The Future of the Senegal River Basin

Making the Right Decisions Now

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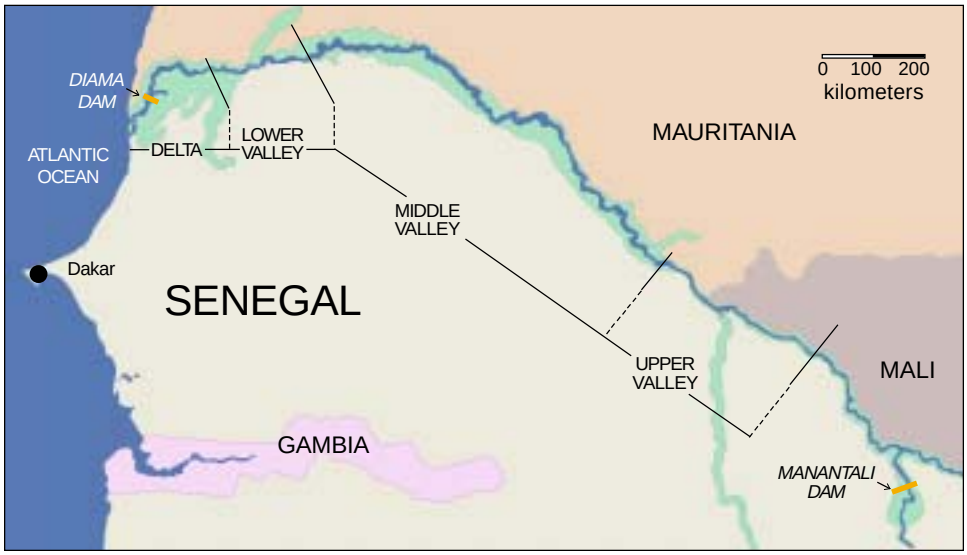
Water, absolutely essential to the well-being of everyone in the world, is no longer seen as a free and renewable resource, but as a limited and often scarce good, with diverse interest groups competing over its control. These groups include hydroelectric power producers; agricultural interests that seek water for irrigation; environmentalists who view water as essential for biological diversity; inland transporters; and recreation interests. Each group seeks support for its position from governments and development institutions responsible for making decisions about water uses. Consequently, the actual management of water resources often reflects which groups have most successfully influenced decision makers.

But in the Senegal River basin there is another group, a much larger group that often has been overlooked in making decisions on water use: those whose lives depend on the natural flow of unpolluted rivers—small-scale farmers, fishers, herders, and foragers. More than ever before, farmers, fishers, and herders have the chance to influence the way the dam-controlled river is managed. Never before has there been such a need for their voices to be heard.

Studies completed over the last several decades have demonstrated the critical *economic* importance of traditional production systems in the middle and lower valleys of the Senegal River. Other studies have shown that there need not be an inherent incompatibility between maintaining the environment on which those systems depend *and* providing adequate water for irrigation and hydroelectric power. Now is the time to get *all* of the interest groups together to work out a plan to optimize water use in the Senegal River valley.



Map by Teressa Heywood and John Magistro

Background

In response to the historic droughts of the early 1970s, the governments of Senegal, Mauritania, and Mali searched for ways to improve management of water resources in the region. The three governments created the Senegal Valley Development Authority (Organisation pour la Mise en Valeur du Fleuve Senegal [OMVS]) to oversee river basin development planning and implementation. Extensive investments in water management were made, in particular through the construction of the Manantali Dam on the Bafing River in Mali and the Diama salt-intrusion barrage between Senegal and Mauritania near the mouth of the Senegal River. The dams were built in the 1980s to expand irrigated farming along the Senegal River and in the delta, generate electricity for urban and industrial development, and make the river more navigable.

Nearly 30 years later, water management in the basin has changed dramatically and irrevocably. Enormous efforts have been made by the governments in the region and their partners. Some of these efforts have paid off in improved livelihoods. Others have failed. Today, new investments worth hundreds of millions of dollars are poised to further influence the well-being of those who live in the basin.

Within the next year or two, a Water Charter will be established to govern how the Senegal River's water resources will be used in the future. This booklet provides information to facilitate an open and informed discussion on the future of the Senegal River basin. A great deal of effort has been spent gathering information about options for river management. Too often, however, debates over these options have taken place in distant cities among people who do not represent the full range of stakeholders. And not all of the existing information has been used to the full extent possible. The process of optimizing the water resources of the basin will work only if everyone concerned—from government planners to the rural people who live and work in the basin—has access to the information generated in earlier studies and takes part in the decision-making process.

Why Has USAID Published this Booklet?

The U.S. Agency for International Development (USAID) has been supporting and assessing development in the Senegal River basin for more than 20 years. From the initial environmental impact assessments in the 1970s, through the resettlement process in the 1980s, to the in-depth studies of the changed water regime in the early 1990s, USAID has been committed to improving the lives of the basin's inhabitants. Now, as decisions are being made that will affect hundreds of thousands of people for decades to come, USAID wants to help minimize further problems. By sharing the information in this pamphlet broadly, USAID hopes that decisions about the Senegal River basin's future will be made in a participatory and well-informed fashion.

Learning from the Past to Benefit the Future

Before the dams were built and the water flow changed, a different economic system reigned in the Senegal River basin. Is there anything we can learn from the past that might help us in deciding how to handle the future? Indeed there is.

Before the dams were built, in years of normal rainfall, hundreds of thousands of hectares of cultivable land on the fringes of the river in Mauritania and Senegal were flooded. At the end of the rainy season, the huge flow from the Senegal's tributaries, coming together at Bakel, flooded the riverbanks, recharging aquifers and enriching the flood lands with nutrient-rich silt. The floods provided soil moisture for wild plants. Farmers grew cereal grains in the flood-watered soil. And families tapped the easily accessible water table to irrigate small vegetable gardens, which became important sources of household nutrition and income.

This low-cost production system supported a larger population of humans and animals than is normally possible in a semi-arid environment. In all likelihood, this was the system of production that the Andalusian historian al-Bakri described 1,000 years ago. Despite more than 10 centuries of continuous use, it continues to this day to produce crops with no evidence of soil degradation.

The Annual Cycle Before The Dams

The annual floods were the basis for a succession of productive activities. During the brief rainy season from June to September, farmers planted millet on the sandy slopes above the floodplain. Yields were modest, but demands on labor and capital were low. Herders moved their livestock away from the river and the millet fields to more remote pastures. These rain-fed pastures, however, could not of themselves support large herds. When the millet was harvested in September, herders moved their animals onto the grain fields to browse the stubble and fertilize the land. Relations between farmers and herders were generally amicable, since their activities supplemented one another's diets with grain, meat, and milk.

Near the end of the rainy season, the rising waters of the Senegal River found breaks in the levees and, in a good year, inundated as much as 400,000 hectares of land. These flooded plains, enriched with dissolved surface nutrients, became a refuge and breeding area for small fish. Before the dams, 10,000 full-time and many part-time fishers caught as much as 30,000 metric tons of fish annually in the river and on the floodplain, providing local villagers with a major source of protein. Average annual fish production on the floodplains was 70 kilograms per hectare, providing a resource valued at 70,000 FCFA per flooded hectare.

As the waters began to recede in October, farmers planted sorghum and cowpeas in the floodplains and maize and sweet potatoes along the newly exposed riverbank and levees. The crops matured in three to four months, drawing only on soil moisture.

In February and March, the harvests in the plain and along the riverbank marked the beginning of the hot dry season, when livestock were most stressed, having exhausted both the natural pastures and the rain-fed crop stubble. During the dry season, cattle, sheep, and goats moved onto the floodplain, browsing sorghum stubble and wild plants in uncultivated areas. This access to the floodplain allowed for much larger herds than could be sustained by rain-fed herbage alone.

The annual flooding cycle also supported thick stands of *Acacia nilotica* trees and a rich and diverse wildlife. In addition to being the major source of fuel in the middle valley, the acacia trees supplied vast quantities of charcoal that, despite prohibiting regulations, supplied urban areas such as Dakar. The tree's dense water- and termite-resistant wood was used in construction. Livestock browsed the pods, and local people used the tannin in the pods and bark to tan hides. Near the mouth of the river, the brackish delta waters housed the Djoudj wetlands, an internationally renowned sanctuary for storks, pelicans, and other migratory birds.

Why Were the Dams Built In the First Place?

In 1972, Senegal, Mali, and Mauritania organized a river-basin authority to oversee construction of the Manantali and Diama dams. The dams were built to:

- Generate 800 gigawatt-hours of electricity per year;
- Increase the amount of area irrigated by pumps in Mauritania and Senegal from less than 50,000 hectares to 375,000 hectares; and
- Provide landlocked Mali with direct access to the sea by maintaining a minimum constant flow of 200 cubic meters per second, building a boat lock and port, and deepening the river.

Together, these three objectives were to have achieved the broader goal of improving the livelihoods of people living in the basin. In addition, they were to have benefited people outside the region with electricity, increased agricultural production, and access to the sea.

These objectives, however, are still far from being realized. Today, the flow of the Senegal River is regulated primarily to serve the interests of irrigated agriculture, since the electric turbines at Manantali are not yet working. Water release from the dam has been haphazard, at least from the perspective of those who live in the valley. One thing is clear, though: The annual floods that formed the basis of a productive pre-dam system have been significantly altered.

Winners and Losers

Thousands of days of work and billions of FCFA have been invested in development plans for the Senegal River basin. Clearly, the landscape of the basin has changed forever. It is neither possible nor feasible to return to life as it was before the dams. And yet there is still need for improvement.

After so much hard work by so many people, it is important to distinguish between the successes and the failures of the efforts. Only with a frank and informed assessment of where we are today can we know where we want to go tomorrow.

On the whole, less has been achieved than had been hoped for. As of the end of 1999, the electric power turbines had not been installed at Manantali. Under current plans, the power that is eventually generated will be exported from the valley to larger cities. Irrigation has been costly and far below levels anticipated. And not a single vessel has passed through the boat lock at Diama since it was completed in 1986. But let us look more closely at the repercussions felt throughout the basin.

The Amount of Food Produced In the Basin Has Declined

Since the dams were finished a decade ago, useful floods have occurred only rarely, and irrigated farming has expanded only modestly, with far higher costs and lower yields than had been anticipated. Consequently, food production in the Senegal River valley has declined. Increasing numbers of young men have emigrated to seek jobs in Senegal's cities, other West African countries, and Europe and North America. As a result, the burden of agricultural labor is increasingly borne by women, children, and the elderly. Many households now depend on remittances from absent members to buy food they no longer produce. The resultant decline in nutrition has left the population even more vulnerable to respiratory and parasitic diseases.

The Costs of Irrigated Perimeters Have Exceeded Their Benefits

To date, irrigation in the Senegal Valley has not performed well. Constructing perimeters is costly. Maintaining them—for example, pump and canal repair and land leveling—translates into high recurrent costs. After several years, yields commonly decline because of salinization, which results in the phenomenon known in the valley as *irrigation itinérante*—farmers abandon recently constructed perimeters and settle on new ones.

Clean, Drinkable Water Is Harder to Find

Because of reduced flooding, shallow aquifer recharge has declined and wells have dried up. Some people are forced to travel long distances to draw water directly from the river and marigots, with attendant health and sanitation risks. Others have expensive boreholes drilled to tap the deep aquifer. Providing several hundred thousand middle valley residents with new, safe, and reliable sources of potable water will be costly.

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Disease Is Increasing

Parasitic diseases in the valley—schistosomiasis, malaria, and Rift Valley fever—have reached epidemic proportions because the changed ecology of the basin provides ideal habitats for snails and mosquitoes. Before the dam was built at Diama in 1985, no cases of schistosomiasis were reported at Richard Toll, the largest irrigated region along the river. Because the upstream movement of saline water is blocked, the snails that host schistosomiasis parasites now thrive in the salt-free river and irrigation canals. By 1987, 80 percent of stool samples were showing infection with intestinal schistosomiasis, a particularly debilitating form of the disease.

People Have Been Forced from Their Land

Dam construction forced the displacement of 10,000 villagers in the valley. Malian Malinke and FulBe agropastoralists were forced from their homes and farms upstream from the Manantali Dam, where an 11 billion cubic meter lake has formed. They were resettled onto lands downstream from the dam and in new villages along the rocky margins of the reservoir. At present, the relocated population is as poor as it was before the move, if not poorer. Although a USAID-supported effort did an exemplary job in getting the resettled involved in selecting new village sites, some people worry that the new lands will prove inadequate for livestock and proper fallowing. There is also concern that conflict will arise between the resettled and host populations over access to land.

Downstream, smallholders have lost their land and trouble has flared over land. Non-valley natives in Mauritania, anticipating large external investment in irrigated pump schemes on the floodplain, obtained control over riverine land by evicting the smallholders who had been living on it, forcing at least 70,000 people to cross the river into Senegal, where they live in precarious conditions in camps.

Social Cohesion Has Suffered

Social relations are never static. As time passes, an inevitable evolution of groupings takes place. This certainly has been the case since the dams were completed. Those ethnic groups and countries best able to take advantage of irrigated farming and changes in land value have done so. For them, the dam investments have been a success. But looking at the region as a whole, it is hard to argue that the dams have advanced social cohesion. On the contrary, as the overall productive capacity of the floodplains has declined, formerly amicable relationships among ethnically distinct farmers and herders have become contentious, as groups are forced to compete for access to scarce resources. In a number of instances, competition has escalated into violence. Where the flood had made possible a succession of mutually reinforcing productive activities—fishing, herding, and farming—the absence of useful floods generates social conflicts that are too readily, and mistakenly, interpreted as reflections of ancient tribal tensions.

People in the Basin Generally Earn Less Than Before

Each effect noted above captures a dimension of the change that has occurred in the region. In the end, perhaps the most important criteria for assessing the change is the overall change in household incomes. USAID's research in the Senegal River valley on the economic value of the traditional production system demonstrates that the succession of flood-recession farming, herding, and fishing generated an economic return that surpassed the returns from irrigation, when all the costs of land, labor, and capital are taken into account. The average annual value of output per hectare of inundated floodplain was 28,550 to 57,434 FCFA for recession cultivation of sorghum, 70,000 FCFA for fish, and 35,000 FCFA for livestock, totaling 133,550 to 162,400 FCFA (in post-1994 francs). Irrigation, even if double-crop irrigation were sustainably carried out on the floodplains, has not proven capable of providing this level of net returns to individual farming families. Indeed, World Bank studies show traditional production systems to be more economical than electrical power production.

What Can Be Expected If the Current Water Management Regime Is Continued?

Hundreds of research reports and studies have made one thing clear: Without re-instituting some form of controlled annual flooding, one or more of the following will likely occur:

- Further declines in soil productivity because of the lack of silting and drops in annual inundation;
- Increased incidence of water-borne diseases;
- Accelerated emigration from the region, especially of young men, which will increase the workload of women, children, and the elderly;
- Declines in the productivity of fisheries and livestock; and
- Deforestation, loss of wildlife, and continued lowering of the water table.

The precise impact of the various water use scenarios for inhabitants of the river basin will not be known for certain until the debates over the different options are resolved. For a variety of reasons, it has been difficult for planners to appreciate the value, importance, and complexity of long-established riverine production systems. One reason is the development field once worked from a model that emphasized large infrastructure projects designed to "regularize" water resources. This model was in place several decades ago when the dams were planned and constructed.

The fact that governments in the Senegal River basin are now considering flood restoration within the context of multiple-use management is a step that deserves the support and informed assistance of all stakeholders. Combining the annual flood model with the "regularizing" model is a difficult task, however, since the two appear contradictory at first glance. Without experience or models to follow, saving the Senegal River basin will take the imagination, hard work, and commitment of everyone involved.

What Impact Can Be Expected From the Power Project?

Complicating the decision-making process is the fact that the power project now being implemented is an effort by governments to generate revenue from a costly, existing dam. The known costs and capacities of the Manantali Dam push planners toward an emphasis on hydroelectric power production. The dam operator, which will be a private contractor, will need to know how much water will be expected for power production in order to bid on the concessional contract. If the minimum power production level is set too high and not allowed to fluctuate based on a plan that optimizes multiple uses, downstream producers will see little or no flooding in most years. Under this scenario there will be a continuation, or even a worsening, of the adverse effects discussed earlier. Similarly, for energy consumers and taxpayers in the three countries, there will be costs and negative impacts if the size of an annual flood is "fixed" and water that could have been retained for electricity production is released onto the middle valley floodplains. Under this scenario, payments to the dam operator might be needed to maintain agreed-upon operator profits. These payments could result in a net revenue loss to national budgets and further weaken the financial stability of the national utilities.

To its credit, the power project has established an Environmental Impact Mitigation and Monitoring Program (Programme d'Attenuation et de Suivi des Impacts sur l'Environnement [PASIE]) charged with exploring and implementing options to minimize expected negative impacts. This program has an advisory council composed of regional and international experts, and one hopes that they will steer the program to address the concerns raised in this pamphlet.

The key to minimizing the negative impacts for all parties is to lay out all of the options and, in a participatory manner, devise a water charter and dam operating contract that minimize the costs and optimize the benefits for all concerned. This is why getting the management plan right is so important. The social, political, environmental, and financial implications for governments, taxpayers, traditional producers, energy consumers, and others are too high to adopt any plan that does not seek the optimal multiple-use course.

What Are the Options?

Long-term water flow data show that in most years enough water would be stored in the Manantali reservoir to create a continuous electric output of nearly 80 megawatts and a water flow that would be more than adequate for existing and future irrigation schemes. During "good" years, there would also be enough water to allow a controlled release that would inundate at least 50,000 to 100,000 hectares of cultivable floodplain, maintain the woodlands, and recharge the surface aquifer.

Meeting all water needs would be more difficult, however, during years of lower than normal flow. Taking the past as an average, approximately 3 out of every 10 years some give and take among the various water users will be required. And none of the uses may be attainable during periods of severe drought. Agreement on how to manage the reservoir during these critical years is the hardest—but also the most important—part of the planning and negotiation process that will take place over the next few years.

For the lower valley, epidemiologists have argued that manipulating reservoir levels and flow volumes could modify the environments favoring parasite reproduction and thereby reduce dam-inflicted disease. These epidemiologists support environmentalists who suggest that the Diama Dam be opened periodically to allow upstream migration of saline waters. Such actions could affect irrigation in the delta, but any losses must be weighed against the advantages of simultaneously reducing the incidence of schistosomiasis, restoring the Djoudj wetlands, and enhancing estuarine and offshore fisheries.

The challenge, however, is bigger than resolving hydrological equations—it is about giving all stakeholders a voice in the process.

In the Senegal River basin, the most influential groups for many years have been those concerned with hydropower generation and irrigation for large-scale agriculture. Small-scale farmers, fishers, and herders have been much less involved in the decision-making process. It's time for the hydropower and irrigation proponents to make these small-scale producers partners in the decision-making process.

Options for the Future

One option for the future is to maintain the current water regime—reduced, haphazard flooding, timed to serve the needs of irrigated agriculture only. Another is to proceed with the proposed energy generation plans. A third and related option is to institute a multiple-use management system in which the annual flood would be controlled to meet the objectives of energy production and the water requirements for the productive areas discussed earlier.

What Can Be Done?

Knowledge is power. A first step is to become better educated about the issues and options presented in this booklet. Sources can be tapped to get more information. As stakeholders become more informed and talk with one another, they will make their voices heard so that democracy can work.

Possible Questions for Discussion

Here are some questions that may be important in deciding the future of the Senegal River and the water management plan. They are only examples, but they may help facilitate debate on the plan.

- How will farmers benefit from the proposed water management plan?
- In how many years out of 10 is it estimated there will be a flood of at least 50,000 hectares?
- What are the incentives for dam operators to institute a controlled release of water?
- Who will determine whether a controlled release will occur? How will this decision be made?
- How will diseases like schistosomiasis be controlled?
- What are some of the demonstrable results from the Programme d'Attenuation et de Suivi des Impacts sur l'Environnement?

Notes

United States Agency for
International Development