over the rest of the valley favours the raising of the water table. It also has a positive effect on both the water withdrawal capacity of wells and, the access of forest ecosystems to water.

Given the many socio-economic activities developing in the basin, the OMVS recognizes the importance of paying particular attention to this aquifer for a better water management (surface and underground, quantitative and qualitative) of the basin. The socio-economic impacts would thus be analysed.

The OMVS is putting in place the necessary system for monitoring water quality and sensitizing stakeholders on the factors underlying different forms of pollution.

The OMVS uses a number of tools to facilitate the transparent and supportive management of the resource. These main tools are:

- For planning purposes: Water Development and management master plans (SDAGE);
- For technical management purposes: the needs / resources and Hydracces dashboard;
- For concerted management purposes: The Permanent Water Commission and the Basin Committee.

The place/role of groundwater in these different tools will be clarified.

With support from USAID and the Dutch cooperation, the OMVS has already initiated major groundwater monitoring programs. A diagnosis of these experiences' strengths and weaknesses has been implemented.

2.3.2. OMVG's contributions in relation to possible tracks of cooperation on the SMAB:

The Gambia basin is crossed by the Senegal-Mauritanian sedimentary basin extending between Mauritania and Guinea-Bissau, through Senegal and Gambia.

The interaction between surface and groundwater is observed in the Senegalese sedimentary basin which contains the Continental Terminal groundwater, which is in turn, in contact with the river and its tributaries. During periods of low water, it ensures the river's flow and allows for the realisation of hydraulic infrastructures for agricultural development, as well as populations' and cattle water supply. It is in this context that the OMVG undertook the construction of hydraulic infrastructures in the transboundary areas of the four states (i.e. village boreholes, village wells, pastoral boreholes).

As in the case of the OMVS, the OMVG was originally created to specifically manage surface water. It has later recognized the need to pay attention to groundwater management. For this reason, this TBO tries to adapt its existing instruments and tools to groundwater management. And these are:

- The Permanent Water Commission;

¹ Hydromorphism is the saturation of the pores of the soil on a period of the year that leads to a lack of oxygenation that disrupts soil fauna and vegetation.

- National monitoring committees and Local coordination and monitoring committees for the monitoring and implementation of the environmental and social management plan, as well as the resettlement plan;
- Consultation platforms (Guinea, Guinea-Bissau, Senegal);
- Permanent monitoring mechanism of the resource;
- Drafting of the water charter project.

In general, OHCHR supports its Member States' technical services (e.g. acquisition, installation of piezometric stations and training of technicians). In return, data exchange protocols are signed between the Office of the High Commissioner and the hydrological services of those Member States.

From 2010 to 2016, under the PGIRE Kayanga / Geba, five piezometric stations were installed (3 in Senegal and 2 in Guinea-Bissau).

Since November 2018 as part of the Energy Project, five sub-watersheds were also equipped and monitored in the Gambia Basin (3 in Senegal and 2 in the Gambia).

Other regional Organisations are also qualified to promote transboundary cooperation in the SMAB. ECOWAS' Water Resources Coordination Centre does so for example and provides technical support or mediation services in political decision-making processes.

2.4. Issues related to the management of SMAB

The roundtable identified five key issues related to the SMAB's management

2.4.1. Improving the knowledge of the SMAB

The fields of hydrogeological knowledge to be improved are the following: geometrical configuration of the aquifer; geological and structural configuration; hydrogeological and hydrodynamic parameters; internal interactions between different aquifers; modelling of 3-dimensional flows; pressure transfer time; natural recharge areas and climate data; natural discharge areas; evolution of levels and flows; global and sectoral potential; geochemical characteristics; water quality; vulnerability to extreme events; demand for water, use and evolution.

The latest study of the SMAB was carried out in 2017 in the field of isotope hydrology, and in the framework of the IAEA project RAF 8 / 011. The results of this study were synthesized by Prof. Yves Travi and concern Mauritania and Senegal. The next planned study project (RAF 8 / 019) is expected to cover Gambia and Guinea-Bissau.

2.4.2. Improving data collection for resources' assessment and monitoring

The question of SMAB's resources assessment and monitoring is to be explored. Although systematic data collection mechanisms exist (e.g. the ECOWAS water observatory for data collection and monitoring, and the SAS), levels of knowledge and data managed nationally, are not equally developed in the four countries.

In addition, the roundtable revealed an interest in exchanging data concerning problems affecting transboundary areas whose understanding is currently limited to national territories, (e.g. iron levels present in aquifers). Furthermore, supervising exploitation by large users, such as industrialists and farmers, remains a problem in relation to the application of national regulatory frameworks.

In relation to the role of TBOs, a USAID project, among others, had been implemented by OMVS concerning the establishment of a Groundwater Unit to assess the impact of dams and the intensive development of irrigated agriculture in the Senegal River Basin. Regular monthly monitoring was carried out from 1987 to 1991 on physico-chemical parameters and water levels via a network of 585 piezometers. Maintenance problems subsequently occurred and the States ended-up being entrusted with the follow-up tasks themselves. The strengths and weaknesses of this experience must be taken into account in the development of a SMAB resources assessment and monitoring system. The question of SMAB's resources assessment and monitoring is to be explored. Although systematic data collection mechanisms exist (e.g.

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In addition, the roundtable revealed an interest in exchanging data concerning problems affecting transboundary areas whose understanding is currently limited to national territories, (e.g. iron levels present in aquifers). Furthermore, supervising exploitation by large users, such as industrialists and farmers, remains a problem in relation to the application of national regulatory frameworks.

In relation to the role of TBOs, a USAID project, among others, had been implemented by OMVS concerning the establishment of a Groundwater Unit to assess the impact of dams and the intensive development of irrigated agriculture in the Senegal River Basin. Regular monthly monitoring was carried out from 1987 to 1991 on physico-chemical parameters and water levels via a network of 585 piezometers. Maintenance problems subsequently occurred and the States ended-up being entrusted with the follow-up tasks themselves. The strengths and weaknesses of this experience must be taken into account in the development of a SMAB resources assessment and monitoring system.

2.4.3. Quality of the resources

The quality of the SMAB resources is uneven depending on the region for one same layer containing an aquifer (e.g. the Maastrichtian as mentioned above) and depending on the layers for one same region (e.g. in Bissau, where waters of superficial aquifers are of lesser quality than the resources of deep aquifers).

Different sources of pollution and contamination also affect the resources of SMAB. The roundtable noted problems of:

- Salinization of water and agricultural land, particularly in Mauritania and the lower Senegal River valley and delta;
- Pollution by wastewater discharges, pesticides and fertilizers, especially in Senegal;
- Pollution from mining in Guinea-Bissau and Senegal;
- Natural rural iron pollution in Guinea-Bissau, Gambia and Senegal;
- Natural fluoride pollution, especially in Senegal;
- High level of Sodium Chloride in the deep aquifer.

These pollution problems are locally exacerbated by the deficit of water recharge and falling levels of the water tables, due to arid climate and population growth.

2.4.4. Governance and the link between the use of SMAB and socio-economic development

The SMAB's resources have a real impact on the lives of peoples who depend on them. Their governance strongly influences the socio-economic and environmental systems of the region: depending on the level of access to groundwater and the quality of the groundwater, the income from small irrigated agriculture projects can change. The same goes for production and operating costs related to drinking water supply.

These resources are indeed essential to supply the region's major cities in water as well as, rural areas unserved through surface water exploitations. They are also essential for the development of priority economy sectors.

Roundtable participants also noted the impact of SMAB's resources on regional peace and security: depending on the level of water availability and quality, the level of regional stability varies and in turn impacts investments along with levels of rural exodus.

It was thus agreed that the resources of the SMAB were strategically important and their sustainable management therefore necessarily called for the establishment of a concerted management mechanism.

The meeting highlighted that the interest to cooperate around the SMAB is not limited to the common aquifer located in the Maastrichtian layer, but includes as well, water resources present in other layers, and sometimes shared only by a sub-group of the SMAB's riparian States (e.g. the Eocene shared by Mauritania and Senegal, or the Oligocene shared by Guinea-Bissau and Senegal). The SMAB's governance

should therefore eventually follow an integrated hydrogeological approach assessing the interactions between surface and groundwater.

From a transboundary rivers point of view, the Roundtable noted that the history of data exchange and trust between the four countries could serve as a solid basis for the governance of SMAB.

From a hydrogeological point of view, both rivers covered by the OMVG and OMVS respective mandates, overlap in the SMAB and both come from the Fouta-Djallon Massif in Guinea.

From an institutional point of view, both TBOs share very similar legal structure and mechanisms, and both have their headquarters in Dakar, which can foster synergies. These intergovernmental organisations are essential mechanisms for coordinating States' efforts in the management of transboundary rivers, including by reconciling divergent interests and identifying opportunities for mutually beneficial activities.

A partnership between both TBOs therefore presents assets for the sustainable management of the SMAB. A consultation process has already been launched among both organisations. It aims at taking aquifers and their protection into consideration, in the governance mechanism.

In addition, expert works, cooperating with national administrations, such as the Sahara and Sahel Observatory, should also be mobilized for such coordinated governance mechanism.

There are other examples in the world of groundwater management mandates entrusted to TBOs such as in the case of South Africa, Botswana, Lesotho and Namibia. In September 2018, the Groundwater Hydrology Committee of the Orange-Senqu River Basin Commission (ORASECOM) conducted a joint analysis of groundwater systems. In Europe, the mandate of the International Commission for the Protection of the Danube River and the International Commission for the Protection of the Rhine, also include the management and protection of groundwater resources.

Finally, Roundtable experts stressed that the sustainable management of the SMAB necessarily involves the definition of common management rules. In this regard, the 1992 Convention on the Protection and Use of Transboundary Watercourses and International Lakes and the non-binding instruments developed under the Convention may help define common rules for the management of SMAB. In particular, the "Groundwater Model Provisions" are specific and non-binding guidelines on the implementation of the Convention in the field of groundwater and are intended to guide the drafting of bilateral or multilateral agreements or protocols on transboundary groundwater. Similarly, the "ILC Articles on the Law of Transboundary Aquifers" also provide the principles and rules of international water law and can serve as an indicator for structuring the SMAB governance model.

2.4.5. Financing

The issue of financing was covered in detail, along with the issues of knowledge and assessment and monitoring of the SMAB's resources. The participants noted the challenges of financing these efforts independently of the realisation of water infrastructures. They also recalled the known failures to sustain monitoring systems, especially with insufficient financial resources. The Roundtable further clarified that funding mechanisms of development banks are generally not designed to generate knowledge and share data unless this is done in relation with projects aiming at exploiting the resource.

At the States' levels, there are different experiences with data collection funding mechanisms that can serve as starting points for reflection. For example:

- In Mauritania, a tax of 3 MRU/m³ has been imposed on companies collecting water, to finance the monitoring of resources. However, the implementation of this tax is challenged by the financial capacities of some of those companies;
- Senegal has a dewatering trust fund ("Fonds d'exhaure") fed by royalties and which partly finances the monitoring of water resources;
- Guinea-Bissau has the intention to create a National Water Fund.

Moreover, the meeting suggested that in order to sustain the monitoring of the resources of the SMAB, it was important to set up an autonomous financial system that does not depend on external funding. To this

end, the funding streams from the financial revenues of the common structures managed by the TBOs were mentioned as options to be explored.

2.5. Potential benefits of cooperation around SMAB's management

In order to better understand the potential for cooperation in transboundary waters of the SMAB, the Roundtable participants met for a brainstorming session in sub-groups. They used the *Guidance Note on the Benefits of Transboundary Water Cooperation*, developed under the 1992 Convention on the Protection and Use of Transboundary Watercourses and International Lakes. They identified a wide range of benefits that an increased cooperation on the basin could generate, economic, social and environmental terms. The results of their exchanges are summarized in the table below.

Economic advantages	Socio economic advantages
Lower investment and operating costs	Extending drinking water supply thanks to the utilisation of this strategic reserve
Growth in productive economic sectors thanks to increase of availability of water resources for immediate use	Better geographic distribution of water resource and better spatial planning
Stabilisation and development of subsistence agriculture and possibilities to increase revenues in small-scale agriculture projects	Enhancing water quality through fight against water pollution
Opportunity to industrially exploit water (mineral waters)	Health protection related to enhancement of water quality
	Positive impact of the economic advantages on the fight against rural exodus
Benefits of regional economic cooperation	Peace and security benefits
Better knowledge for optimal management	Stabilization of populations (fight against exodus and migration) thanks to the securitisation of drinking water in rural zone
Better project planning and possibility to develop joint projects	Reinforcement of regional stability conducive to investment
Economies of scale and risk reduction	New opportunities stemming from reinforcement of mutual trust
	Major potential for reducing vulnerability to climate change
	Creation of spirit of membership around a common strategic reserve

3. Future projections and recommendations

3.1. Overall objective

Given the wealth of benefits around the integrated management of the SMAB and in order to achieve them, the Roundtable drafted an overall objective that should serve as a compass to guide, any cooperative initiative around basin's resources and more broadly, any development intervention in the region:

Promoting resilience, sustainable development and stability in the region through strategic management of the SMAB.

3.2. Operational objectives

In order to achieve this global objective, 3 operational objectives were identified:

1st operational objective: Protection and integrated, sustainable management of the strategic resource

Recommendations tracks

A number of possible actions were suggested in order to achieve the protection as well as the integrated and sustainable management of the strategic resources of the SMAB.

- Synthesize existing hydrogeological knowledge.
- Better understand the evolution of the quality and quantity of water resources. Also study related problems of surface water quality.
- Establish permanent observation networks for measurements and data collection.
- Study the recharge rate of the aquifer and the possibilities to improve it.
- Study the flows.
- Establish a map.
- Set up a digital model of the deep aquifer.
- Make future projections related to the water balance of the region and the groundwater reservoir, in order to anticipate the impact of climate change and fight against poverty and areas of poverty.
- Establish a regular, sustainable and standardized system for sharing and exchanging data and experience so that it can be used by all.
- Establish useful, necessary and strategic links between technical and scientific data on the one hand, and challenges related to social, economic, environmental and regional security and peace policies on the other.

2nd operational objective: Governance for coordination and cooperation

Recommendations tracks

In order to achieve governance based on coordination and cooperation, the Roundtable indicated the following avenues for action:

- Study the interests of coordination between OMVS and OMVG in achieving the overall objective.
- Mobilize political decision-makers (Member States, competent ministers, etc.), to:
 - Make them aware of the overall goal;

- Offer them coordination between OMVS and OMVG (i.e. have these ideas adopted by ministers in charge of water) which would be initiated by the establishment of a group of experts on groundwater within the TBOs and/or the creation of a consultation committee between both TBOs. As the advisory commission of the Council of Ministers, the Permanent Water Commission was mentioned as a relevant entry point;
 - Finally expand the TBO's mandates to include groundwater protection and management;
 - Adapt the geographical coverage of a joint TBO mandate to ensure overlap with SMAB groundwater.
- Involve other national, regional and international actors.
 - Make government stakeholders aware of the importance of sustainability in general, and the sustainability of projects, so that they commit to it and guarantee it when engaging in new projects.
 - Establish the basis for appropriate national rules that would regulate the use of resources within the borders of each State, pending the establishment of a joint and sustainable joint management mechanism at the sub-regional level.

3rd operational objective: Financing

Recommendations tracks

Several courses of action were recommended by the Roundtable in its discussion on the mobilisation of the necessary financial resources to achieve the overall objective. They are all intended to establish sustainable financing of interventions in the SMAB as well as the sustainable management of its underground water resources.

- First develop, a strong case to convince the concerned government actors and donors, so that they invest themselves in the improvement of the knowledge of the SMAB and monitoring of its resources. The establishment of permanent observation networks of measurements, as well as the collection and exploitation of data require, not only human and financial resources for their implementation, but also a firm political will to perpetuate them. An important axis of this argument should be built around the direct use of knowledge, such as for the improvement of the rate of negative drilling, or the watch of risks of potential dam failure.
- Differentiate between national levels and the sub-regional level, which should then be prioritized by pooling resources.
- Establish return-on-investment analyses (including from the point of view of stability, security, etc.) in order to attract and retain financial partners.
- Engage concerned States financially before they can subsequently attract other financial partners.
- Explore funding opportunities through "local investments (i.e. resources from OMVG and OMVS)" that would make management, cooperation and monitoring more sustainable.
- Establish twinning between SMAB and other aquifers around the world, international project fees, or access to information.
- Establish a system of user fees and payments for their water rights so that SMAB's data collection and groundwater management are self-financing.
- Invest in the reinforcement of human resources (capacities) in order to guarantee the availability of local capacities and the durability of results of any intervention (option: field visit in Geneva).

As part of this round table, representatives of the technical and financial partners outlined potential avenues for collaboration to support inter-state cooperation on the Senegal-Mauritanian aquifer system. The report reproduces here the main messages communicated during this session.

3.3 Potential contributions from technical and financial partners in support cooperation around the SMAB

During the roundtable, representatives of a number of technical and financial partners outlined potential avenues for collaboration to support inter-state cooperation on the Senegal-Mauritanian aquifer system. The report reflects below their main messages.

International Agency for Atomic Energy (IAEA)

Within the framework of IAEA activities, Project RAF / 7011 on transboundary aquifer management improved the knowledge of the SMAB, particularly through the use of chemical and isotopic approaches. The studies conducted by the Senegalese and Mauritanian partners were reflected in a summary report (Prof. Yves Travi) highlighting common achievements as well as, knowledge gaps, related to the functioning of aquifers in Mauritania and Senegal. Taking into account the conclusions and recommendations of this report, a new project (RAF / 7019) is currently under development. It aims at expanding the work to Guinea Bissau and The Gambia. Information to be newly acquired on the SMAB's deep aquifer recharge, at the level of Guinea Bissau, is considered key for the development of a global model. This tool should serve for the development of a better long-term vision related to the evolution of the water resources and, the support of the SMAB's collaborative management.

African Development Bank (AfDB)

The new AfDB water policy is about to be approved. Water security is a key element and transboundary aquifers are also recognized as such. Its representative's recommendations can be summarized as follows:

- Country strategy papers should clearly explain the benefits of such an initiative, for countries' development *per se*, in particular with respect to how water has an impact on the holistic development in order consider the issue of water (both surface and groundwater) as a matter of national priorities.
- Since funding requests to the Bank are in particular formulated by countries, there is a not for these specific requests to express the needs in terms of regional or transboundary scope within the submitted project framework.

Swiss Development Cooperation (SDC)

Several institutions are interested in the SMAB at the international, regional, sub-regional and local levels. The SDC suggests to assist through a capacity building project that would twin the transboundary Geneva aquifer with the SMAB.

Whiling having endorsed a strong role as a co-convening country of the Global High Level Panel on Water and Peace, Switzerland engages in particular with other partners on the issue of innovative financing that support transboundary cooperation and intersectoral cooperation for the sustainable development of water infrastructures. It also assists the designing of joint investment plans. Further, the SDC continues its support through for instance:

- Follow up activities in partnership with UNECE (financing support precisely for this type of meeting as well as other workshop mentioned by UNECE)
- A complementary support to initiatives exposed in this document, focusing on existing partners such as GWH, UNECE, UNESCO-GGRETA, WMO, etc.
- An exchange to organise a tailor-made technical, financial or other type of support (for instance, following up on exchanges already engaged between actors of the French-Swiss transboundary collaboration on the Geneva Aquifer and actors of the SMAB)
- An ongoing advocacy effort toward integrating an approach that comprises surface water and groundwater within investment plans.

The State of Geneva

A representative of the State of Geneva presented the experience of 40 years of transboundary cooperation around the Geneva Aquifer. This Aquifer has historically been the subject of the first transboundary agreement in the world for underground water resources management. The technical solution used in this case to artificially recharge the Geneva aquifer with surface water could indeed be of interest to address the SMAB's issues. Decentralized cooperation channels could hence be explored.

The Geneva Water Hub (GWH)

As a center of excellence specializing in hydrogeopolitics and hydrodiplomacy, the Geneva Water Hub offers several angles of collaboration. On the knowledge side, the GWH engages in research projects related to institutional arrangements for better management of water resources and develops tools to better understand the political tensions arising from water-related conflicts of use. In addition, it offers online or face-to-face training to build capacity in hydrogeopolitics and international water law. On the hydrodiplomatic component, the GWH is developing a Global Observatory for Water and Peace in collaboration with a number of regional partners. This new platform for water diplomacy, resulting from a recommendation of the Global High Level Panel on Water and Peace, will have a strong anchor in the region through the Dakar Water Hub and will support the facilitation work started at this round table.

International Center for Groundwater Resources Assessment (IGRAC)

For the past 16 years, IGRAC has been working on the assessment of transboundary groundwater resources, as well as on the promotion of cooperation between states sharing such resources, to manage them sustainably. Within a GEF project aiming at integrating groundwater management within the mandates of transboundary river basin organizations in Africa, IGRAC is developing an internet portal synthesizing available data and information on the SMAB. This portal is designed as a platform for data exchange among regional partners: the OMVS, member states' groundwater departments, universities and research institutes, non-governmental organizations (NGOs), etc. The goal is to achieve an integrated and joint vision of the SMAB. IGRAC will train the OMVS teams for the use of this portal.

IGRAC would like to organize more workshops, including with member states, to build capacity in terms of collecting and sharing groundwater data, including piezometric and borehole data.

Federal Institute for Geosciences and Natural Resources of Germany (BGR)

The representative of the BGR presented the institute's spectrum of activities in the field of groundwater and soil sciences. These include international technical cooperation. Their tools provide a better understanding of the properties, quality and dynamics of groundwater and soil. In particular, the BGR has developed research and development tools to explore coastal groundwater from a helicopter airborne radar. These tools are designed to facilitate resource management decision-making.

The Secretariat of the UNECE Water Convention

The Secretary of the Water Convention, hosted by UNECE, presented the activities undertaken under the umbrella of the Convention, as well as the type of support provided to States Parties to the Convention. It was highlighted that non-States Parties also benefit from many of such activities. In this connection, the possibility for States to join the now global Convention was recalled.

Under the program of work for 2019-2021, the Water Convention offers States the following activities:

- Support to political processes at national and basin levels:
 - o Improved national water governance and IWRM (NDP)
 - o Support for accession to the Convention for interested countries
 - o Support for the development of agreements and the establishment of joint bodies

- Capacity building on technical and policy issues
- Workshops for sharing knowledge and experiences (reporting, monitoring and evaluation and data sharing, climate change adaptation, water resource allocation, financing of transboundary basin development)
- Technical assistance projects in basins on climate change adaptation, benefits of cooperation, monitoring and evaluation, nexus water-food-energy-ecosystems
- Tools and policy recommendations

The Convention's Secretary also highlighted activities and tools specific to transboundary aquifer management, including the Model of Transboundary Groundwater Provisions, intended to guide the drafting of bilateral or multilateral agreements or protocols and strengthen governance of transboundary groundwater.

UNESCO

UNESCO aims at launching a project of the Global Environmental Facility on the SMAB. Its objective would be to monitor the aquifer, its data and development. In addition, the representative of UNESCO stressed the importance of establishing a cross-cutting expert group between the two RBOs in order to improve the status of groundwater and give it the interest it deserves. UNESCO would be ready to financially support an initiative aiming at enhancing cooperation around the SMAB.

4. Next Steps

Given the critical management issues of the SMAB, as well as the aim to prevent major and urgent issues, Roundtable participants agreed that the timing was appropriate to start interstate cooperation on groundwater and build solid mechanisms to support it.

It is up to the participants of the Roundtable to adopt in order to achieve them, the recommendations and actions necessary to promote the resilience, sustainable development and stability of the region through a strategic management of the SMAB.

Below we highlight 3 elements addressed during the exchanges in view to initiate a process of transboundary cooperation on the SMAB:

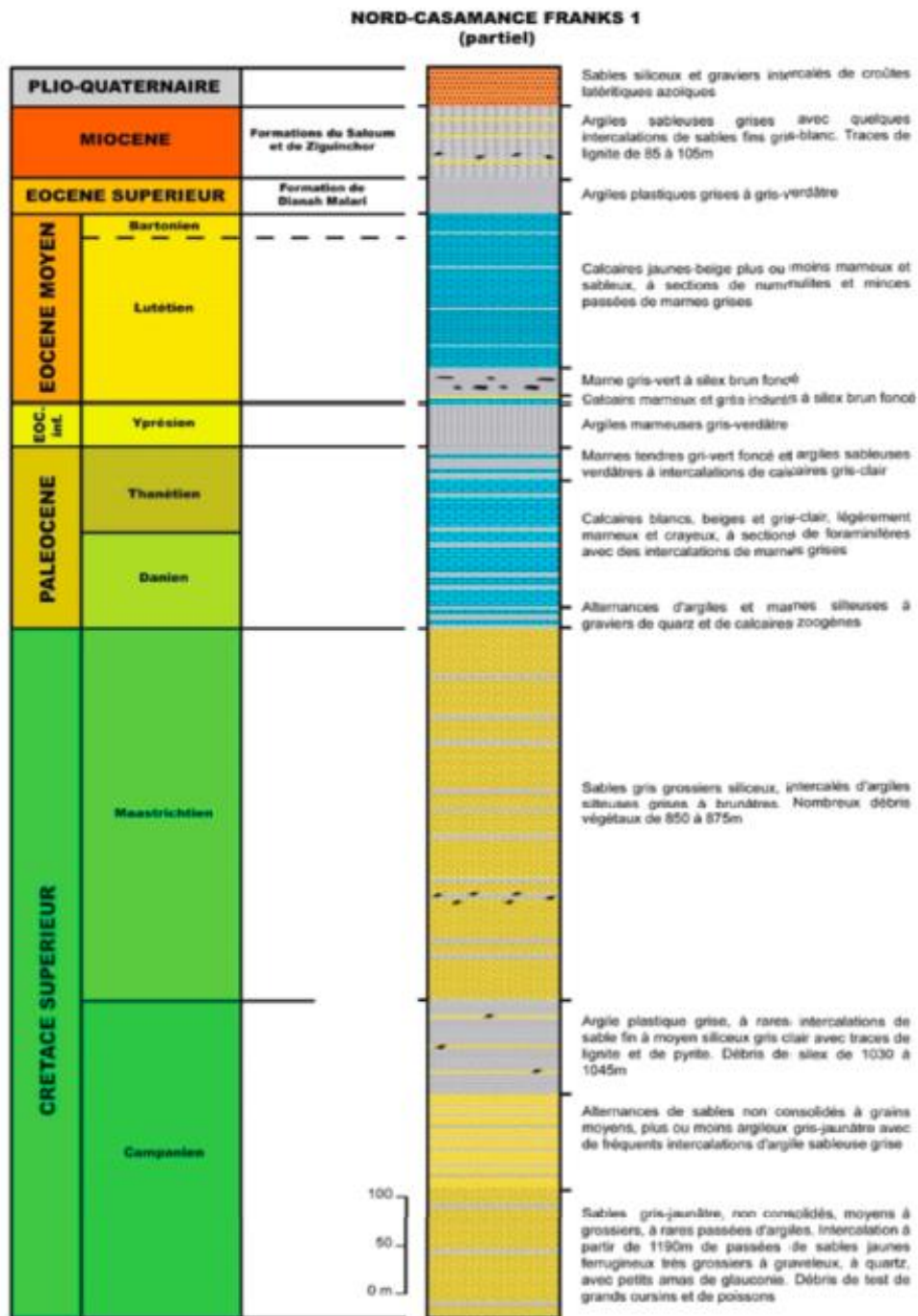
- A) *Commitment of political leaders to validate the principle of transboundary cooperation. The experts from each state are thus invited to meet with line ministers to initiate the process of sensitizing government actors and invite them to adopt the overall objective;*
- B) *Set up of a Task Force with representatives of the four states and the transboundary basin organisations to hold the mandate to produce the design of a joint project and initiate fundraising;*
- C) *In addition to the engagement of national experts, consider the organisation of an intermediary meeting on the role of OMVS and OMVG in the project of monitoring the SMAB.*

While the implementation of the transboundary cooperation process relies on the willingness of the sovereign states, the latter may count on the support of the technical and financial partners that organised or contributed to this roundtable.

Annex 1: List of acronyms

IAEA	International Atomic Energy Agency
UNECE	United Nations Economic Commission for Europe
SMAB	Senegal Mauritanian Aquifer Basin
ILA	International Law Commission
ECOWAS	Economic Committee for West African States
CT	Continental terminal
DGPPE	Direction de la Gestion et de la Planification des Ressources en Eau (Directorate of water resource management and planification)
DSA	Deep Standstone Aquifer
MSGGB	Mauritania-Senegal-Gambia- Guinea-Guinea-Bissau
UNIGE	University of Geneva
OMVG	Organisation for the development of the Gambia River
OMVS	Organisation for the development of the Senegal River
ORASECOM	Orange-Senqu River Commission
PGIRE	Project for the integrated management of the water resources and the development of multiple uses of the Senegal Basin
UNDP	United Nations Development Programme
SCA	Semi Confined Aquifer
SDAGE	Water Development and Management Master Plan
SSA	Sole Source Aquifer
TBO	Transboundary Basin Organisation
USAID	United States Agency for International Aid

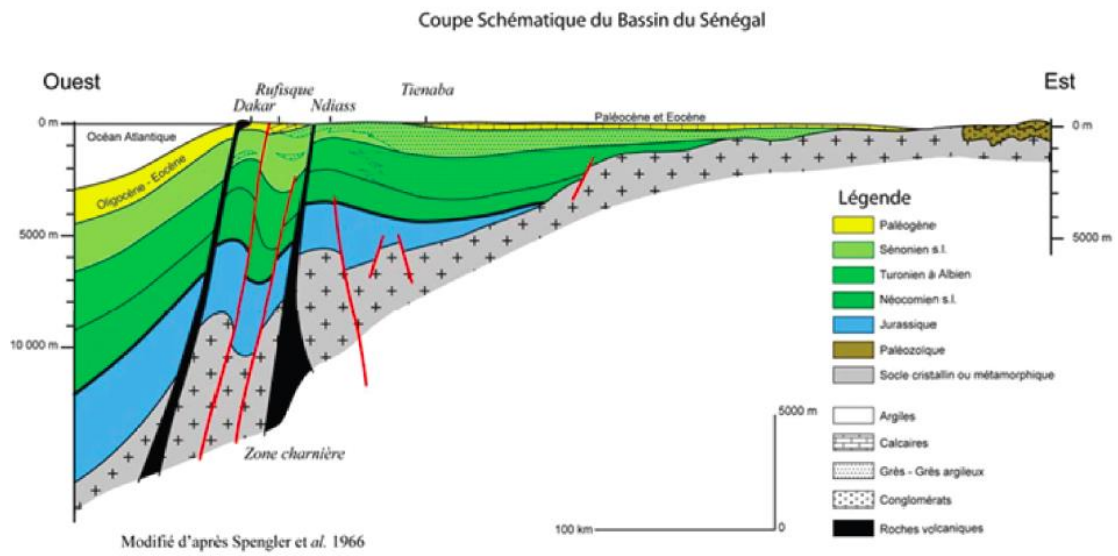
Annex 2: Synthetic stratigraphic column of the meso-cenozoic Casamance series.



Compilé d'après le rapport de fin sondage de Nord-Casamance Franks 1 (Société des Pétroles du Sénégal 1960)

Annex 3: Schematic cut of the Senegal basin

(modified from Spengler et al., 1966)



Annex 4: List of participants of the Roundtable

State Delegations

States	First names & NAMES	Function	Minister
Guinée-Bissau	Inussa BALDE	Directeur Général des Ressources Hydriques et Coordonnateur de la Cellule National OMVG	Ministère de l'énergie, de l'industrie et des ressources naturelles
Guinée-Bissau	Hilario SANHA	Technicien Senior de la Direction General des Ressources Hydriques et de Point Focal de la Gestion Intégrée des Ressources en Eau	Ministère de l'énergie, de l'industrie et des ressources naturelles
Mauritanie	Mohamed Ould Abdellahi Salem AHMEDOUA	Secrétaire Général	Ministre de l'Hydraulique et de l'Assainissement
Mauritanie	Saadou Ebih MONANE	Chargé de Mission au Cabinet du Ministre	Ministre de l'Hydraulique et de l'Assainissement
Sénégal	Niokhor NDOUR	Directeur la Gestion et de Planification des Ressources en Eau	Ministre de l'Hydraulique et de l'Assainissement
Sénégal	Youssooupha KAMARA	Coordonnateur de la cellule OMVS/OMVG	Ministre de l'Hydraulique et de l'Assainissement
The Gambia	Alhagi JABBI	Head of Rural Water Supply	Department of Water Resources
The Gambia	Yusupha BOJANG	Integrated Water Resource Management National Focal Point	Department of Water Resources

Delegations of Transboundary Basin Organisations

TBO	First names & NAMES	Function	Transboundary Basin Organisations
OMVG	Ababacar NDAO	Secrétaire Général	Organisation pour la Mise en Valeur du fleuve Gambie (OMVG)
OMVG	Kabir Silla SONKO	Directeur de l'Environnement et du Développement Durable	Organisation pour la Mise en Valeur du fleuve Gambie (OMVG)
OMVG	Lamine KONATE	Expert Hydrologue	Organisation pour la Mise en Valeur du fleuve Gambie (OMVG)
OMVS	Brahim Lebatt H'MEYADE	Haut-Commissaire adjoint	Organisation pour la Mise en Valeur du fleuve Sénégal (OMVS)
OMVS	Amadou Lamine NDIAYE	Directeur de l'Environnement et du Développement Durable	Organisation pour la Mise en Valeur du fleuve Sénégal (OMVS)

Experts and representatives of technical and financial partners

First names & NAMES	Function	Organisations
David Jonathan HEBART-COLEMAN	Water Resources & Climate Change Specialist	Banque Africaine de Développement (BAD)
Johan GELY	Chef du programme global eau, DDC, DFAE	Coopération suisse (DDC)
Nadia BENANI	Programme manager programme global eau, DDC, DFAE	Coopération suisse (DDC)
Isabella PAGOTTO	Senior Advisor /Programme Manager programme global eau, DDC, DFAE	Coopération suisse (DDC)
Sara VASSOLO	Experte	Federal Institute for Geosciences and Natural Resources of Germany (BGR)
Arnaud STERCKX	Researcher	International Groundwater Resources Assessment Centre (IGRAC)
Andrea AEBI	Conseillère Paix et Sécurité	Mission suisse ONUG
Gabriel DE LOS COBOS	Chef du secteur du sols et sous- sol	Service géologie, sol et déchets du Canton de Genève
Alice AURELI	Chief of Section on Groundwater Systems and Settlements Section	United Nations Educational, Scientific and Cultural Organization (UNESCO)
Abou AMANI	Chief of Section on Hydrological Systems and Water Scarcity Section	United Nations Educational, Scientific and Cultural Organization (UNESCO)
Yves TRAVI	Professeur émérite de l'Université d'Avignon	Université d'Avignon

Raya STEPHAN	Experte indépendante sur le droit international de l'eau	
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Representatives of the host organisations of the roundtable

First names & NAMES	Function	Organisations
Francesca BERNADINI	Secretary of the Convention	United Nations Economic Commission for Europe (UNECE)
Chantal DEMILECAMPS	Environmental Affairs Officer	United Nations Economic Commission for Europe (UNECE)
Annuikka LIPPONEN	Environmental Affairs Officer	United Nations Economic Commission for Europe (UNECE)
Komlan SANGBANA	Legal Expert	United Nations Economic Commission for Europe (UNECE)
François MÜNGER	General Director	Geneva Water Hub
Natasha CARMI	Lead water specialist	Geneva Water Hub
Rukan MANAZ	Senior Project Manager	Geneva Water Hub
Monica NUNEZ	Project Assistant and Analyst	Geneva Water Hub
Caroline PELLATON	Corporate Operations Administrator	Geneva Water Hub
Léna SALAME	Senior Project Officer	Geneva Water Hub
Mara TIGNINO	Senior Legal Adviser	Geneva Water Hub
Jean WILLEMIN	Senior Project Officer	Geneva Water Hub