



INITIATIVES POUR L'AVENIR
DES GRANDS FLEUVES
INITIATIVES FOR THE FUTURE
OF GREAT RIVERS

Senegal
Saint-Louis
Dakar



**Making the Senegal
river navigable**
to transform it into an
instrument for economic
development and integration

6th
SESSION

APPEALS AND RECOMMENDATIONS

9-13 April 2018

Bringing together actors committed to the development and protection of the world's rivers, Initiatives for the Future of Great Rivers (IFGR) offers an original, international and multidisciplinary forum open to stakeholders and oriented towards action. It acts to conceive the river of tomorrow and contributes to enriching national and international debates on water and climate change. Indeed, rivers are situated at the heart of current climatic and environmental issues (energy, production, food security, public health, mobility, etc.) and could also provide solutions for building a sustainable world.

Founded by CNR, the multipurpose concessionary of the River Rhone and France's leading producer of 100% renewable electricity, IFGR is an association in the general interest chaired by Erik Orsenna, an economist and writer, member of the prestigious Académie Française.



IFGR

2, rue André Bonin - 69004 Lyon - France

Tel: + 33 (0)4 72 00 69 48 - contact@iagf-ifgr.org

www.initiativesrivers.org



Introduction

The 6th international session of the association Initiatives for the Future of Great Rivers was held from 9 to 13 April, between Saint-Louis and Dakar, in Senegal, hosted by the Organisation for the Development of the Senegal River (OMVS), one of its members.

A basin management body that brings together Senegal, Mali, Mauritania and Guinea, the OMVS, founded in 1972, is an outstanding example of cross border cooperation.

“ *There, where water is a source of dispute, here, between us, it is a source of conciliation, integration and cooperation. A remarkable achievement.* ”

HAMED SEMEGA, HIGH COMMISSIONER, OMVS

The OMVS was created in the wake of important droughts in the 1970s. Its purpose was to allow a better management of water, following three basic principles: the river and its tributaries are international property; their resources are exploited mutually and fairly; all the structures are the common property of the States. Cooperation and integration are therefore the two strong values of this intergovernmental organisation. The ultimate goal of the OMVS is to reach food self-sufficiency for local populations, boost economic development by using the river's potential and insure an ecological balance in the basin¹.

In order to fulfil its ambition, the OMVS must however accomplish one of its missions: **that of making the river navigable.**

Navigation thrived during the 1960s between Saint-Louis and Kayes, but stopped completely in the 1970s due to the combined effects of poor river bed maintenance and the great drought of 1973-1975. Today, the river is plied by only one tourist boat, the *Bou El Mogdad*.

¹ See Appendix 1: The OMVS: a single body of governance and a model of integrated management, p. 25

The OMVS has worked on this navigation project ever since it was founded, carrying out many technical, environmental, economic and financial studies. It has now become one of the priority objectives of its agenda and the OMVS hopes to quickly start the first phase of its project **to create a continuous and lasting navigable waterway of 905 km, between Saint-Louis (Senegal), at the estuary on the Atlantic coast, and Ambidedi (Mali).**

By hosting the IFGR Committee on the African continent for the first time, the OMVS wanted to place its programme in perspective. It wished to gain from the experiences of other river management bodies around the world and their varied competences to ensure the full economic, environmental and societal success of its project and make it the driving force for developing the territories crossed by the river.

An important exchange of views, as Senegal is preparing to host the World Water Forum in 2021.

“ At a time when the effects of climatic change and pressure on water resources are increasing, I consider this multidimensional approach to be particularly relevant. I ask you to help us better understand the relations between the dimensions of the problem and provide the pertinent answers. ”

MANSOUR FAYE,
MINISTER OF HYDRAULICS AND MAYOR OF SAINT-LOUIS

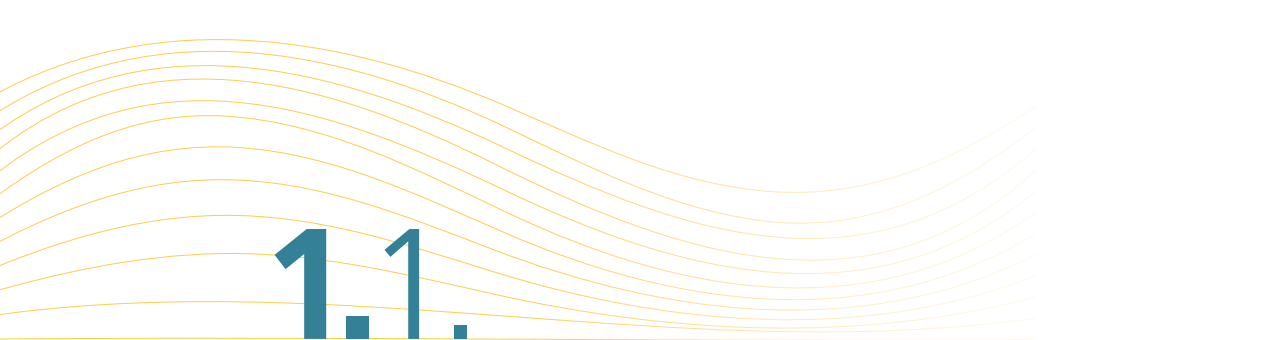
The challenges to be overcome

1

Thanks to its integrated development Program, based on the mastering of water resources, the OMVS built news infrastructures which allowed to extend the uses of the river to hydroelectric energy production, irrigation of farming lands, and drinkable water distribution².

New challenges now have to be overcome.

² See Appendix 2: a river and its uses, p. 28



1.1.

The proliferation of cattail and its environmental impacts

The commissioning of the dams of Diama³ and Manantali had highly positive impacts but they also radically changed the flow regime of the Senegal River. Cattail, an indigenous plant whose development had been previously impeded by salinization, progressively invaded the river and replaced the existing vegetation. In the Delta and the Lower Valley, cattail has developed considerably in terms of both magnitude and speed of propagation. The surface area covered by cattails already exceeded 100,000 ha only a few years ago. When it is torn out, the plant grows back again in eight to ten months. Cattail is therefore a serious threat for biodiversity, through the eutrophication of habitats and the degradation of water quality. In time it can also seriously impede socioeconomic activities such as fishing, agriculture, gaining access to drinking water for rural populations, and navigation, by altering the natural flow regimes of the river.

“Cattail is a major barrier and will prevent us from reaching the targets set for irrigated farming if we don't find a solution. It is also a health problem.”

TAMSIR NDIAYE, MANAGING DIRECTOR OF SOGEM

More than
200
million people
are affected
around the world
by the bilharzia

Water borne diseases are indeed another facet of the problem of cattail. A correlation can be clearly established between the endemic nature of malaria and the presence of this invasive plant. Mirdad Kazanji, the Director of the Pasteur Institute of Guyana, also mentioned the case of bilharzia (also called schistosomiasis), a disease that is now undergoing recrudescence due to cattail.

and it kills
300,000
people
every year.

It affects more than 200 million people around the world and kills 300,000 every year in developing countries. Bilharzia is transmitted by an intestinal worm and contact with infested water. One biological method of combating it makes use of a crayfish which eats the snails that act as the vectors of the disease. However, to achieve this, the crayfish have to be reintroduced into the river and their migration made possible by systems that enable it to cross the dams.

³ See Appendix 3: the contribution of the Diama dam to the development of water use, p.30

What are the solutions? The OMVS is monitoring this phenomenon through its Environmental Observatory set up in 2000, and is evaluating and working on responses. At present the natural enemy of cattail has not been identified and the use of chemical solutions is excluded. The population uses cattail for craft purposes to make false ceilings, build palisades and weave baskets.

“ *This artisanal utilisation does not get rid of the problem. We have to find an industrial activity that uses cattail as a raw material.* ”

TAMSIR NDIAYE

Tests have been carried out to produce compost, charcoal briquettes, and so forth, but have not proven conclusive.

Corinne Castel, a Director of Research at the CNRS, presented a project managed by the association CRAterre between 2014 and 2016 in Senegal to use cattail as a construction material with earth in the framework of sustainable development: construction with low energy and environmental impact; habitat friendly construction using local methods, etc.

The programme was stopped for want of sufficient political backing and the authorisation to build a prototype. According to her, however, it provided a genuine opportunity to **make cattail a sustainable resource**.



1.2.

Climate change: the increased vulnerability of coastal habitats and populations

In the 1970s, West Africa was severely hit by the effects of climate change. Water is a major indicator of these effects, with rainfall fluctuating dramatically between periods of droughts and floods, and rising sea levels. Indeed, along with Asia this region is the most vulnerable to rising ocean levels, due to the low altitude of large plains along the coast. The sea level was constant during the 1950s though has risen rapidly since (from 1.7 mm/year from the 1950s to about 3.5 mm/year since 2000 while a rise of 1 m is forecast for 2100).

“ Saint-Louis, a town at the mouth of the river and on the zone of transition between Saharan and Sahel climates, is severely impacted by the consequences of climate change. ”

MANSOUR FAYE,
MINISTER OF HYDRAULICS AND MAYOR OF SAINT-LOUIS

It's constantly threaten farming, the need for water for both the population and the environment, and the region's capacity to be "Senegal's granary".

Luc Descroix, a hydrologist at the Institute of Research and Development (IRD) and Deputy Director of the Joint International Laboratory of Heritage and Water at Dakar, presented three major impacts of rising ocean levels.

THE AGGRAVATION OF COASTAL EROSION

Coastal erosion is occurring everywhere around the world and is especially apparent in West Africa, where it threatens fishing villages and tourist facilities in Casamance. At the end of the 2000s, two villages located in Guandiol, Doun Baba Dieye and Keur Bernard, were washed away by coastal erosion. Inland in Casamance, villages located at zero altitude are particularly hard hit during spring tides.

The entire shoreline is receding by an average of 6 m a year.

One way of slowing this erosion – without stopping it completely – is replanting, a practice that many villages implement spontaneously. Another method concerns the nourishment of beaches (recharging with sand), to withstand strong storms and winds and avoid the construction of stone levees that cause the disappearance of beaches and the natural shoreline.



WATER AND SOIL SALINIZATION

Areas with naturally salinized soils are very frequent in the coastal mud flats of tropical regions, but they expanded here during the drought period between 1968 and 1990.

Now, the progression of salinization can no longer be attributed to drought alone. The salt content of the groundwater is very high in the Guandiol region, where the coast is exposed due to a breach opened in 2003.

In other areas, the problem of over-salty drinking water is a concern for villages that have introduced motorised pumps or which have built too many tourist facilities. Most of the villages currently have access to drinking water free of salt though increasing problems could worsen this situation in the future.

Indeed, Senegal is affected by a rare phenomenon, that of inverted estuaries: in the Saloum and Casamance regions, salinity increases the further one goes upstream. These shallow estuaries form large surface areas in which the seawater evaporates, which explains why the salinity gradient increases from the coast to inland areas.

INCREASED RISK OF SUBMERSIONS

The height of the sea water increases the risk and frequency of submersions by waves and storms. Coastal cyclones have been observed regularly since 2014 and are a new phenomenon that can be explained by global warming. They can have considerable impacts: the opening of breaches on the coast, the loss of harvests in rice-growing areas ... despite the fact that this age-old farming tradition requires salinity and submersions!

THE BREACH OF SAINT-LOUIS: AN AGGRAVATING PHENOMENON

The breach was opened on the spit of Barbarie on 4 October 2003, when the river was in full flood. The aim was to lessen the pressure of water on the city of Saint-Louis and protect the property of 70,000 people, by increasing the discharges of the Senegal River into the Atlantic Ocean. This fragile spit of land 35 kilometres long and a few hundred metres wide had been breached several times naturally in the past.

Initially
4 m
wide,
this opening
increased now to
6 km

As confirmed by Luc Descroix and Tamsir Ndiaye, the problem does not stem from the necessary and carefully considered decision taken at the time, but due to the absence of any accompanying measure, leading to the considerable progression of the breach. Initially 4 m wide, this opening increased to 200 m wide two days later and then to 1.6 km in 2006 and now to 6 km.



4 October 2003: 4 m wide



6 October 2003: 200 m wide

Henceforth the breach to a great extent structures the dynamics of the water in the estuary, with the sea advancing into the coastal regions with dramatic consequences: the loss of life of many fishermen following accidents, the disappearance of certain habitats, etc. To stop it from widening, Luc Descroix emphasised the need to preserve the transit of sediments from the Mauritanian coast to maintain this natural process from north to south.

As for the SOGENAV*, represented by Mamadou Faye, its Managing Director, it declared that works to stabilise the breach with breakwaters had been recommended in the preliminary designs of the navigation project, in order to dredge an access channel through the breach. Another option would be to fill part of the breach and then stabilise it.

1.3.

The river remains unnavigable

The river has always been one of the trade links between West Africa and the regions of North Africa, and between Europe and Asia Minor. Navigation reached its zenith at the beginning of the 20th century with 125,000 tonnes being transported on the river every year. Groundnuts, cotton and food crops were transported along the whole valley for export.

Navigation slumped due to the severe drought which lasted from 1970 to 1973, considerably reduced the river's flow regime and caused several sills (obstacles) to emerge. Poor maintenance of the river bed with a lack of cleaning and dredging further worsened the situation.

In order for the river to recover its role in the economic development of the neighbouring countries, the OMVS has studied the navigation project since its inception in 1972 and has carried out a large number of studies. The ecosystem of the basin has been weakened by desertification and the rural exodus. River transport can open up new economic perspectives and help to sustain existing populations on the river's banks and bring back those that have left. 7.6 million people currently live in the basin, i.e. 15% of the total population of the four member States of the OMVS.

For Mansour Faye, the navigation project will give Saint-Louis new means to ensure its outreach and development.

“*The whole economic environment will be transformed with the fishing, craft and industrial port, closely linked to the city, the cargo port, the marina and the mineral terminal. Hope is therefore allowed.*”

The river is an interesting route for transporting mineral ore, as recalled by Hamed Semega: phosphates at Bofal (Mauritania) and Matam (Senegal) and iron and bauxite mines in Senegal and Mali. It will also serve and provide access to isolated areas with substantial agricultural potential and encourage existing businesses to produce more.

7.6
million people
live in the basin

i.e.
15%
of the total
population of
the four member
States of the
OMVS.

Mali, a landlocked country at the heart of West Africa and with many borders, is the one that stands to gain most from this navigation project, since the river will provide an international corridor to the sea via Saint-Louis. The port of Saint-Louis, combined with that of Dakar and Nouakchott will permit developing the economy of the country and the hinterland up to Burkina-Faso, another landlocked country.



Furthermore, combined with the other modes of transport planned in SITRAM (*cf. part 2. 1*), this project will permit **organising a competitive transport system to provide an alternative to road transport.**

However, so far, this orientation of the OMVS's infrastructure programme has not been studied in-depth. Regarding OMVS's policy of shared basin management, the economic options decided first focused on energy and agriculture. Navigation has now not only become an economic priority, but also a political and social one.

Making navigation a project for sustainable development

2

Navigation has now not only become an economic priority, but also a political and social one.

2.1.

Presentation of the project driven by the OMVS

In 2010, the Senegal River Operating and Navigation Management Company (SOGENAV) was founded to **manage and administer navigation and transport activities on the river as well as the operation, maintenance and renewal of the structures entrusted to it**. By virtue of this, it is responsible for implementing the SITRAM – Senegal River Integrated Multimodal Transport System – which includes a river navigation component, a road component (roads giving access to Manantali dam; the Rosso-Diama link road; the Labé-Tougué-Dinguiraye-Siguiri road) and a rail component.

In its implementation phase, the navigation project has two sections:

A PRIORITY INVESTMENT PROGRAMME (PIP)

It aims at creating a continuous and durable navigable waterway 905 km long, between Saint-Louis (Senegal), at the mouth of the river on the Atlantic coast, and Ambidédi, downstream of Kayes (Mali). It includes:

- **the construction of two ports:** one at Saint-Louis, which comprises a marina, a fishing port and a cargo port; the other at Ambidédi, an inland river port;
- **the creation or upgrading of 7 wharves and 9 stopovers;**
- **the development of a 905 km channel** by dredging and cleaning: it will be from 35 to 55 metres wide and 2.10 to 2.50 metres deep; very considerable quantities of dredged sediment and rock must be removed, i.e. from 7 to 8 million m³, including 6 million at Saint-Louis alone, from dredging the mouth. These operations amount to 40% of the investment;
- **installing beacons;**
- **setting up agencies to operate the river barges and maintain the navigable waterway;**
- **the construction of a shipyard** at Rosso (Mauritania) is also planned for phase 2 of the project.



Localisation of the project sites

A MINERAL ORE TRANSPORT SECTION

It is scheduled in the second phase to complete the ordinary and goods transport section, with:

- **the construction of a deep water mineral terminal** to the north of Saint-Louis,
- **the development of mineral wharves** next to the deposits,
- **the widening of the navigable channel** to a width of 75 metres and a minimum guaranteed depth of 2.5 m,
- **the acquisition and operation of a dedicated fleet.**

The SOGENAV wants to entrust the widening of the channel and the construction of the mineral terminals to the private sector, likewise for the operation of the river.

This ambitious project in terms of objectives and content requires an investment of €500 million for its priority phase (excluding operation). The OMVS wants to start it before the end of 2018. It has signed a memorandum of understanding (MOU) with an Indian multinational construction company, AFCONS, which submitted its technical financial offers at the beginning of 2018.

The latest studies (detailed preliminary design, call for projects, economic feasibility study, environmental and social impact study) were being finalised during the first half of 2018 and will permit updating the costs of the project's different components, in view to seeking funds.



2.2.

The recommendations proposed

On the basis of the different presentations made by the OMVS and field visits organised at Saint-Louis to provide better understanding of the project, the members of IFGR's Rivers Committee were able to provide their experience and knowhow in order to set the project in perspective. These fruitful exchanges were summarised in the form of recommendations on the last day of the session.

1. POLITICAL RECOMMENDATIONS

Display the project's ambitions

It is not only a navigation project but a genuine global development programme. It must be presented as a new and modern way of harnessing the river. To achieve this, the following was recommended:

- **Make the launching of the project a means of centralising the stakeholders' interests** (more sustainable irrigation along the river, controlled pollution, the introduction of new modes of payment, etc.) by calling, if necessary, on international non-governmental organisations (e.g. Melinda and Bill Gates Foundation).
- **Ensure dynamic communication to accompany the project** and determine a communication strategy before launching it (what sectors of the public; what resources). This will help explaining the importance of making the river navigable again to the neighbouring populations renew their links with the river.

Do not reduce the project to its technical dimensions

It is necessary to speak about other aspects of the river and basin project rather than only navigation and optimising the channel, in order to get the population to make the river its own.

2. TECHNICAL AND TECHNOLOGICAL RECOMMENDATIONS

Collect data before, during and after

Bathymetric and meteorological data must be obtained before signing contracts for the works. They must be regularly updated to follow changes and direct decisions.

These data could be made public in a form yet to be determined in order to facilitate appropriation.

Control and evaluate the dredging works

It seemed it was necessary to **set up a system to monitor the dredging works with the main contractor and have it written into the contract** to make sure the results can be evaluated and controlled (draw up smart contracts). The example of the Mongla River in Bangladesh was given, where major dredging works have been engaged to open the navigable waterway and avoid the recurrence of sedimentation every year.

Obtain good knowledge of the river's flow regime and sediment transport

The importance of good knowledge of sediment flows in the river and how they shift has to be emphasized, to decide on the solution to implement: mechanically by dredging or by physical measures to ensure that the sediments are evacuated naturally at the mouth.

Ensure adaptive project management

The very magnitude and duration of the project required flexibility. It is necessary to observe how the river reacted to the first dredging operations and adapt the technical methods used accordingly. Another recommendation was to include in the contract(s) the possibility of modifying certain aspects to incorporate items resulting from benchmarks. Finally, it is critical to keep traces of the project with a documentation and research centre capable of recording the project and providing outlooks. An observatory of different uses to which the river is put could also be set up and benefit from support from universities.

Create value through innovation

This major project could make the Senegal River a **site of innovation and experimentation** in different fields. Innovative technologies could be adapted to the local context.

To this end, different innovative partnerships could be imagined for all the components of the project (dredging, port operations, territorial development, navigation).

It is also necessary to resituate the project in a general and planetary context of combating climate change. It could be of interest to international funding bodies if it included the use of innovative techniques, modes of financing and even fund collection (regarding property tax, etc.). Furthermore, the future of the Senegal River relies on the country's youth and the diversity of its people. It is necessary to stir national dynamism to develop the competences present and find local solutions capable of fuelling the World Water Forum scheduled for 2021 in Dakar.

The OMVS can embody modernity, already evident in the organisation's management methods, which could also be applied to the choices made for river transport: the types of boat, port buildings and warehouses, etc., by combining energy efficiency and local culture.

Several proposals for innovations and experiments were made:

- **Produce prototype boats:** as a function of the different types of user foreseen (goods, river tourism, etc.) and have this built by the future shipyard of Rosso.
- **Develop an array of experiments to exploit cattail, by involving the local construction sector** to build warehouses along the river, schools, etc., capable strengthening the relation between the population and the river.
- **Use the dredged sediments for other purposes** (such as filling the breach, strengthening and raising the levees). This could help to reduce the cost of the project and its environmental impact.
- **Integrate start-ups and incubators in the execution of the project.** Benefit could be obtained from the hosting of the forthcoming World Water Forum in 2019 with the organisation of a *hackathon* session (*an event where a group of voluntary software developers gather and collaborate to produce computer programs. It is a creative process frequently used in digital innovation*).
- **Launch a crowdfunding campaign** for some of the actions planned in the project (such as the purchase of a pilot boat), in order to favour the appropriation of the project by the neighbouring populations

3. ECONOMIC RECOMMENDATIONS

River transport will permit the shipment of mineral products and other local goods. However, its economic performance must be considered at the regional and multi-sectorial scale.

Adopt a common vision between the ports of Saint-Louis and Dakar

This common vision is vital to ensure synergy between the supply of services and to generate the added value of this project to distinguish it from other ports and rivers. Account must be taken of the fact that, globally, there is a two-fold phenomenon of ports grouping together – to be more competitive and invest in new terminals – and of the concentration of shippers. The river-maritime transport market is complicated.

Perform operational benchmarking at regional scale

It was also recommended to integrate the project in the events occurring around it at the regional scale, and to set up operational benchmarking of competing projects (other port developments).

Establish the operational strategy of intermodal networks and think on the scale of all the infrastructures

The SITRAM plans the construction of river and road infrastructures. They must be operated in coordination and in synergy, to ensure transport and the flow of traffic (goods and passengers) in the Senegal River basin, under the best conditions of safety and cost. This requires an overall operational strategy that takes into account the infrastructures (ports; dams; mining sites and agricultural centres, etc.), the transport routes to be built (waterway; road; railway) and the strategic objectives of improving access in the basin.

In the same frame of mind, the synergy between the river and hydraulic infrastructures should be emphasised. Ensuring navigation on the river will require a minimum volume of water to ensure the necessary draught in the channel, whatever the rainfall conditions. Thus the construction of a dam at Goubassy (Mali) is vital, in addition to the existing dam of Manantali.

“ In so far as the Goubassy dam will allow regulating 75% of the river water and providing an additional third in volume, building this dam should be given as much attention as the navigation project itself. ”

KABINÉ KOMARA,

INTERNATIONAL CONSULTANT, MEMBER OF THE INTERNATIONAL ACTION COUNCIL

Explore the potential of river tourism

It will generate economic spinoffs and participate in the project's innovative nature.

Start works downstream

Regarding the phasing of the works, it is recommended to start at Saint-Louis, where the volume of material to be dredged is greatest. The construction of the port and the channel will permit generating the initial income.

Involve the future stakeholders of the waterway:
operators, shippers, industrial clients, mines,... from the outset.

Quickly select the operator(s) of the new developments

It is important to ensure the profitability of the infrastructures. The recommendation goes as far as making the start of the project coincide with the appointment of the operator.

It is critical to estimate the project's ROI (return on investment), as much regarding the economics involved as the social, societal and cultural dimensions. Whatever the case, a balance must be maintained between the economic and social dimensions, the return on investment and the general interest. This balance is essential for the project, given its nature and its ambition.

4. ENVIRONMENTAL RECOMMENDATIONS

Cattail is already a serious risk for the river and its uses and as yet no lasting means of destroying it or putting it to good use has been found. The navigation project must take the environment into account to avoid adding new pressures on an already fragile ecosystem. What impacts will the project have on water pollution, the proliferation of invasive plants and the circulation of fish, among other things?

The following proposals were put forward:

Explore new uses of typha

In France, in Montpellier, the Chemistry Bio-inspired and Ecological Innovations Laboratory (CNRS – University of Montpellier) works on the use of fibrous plants to hold back metal pollutions (eg: to clean waters from mining activities) or as a catalyst. Using typha as a means of metal depollution could be the subject of studies. In Benin, a company called Green Keeper Africa (GKA) is already marketing products made from the water hyacinth in order to retain hydrocarbons.

Conduct a strategic impact assessment regarding the ecological issues

An assessment of the ecoton, in the ecological transition zone between several ecosystems should be conducted.

Ask private companies to contribute to preserving the environment during every phase of the project

This affects construction companies, infrastructure operating companies; lessee companies in the enterprise zones and port sites. Companies could be asked to make environmental proposals and they could be made a selection criterion in calls for tenders and contracts. These measures to share out responsibility (e.g. the installation of sensors to measure water quality; the restoration of natural habitats, etc.) would benefit the territories and allow the OMVS to forego bearing full environmental responsibility in the framework of the project.

Implement a PhD exchange programme between universities to study this issue. Another solution would be to set up a local research unit by relying on local competences.

Anticipate the regulatory framework to apply with respect to the potential generation of pollution

Set up a water quality monitoring procedure

A plan to monitor the environmental impacts of dredging could be implemented. This entails the prior measurement of sedimentation levels at different points of the river's confluence to assess their quantity and transport. During the dredging phase to excavate the channel, it will be necessary to collect data and take measures adapted according to the origin of the sediments: soil erosion or organic pollution. Lastly, the quality of the water intended for human consumption and irrigation must be controlled continuously.

5. CULTURAL RECOMMENDATIONS

Going beyond the technical aspects of the project

There is a need to go beyond the issue of getting the population to not only accept the project but also to make it its own. Although the initial steps are of a technical nature, symbolic actions that involve the population are required to **write and tell a story** and give a global image of the project, strengthen its local acceptance and success through time, through full appropriation. For example:

- **Explain the dredging to the surrounding population;**
- **Assuage possible fears**, without talking about the urgency of the project but of the imperative need to carry it out;
- **Provide a new way of experiencing the river with a pilot boat** which would be an object of innovation in itself,

- **Identify communication relays:** can religious communities play a role in transmitting the message?
- **Use different resources to assist communication** (music; writing; a dynamic mock-up of the river to follow-up the progression of the project; “bush radio”; social networks; a travelling exhibition) to link different territories and identities.
- **Create a mobile dispensary** intended to treat the populations that could be reached via the river, in isolated villages and areas where infectious diseases are commonplace.

Strengthen the Africanicity of the project

Several proposals were made to develop the project’s societal and cultural dimensions, to go beyond the navigable channel and make it a global territorial development project:

- **Mobilise local competences** to carry out the technical works, by involving consultant engineers trained in Africa, whether for data collection and control or for determining cross-sections, represented by way of drawings and shared with the local populations;
- **Ensure diversity in the project organisation committee** and set up a support committee to give a sense of importance to all the stakeholders in this project for the future (women entrepreneurs; farmers; environmentalists, etc.). Whatever form it takes, a permanent body will be needed to bring the stakeholders together. Tamsir Ndiaye (SOGEM) also suggested representatives of civil society should be appointed to the decision-making committees.

6. ORGANISATIONAL RECOMMENDATIONS

The territorial, financial and socioeconomic magnitude of the project requires **stable governance**. To ensure this, the following recommendations were proposed:

Use the Basin Committee and its different colleges (administrations; researchers; elected representatives; civil society) as the support for decision-making in the OMVS. The composition of the Basin Committee could be revised in order to include the river transportation dimension, by associating civil society representatives, administrations, port authorities, industrials, fishermen, etc.

Set up an international cooperation network to make the Senegal a river that extends beyond its banks and create cooperation between rivers.

Establish a framework plan for the entire region that persists despite political changes that would be implemented by a Commission with permanent posts.

Conclusions and outlook

To sum up, IFGR's recommendations can be described by the following active verbs:

KNOW through data, and the exchange of knowhow and practices

SET the pace so that the project is performed within a given time and is clear to all

MESH to make this project one of winning back the river and its banks and associate it with the populations, the countries crossed and beyond between Africa and the rest of the world;

AFRICANISE by opening up the project to African competences

GIVE LIVE: transform this project into an opportunity to strengthen the link between the river and the people, and the river and biodiversity

... and they will be taken into account by the OMVS for its road map, as underlined by Hamed Semega, when thanking IFGR's members for their *"remarkable contribution to improving the structural navigation project on the Senegal River"*.

On its part, IFGR proposed to continue this collaborative work during the preparatory phases of the project and its launch.

This collaboration, which mirrors IFGR's method of working, could also be presented at the next World Water Forum. This is in line with the call made by Mansour Faye.

“ Regarding the outlook, Dakar will host the World Water Forum, so it's necessary to develop the question for which pertinent results will be presented in 2021. Whereas the Marseille Forum was a Forum of solutions, we want the Dakar Forum to be one of results. I hope you will join us in obtaining them. ”



APPENDICES

Appendix 1

The OMVS: a single body of governance and a model of integrated management

The Organisation for the Development of the Senegal River (OMVS) was founded in 1972. It is the result of long discussions between the States crossed by the river on its navigability, though the severe droughts that hit the region in the 1970s accelerated its evolution. Managing the resource therefore became an essential goal for the population and ecosystem, making cooperation between governments vital.

The OMVS is therefore a political and institutional response to the vulnerability of the member States (Senegal, Mali, Mauritania and Guinea) in the face of climatic fluctuations, and a lever for economic development and a tool of regional solidarity.

ITS OBJECTIVES

The OMVS was founded with three basic principles: the river and its tributaries are international property; their resources are exploited mutually and fairly; all the structures are the common property of the States. Cooperation and integration are therefore the two strong values of this intergovernmental organisation.

It has 5 main objectives:

- **Attain food self-sufficiency** for the population and the basin and the sub-region;
- **Secure and improve the incomes of the basin's inhabitants** and of the neighbouring areas;
- **Ensure ecological balance in the basin** and encourage its presence in the Sahel region;
- **Make the economies of the member States of the OMVS less vulnerable** to climatic conditions and external factors;
- **Accelerate the economic development** of the member countries by promoting regional cooperation and exploiting the basin's hydroelectric potential.

1986

building of the
dam of Diama

1988

building of the
dam of
Manantali

The approaching desert and a discharge with very marked seasonal variations quickly led the authorities to reflect on optimising the river's hydraulic potential and drawing up an ambitious overall development plan to combat climatic events. Its integrated development programme, based on controlling the river's water resources, was formulated on the basis of building two main structures: the multipurpose regulation dam of Manantali (1988) and the anti-salt dam of Diama (1986) in the delta. The combined functions of these two structures should permit the joint production of hydroelectricity, the irrigation of farmland and navigation.

Over time, the OMVS has become a world reference. In 2016, it was named the best basin organisation in the world for the quality of its programmes and its model of shared water management in the framework of community cooperation. In addition, it ensures the permanent secretariat of the African Network of Basin Organisations.

Presentation of the Senegal River

The Senegal River flows east-west along 1,790 km. Its source is the confluence of the Bafing, the "black" river, which flows from Fouta Djallon at an altitude of 800 m (Guinea), and the Bakoye, the "white" river whose source lies on the Mandingue plateau. Its main tributary is the Falémé, which drains the entire eastern part of Senegal.

The river basin covers 337,500 km² and more than 800,000

ha of arable land. It is divided into three main parts: the Upper Basin, the Valley and the Delta. The average rainfall on the basin is 550 mm/year with considerable differences between the Upper Basin (the Malian and Guinean parts of the basin) with a rainfall of about 1,500mm/year and only 200-

250 mm/year in the Lower Valley (the Senegalese and Mauritanian parts of the basin). In addition to the climatic contrast between the Upper Basin and the Lower Valley, another characteristic of the rainfall in the Senegal Basin is its considerable intra-seasonal and inter-annual variability.



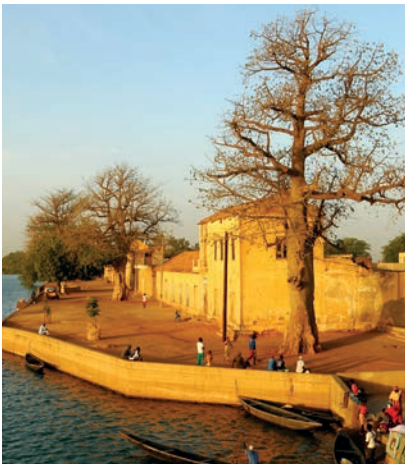
ITS ORGANISATION

The OMVS is composed of several bodies:

- **A Council of Heads of State and Government**, currently chaired by Mr Macky Sall, President of Senegal;
- **A Council of Ministers**;
- **A High Commissioner**, who coordinates the road maps drafted by the Heads of State and the Council of Ministers.

Consultative bodies are called on to support these main bodies:

- **Consultative bodies are called on to support these main bodies**: gathers the representatives of local authorities, civil society and the scientific community;
- **The Permanent Commission on Water** in charge of water resource allocations as a function of use: energy production, crop irrigation, and navigation;
- **The Regional Planning Council**.



Lastly, specialised agencies called management companies implement the decisions made. They fall under the authority of the OMVS but have their own management structures (Management Board, Senior Management, General Assembly of shareholders):

- **The SOGED** (Diamas Dam Management and Operating Company);
- **The SOGEM** (Manantali Energy Management Company) responsible for operating the dam and the plant, and transporting electricity. It has set up a subsidiary, SEMAF, dedicated to harnessing the energy of the Manantali and Félou dams, which it manages.
- **The SOGENAV**, for river navigation;
- **The SOGEOH** (Upper Guinean Basin Structure Management Company), founded in 2017 to develop energy production in the Upper Basin.

Appendix 2

A river and its uses

IRRIGATION

Agriculture is one of the most important economic activities in the river basin and potential remains for development, especially in Senegal. It currently occupies half of the country's population and contributes 10% of its gross national product.

The Senegal River Valley therefore plays a decisive role in satisfying national food demand, the export of agricultural products and generating jobs for the young and women.

Three types of agriculture are practiced:

- **Rain fed agriculture** in the Upper Basin (maize, sorghum, water melon, etc.)
- **Flood recession agriculture**, a traditional method still employed by more than 40,000 families at present. Flood control has reduced the importance of this practice which involves a wide variety of crops: maize, aubergines, tomatoes, pumpkins, rice, etc.
- **Irrigated agriculture**: the surface areas farmed in the 4 countries are estimated at about 130,000 ha, i.e. 60% of the surface area developed in the basin. They are used for cereals (including rice) and horticultural production (onion, tomatoes, etc.).



Besides agriculture, two other economic activities can be found in the basin:

- **Livestock breeding**, whose development is a means of combating poverty. It currently employs 60% of the rural population in each of the neighbouring countries, while its contribution to GNP varies from 4 to 12%.
- **Fishing**, which is practiced in the main channel, the tributaries and flooded pools of the river. Fish production varies from 26,000 and 47,000 tonnes per year, making it one of the most important activities in the basin.

DRINKING WATER



The construction of the Diama dam has permitted the supply of the towns located in desert and semi-desert areas with drinking water throughout the year. The river supplies almost 100% of the drinking water of Nouakchott, 200 km away, and 50% of Dakar's

The river supplies
50%
of Dakar's
water needs.

water needs. Before, during the dry seasons, salt intrusion from sea water could infiltrate up to 200 km upstream of Saint-Louis, which obviously led to shortages of freshwater for domestic and agricultural uses, among others.

The challenge of freshwater nonetheless remains poignant, with the salinization of freshwater close to the coast and the proliferation of cattail. Some regions, like that of Matam (west Senegal), suffer from several sources of instability, including food insecurity. Access to drinking water in these areas is there a vital issue.

ENERGY

Very early on OMVS wanted to develop the basin's hydroelectricity potential, to aid industrial development and reduce the energy deficit of the member countries.

Two hydropower development schemes were built: **Manantali** (2002) and **Félou** (2013), with an installed capacity of 260MW and an average output of 1,100 GWh/year, distributed to all the countries via a grid of 1,300 km of power transmission lines.

To satisfy energy requirements, which will double from now to 2025, the OMVS aims to commission new plants (Gouina, Boureaya and Goubassi) to reach more than two thirds of the total available hydroelectric capacity of the basin and store nearly 23 billion m³ of water to control the discharges of the river and its tributaries.



Appendix 3

The contribution of the Dama dam to the development of water use

SOGED was founded in 1997 and is responsible for operating, maintaining and renovating the Dama dam, the water intakes, levees and other associated structures.

This dam, built in 1986, fulfils an essential function, that of **preventing salt intrusion in the river and making the formerly saline land** of the delta fit for agriculture. It was transformed into a **reservoir dam** (from 250 to 535 million m³) by the construction of levees and it now permits the partial regulation of the water level in the delta and the reduction of pumping heights for irrigation. It provides water for the irrigation of 50,000 ha of flood recession crops, and, linked with the Manantali dam, 375,000 ha for extensive farming. In addition to the cultivated land, it has allowed the diversification of crops and methods in the agribusiness sector.

Among the other benefits provided by the dam are:

- **Drinking water supplied throughout the year** and the supply of freshwater in sufficient quantities for domestic consumption and for the mining industry.
- **Navigation:** the dam has enabled better management of the flow required for boats to navigate on the river, and it is equipped with a lock.
- **The revitalisation of ecosystems** (with in particular Djoudj nature reserve) and the recharging of local aquifers, although the dam has given rise to other environmental impacts such as the proliferation of cattail.





The Djoudj

Composition of the rivers Committee

Ricardo Javier Álvarez

Vice-President of the Argentine subsidiary of the Spanish American Maritime Law Institute (IIDM) and legal coordinator of Hidrovías of Latin America.

Pascal Bourdeaux

Historian, Associate Professor at the Ecole Pratique des Hautes Etudes (Religions of Southeast Asia).

Corinne Castel

Archaeologist, CNRS Director of Research, Director of the Franco-Syrian Archaeology Mission of Al-Rawda, belonging to the laboratory "Archéorient. Environnements et sociétés de l'Orient ancien" of the Maison de l'Orient et de la Méditerranée (MOM).

Julien Clément

Doctor of anthropology, Deputy Director of the Research and Education Department of the Musée du Quai Branly Jacques Chirac.

Daniel Dagenais

Vice-President of Operations of the Montreal Port Authority.

Katherine Daniell

Doctor of Water Science and researcher at the Australian National University, member of the National Committee on Water Engineering (Engineers Australia); specialist in water governance and participatory processes.

Bernd Gundermann

Architect, founder and Director of the Urbia-Group – Think Beyond.

Mohammad Mozammel Haque

President of the Bangladesh Inland Water Transport Authority (BIWTA).

Mirdad Kazanji

Director of the Pasteur Institute of Guyana.

Sergio Makrakis

Associate Professor and researcher at the University of the State of Western Paraná - Unioeste (Brazil); specialised in evaluating the impacts of fish passes on migrating fish.

Ghislain de Marsily

Emeritus Professor at Sorbonne University (Paris VI-Pierre-et-Marie-Curie) and at the Ecole des Mines de Paris, member of the Academy of Sciences.

Gilles Mulhauser

Managing Director of the Water Agency of the State of Geneva, Switzerland.

Tamsir Ndiaye

Managing Director of the Manantali Energy Management Company (SOGEM-OMVS).

Kabiné Komara

International consultant, member of the International Action Council.

Erik Orsenna

Economist, author, member of the French Academy and specialised in sustainable development, the environment, agriculture and emerging economies.

Irina Ribarova

Professor at the UACEG (University of Architecture, Civil Engineering and Geodesics, at Sofia, Bulgaria); expert in the integrated management of water resources and the circular economy in the sector of water.

Papa Abdoulaye Seck

Minister of Agriculture and Rural Facilities of Senegal.

Hamed Diane Semaga

High Commissioner of the Senegal River Development Organisation (OMVS).

Alfredo Sese

Technical Secretary for Transport and Infrastructure at the Rosario Stock Exchange (BCR).

James Spalding Hellmers

Paraguayan Managing Director of Itaipu Binacional.

Yangbo Sun

Director of International Cooperation of the Yellow River Conservation Commission, Ministry of Water Resources, China.

Marie-Laure Vercambre

Director of the Water for Life and Peace programme, Green Cross International.