



# AN ALTERNATIVE FOR MANAGING TROPICAL FLOODPLAIN RIVERS

by *Michael M Horowitz*

In 1993, major floods from the upper Mississippi and Missouri rivers—among the most heavily dammed, levied, locked, and diked fresh water streams in North America—generated critical rethinking about the costs and benefits of attempting to control a river’s natural flooding.<sup>1</sup> Beginning with the building of the Hoover Dam on the Colorado River in the 1930s, construction of large impoundments (those that raise water levels 15 meters or more) has mushroomed, first in the industrial world and then, as suitable unexploited sites in these countries became scarce, in the developing world.<sup>2</sup> Today, there are more than 40,000 of these structures in the world.

Providing what seemed to be technological triumphs over uncontrolled nature, the dams initially enjoyed excellent press. Woody Guthrie, the most socially conscious of U.S. poets in the mid-20th century, wrote:

The world has seven wonders  
that travelers always tell;  
Some gardens and some towers,  
I guess you know them well.  
But now the greatest wonder, in  
Uncle Sam’s fair land;  
Is the keen Columbia River and  
the big Grand Coulee Dam.

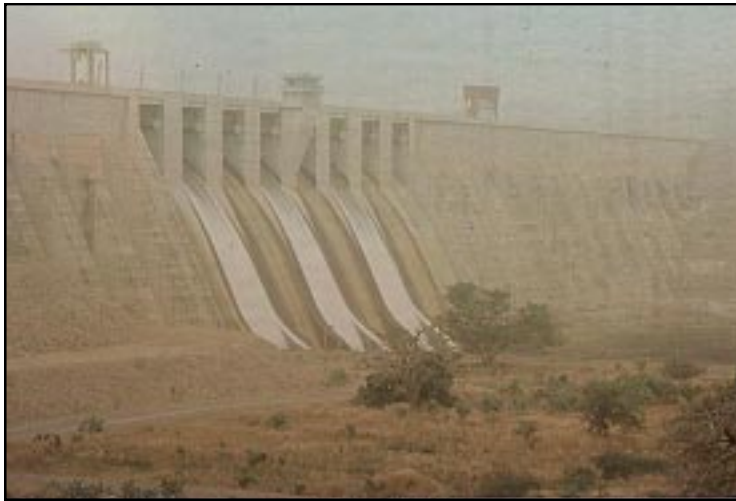
Informed by the economic depression and the midwestern Dust Bowl of the 1930s, Guthrie enthusiastically em-

**Dams initially  
enjoyed  
excellent press**



Irrigation scheme on the Senegal River

braced the expansion of hydroelectricity in both rural and industrial sectors because of its potential to create employment and improve the quality of life for the poor. The only major challenge to dam construction on the Columbia River came from Native Americans. They correctly feared devastating impacts on the salmon runs



Manantali Dam

Even advocates of dams do not agree on how the structures should be managed. Hydropower engineers tend to define water that does not drive a turbine as “wasted.” Irrigation specialists, seeking to raise downstream water levels to reduce the cost of pumping, may press for reservoir releases in excess of power-generating requirements. Transport engineers, though, maintain that the water in the main river channel should be retained.

None of these experts, including recreation advocates who seek to sail, ski, and fish the impounded waters, show much concern for the many people forced to move from the reservoir area or for the often far larger number of smallholder farmers, herders, and fishers *downstream* from the dams, whose production systems depend upon unimpeded river flows and periodic flooding. While the negative impacts of dams on the natural landscape and wildlife has received considerable visibility in recent years, and the World Bank and other development organizations have elaborated guidelines for relocation from the impoundment area, very little concern has been shown for the downstream inhabitants. This is a matter of enormous consequence, whose solution is often made more difficult by the transboundary nature of many large river systems: upstream countries build dams for power, irrigation, navigation, flood control, and

that were so important to their economies and diets. Engineers and politicians committed to dams dismissed this fear: fish ladders, they claimed, would enable salmon to reach their upstream spawning grounds.

## FROM ENTHUSIASM TO CONFLICT

The naive enthusiasm of the immediate pre- and post-World War Two period is gone. Today, river-basin development is a contentious issue.

**Downstream countries bear the costs of dam-altered flow**

recreation; downstream countries bear the costs of the dam-altered flow regime.

Within downstream countries, changed river flows have caused violent

costly demands for capital and labor. Ironically this sometimes forces wage labor migration from the labor-intensive irrigation area as laborers seek to earn money to support capital costs and to purchase food that is no longer farm produced.

## Changed river flows have caused violent conflicts

### Conflict between pastoralists and farmers

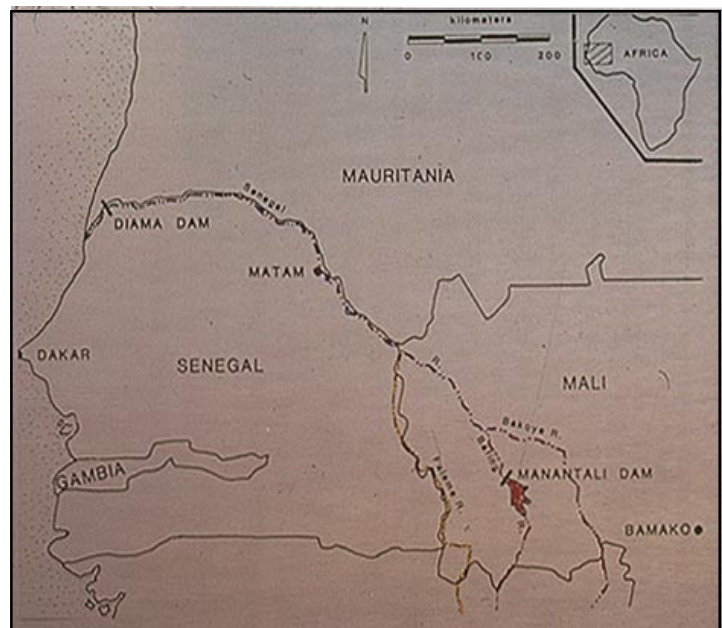
On 12 July 1992, a severe battle occurred between Fulani pastoralists from the village of Kher and Wolof farmers from the village of Ronkh in the Walo region around Rosso, Senegal. The Wolofs set fire to the village of Kher, and more than 40 people were injured and a similar number arrested. Even though tension between the two groups has a tribal basis, the core reasons for this particular conflict were issues around land tenure and the construction of a dam. (Ibrahima Traore. *Le cafard Libéré*, #236, 12 August 1992. Trans. from the French by Gnomou Yazon.)

### RESEARCH SOLUTIONS

**B**ASIS member, the Institute for Development Anthropology (IDA), undertook a multiyear study of the upstream and downstream impacts of the Manantali and Diama dams on the riparian peoples and their habitats in Mali, Mauritania, and Senegal.<sup>4</sup> With support from USAID/Dakar and USAID/Bamako, this research was carried out under the SARSA Cooperative Agreement (Systems Approaches to Regional Income and Sustainable Resource Assistance). The research demonstrated that the net

conflicts among peoples whose previous relationships were far less confrontational.<sup>3</sup> Herding and farming peoples, for example, who symbiotically exploited floodplain lands in calendric sequence, now are forced to compete for access.

While planners often argue that the transition from flood-recession farming, herding, and fishing actually increases the productivity of land, this productive gain is usually accompanied by more



**The unimpeded flow of the river makes possible a succession of food-producing activities**

returns to the producers from “traditional” flood-dependent farming, fishing, and herding, when *all* production factors—land, labor, and capital—were taken into account, far exceeded those from the irrigated perimeters which were supposed to replace them.



Local market selling produce from floodplain

With its annual flooding toward the end of the brief rainy season, the unimpeded flow of the river makes possible a succession of food-producing activities. When the fringing plains become flooded during the rainy



Sorghum harvest

season, farmers grow millet on sandy upland soils away from the valley. Herders are further away grazing their flocks on rainfed pastures. Fishers focus on the flooded plains, where smaller fish migrate for safety and food.

At the end of the rainy season, farmers harvest their millet fields and descend onto the plains and natural levees, where, as the waters recede, they plant sorghum, cow peas, maize, and sweet potatoes. As there is no more rain, these crops mature by drawing on soil moisture alone. Herders move their flocks onto the harvested millet fields in an exchange of manure for millet stalks. The attention of fishers moves to the river channel itself. When the flood-recession crops are harvested, the herders then move onto the floodplain, grazing the sorghum stalks and the rich grasses and shrubs that colonize unfarmed areas.

Thus, in a region of very low rainfall (as low as 200-300mm annually), a dense human and animal population was able to sustain itself for at least a millennium with no evidence of soil degradation. Farmers, herders, and fishers, ethnically distinct peoples, lived in mostly amicable symbiotic relationships.

## IMPACT OF DAMS

The Manantali and Diama dams were built with the ambition of generating electricity at 800 GwH/year, increasing the area of pump-scheme irrigation in Mauritania and Senegal from less than 50,000 hectares to 375,000 hectares, and providing landlocked Mali with direct access to the seas. This would be accomplished by maintaining a minimum constant flow in the main river channel of 200m<sup>3</sup>/sec, deepening the river, and constructing a port and boat lock.<sup>5</sup>

Yet, to date, no power has been produced at Manantali, irrigation has been costly and far below levels anticipated, and not a single vessel has passed through the Diama boat lock since it was completed in 1986.

Like similar structures on other tropical rivers that terminate or substantially reduce the natural annual flood, conventional management of the Manantali and Diama dams degrades the habitat and renders the traditional production systems unsustainable. This increases the dependency of the local populations on wage-labor migration, further burdening those, mainly women, children, and the elderly, who remain in the valley.<sup>6</sup> The Diama Dam, by blocking the upstream migration of saline waters for expansion of irrigation in the lower basin and delta, has contributed to an explosion of water-

borne parasitic diseases, including schistosomiasis, malaria, and Rift Valley Fever.<sup>7</sup> Because of this and the adverse nutritional impacts of the reduction in traditional food-production activities,

**Not a single vessel has passed through the Diama boat lock**



Diama Dam boat lock

the overall health of the riparian populations has seriously deteriorated.

Yet industrial and urban demands for cheap and reliable electricity must also merit response. Power produced at Manantali, once turbines and transmis-

## New approach to managing dam-regulated floodplain rivers

sion lines are installed, would go a long way to meeting these demands. Must there be a trade-off between the power-hungry urban and industrial sectors and the well-being of hundreds of thousands of riparian peoples whose production systems sustained them for a thousand years or more?<sup>8</sup>

### NEW APPROACH

Informed by studies from Asia, other parts of Africa, and South America, SARSA research generated a new approach to managing dam-regulated floodplain rivers in the tropics. Too often the conventional approach worsens living conditions for people both upstream and downstream from impoundments designed for hydropower, flood control, expanded irrigation, and navigation.

SARSA sought a nonzero-sum resolution to the controversy over river-basin development. The approach seeks socially equitable, gender sensitive, and environmentally sustainable means of achieving the purposes of large-dam construction without further impoverishing the vast majority of riparian peoples whose livelihoods depend on rivers' natural flows and silt transport regimes. The new approach suggests ways to reduce waterborne diseases that often reach epidemic proportions as a consequence of dam construction and expanded irrigation.

SARSA's hydrologic research proved that the Manantali reservoir contains enough water simultaneously to produce electricity at profitable levels *and* to allow for a controlled release towards the end of the rainy season which, added to the undammed flows from the river's other principal tributaries, replicating a natural flood, would support flood-recession farming, fishing, and herding on more than 100,000 hectares of floodplain in Mauritania and Senegal. Epidemiologists believe that periodically manipulating reservoir levels and allowing saline flows upstream from Diama would markedly reduce the insect and snail vectors that host disease pathogens.

A similar type of artificial flooding at the Glen Canyon hydropower dam on the Colorado River in the United States was carried out with stunning results. Ecologists are beginning to appreciate the contributions of flooding to maintaining the viability of riverain ecosystems. The research on the Senegal River proves that artificial flooding would maintain the downstream ecosystem (including afforestation of the important *Acacia nilotica* woodlands that fringe the river and recharge the shallow aquifer on which riparian villages depend for domestic water supplies) without undue costs in potential hydropower generated and permitting modest expansion of irrigation.<sup>9</sup>

## THE NEED FOR A STRATEGY

Although the Government of Senegal, through its Cellule d'Après Barrages, formally embraced the SARSA recommendations, they have not yet been adopted by the three-country Senegal Valley Development Authority that oversees dam operations nor by the World Bank which is to participate in lending for the

Fortunately, the hydropower components of the project have not yet been installed and there is still time for the affected countries and the donor organizations to commit to a dam management strategy that would transform the Senegal Valley from a disaster to a model for river-basin development in other parts of the tropical world.<sup>11</sup>



Flood land

turbines and transmission lines. Indeed, despite the fact that the dams were completed more than 10 years ago, and their consequences have included violent social conflict, sharply reduced agricultural productivity, adverse effects on woodlands and wildlife, massive deterioration of health and nutritional levels, and accelerated emigration from the valley, a senior World Bank official insists: “There is no question that the Manantali and Diama dams *have improved* the living conditions of the people of the Senegal valley.”<sup>10</sup>

The dams were built to insulate the region from the ravages of drought. To date, they have caused hunger, disease, environmental degradation, flights, and social violence. Properly managed, the Manantali and Diama dams could benefit the vast majority of the project-affected peoples.

Will the countries and funding organizations have the courage to institute an innovative management strategy that will achieve this objective?





## BASIS Briefs

### Author

Michael M Horowitz,  
Director, Institute for  
Development Anthropology.  
Professor and director,  
Center for Research in  
Environmental Systems,  
Binghamton University of  
the State University of New  
York.  
mhorowi@binghamton.edu

The author gratefully  
acknowledges the excellent  
research assistance of  
Allison Berland, intern,  
Institute for Development  
Anthropology.

### Other BASIS Briefs

Christopher Barrett and  
Michael Carter. "From Relief  
to Asset Building: Enabling  
Accumulation by Firming up  
Factor Markets."

Brent Swallow and Frank  
Place. "Tenure and Manage-  
ment of Tree Resources in  
Eastern and Southern Africa."

Publication made possible  
by support in part from the  
US Agency for International  
Development (USAID)  
Grant No. LAG-A-00-96-  
90016-00 through the BASIS  
CRSP. All views, interpreta-  
tions, recommendations, and  
conclusions expressed in this  
paper are those of the  
author(s) and not necessarily  
those of the supporting or  
cooperating organizations.

Edited and layout by  
Kurt Brown

BASIS Brief

## ENDNOTES

<sup>1</sup>Interagency Floodplain Management Review Committee. "Sharing the Challenge: Floodplain Management into the 21st Century." 1994. Report to the Administration Floodplain Management Task Force. Washington, DC: US Government Printing Office; Richard A. Haeuber and William K. Michener. 1998. "Policy Implications of Recent Natural and Managed Floods." *BioScience* 48(9): 765-772.

<sup>2</sup>Sub-Saharan Africa has almost 40 percent of the world's unexploited hydropower potential (Thayer Scudder. 1980. "River Basin Development and Local Initiatives in African Savanna Environments." In *Human Ecology and Savanna Environments*, edited by D.R. Harris, p.403. London: Academic Press).

<sup>3</sup>Michael M. Horowitz. 1989. "Victims of Development." *Development Anthropology Network* 7(2): 1-8.

<sup>4</sup>The most comprehensive report of the study is Muneera Salem-Murdock, et al. 1994. *Les Barrages de la Controverse*. Paris: L'Harmattan. IDA produced a documentary video on the research, *Large Dams and Small People: Management of an African River*. Summaries of the research findings are available from IDA in English, French, and Pulaar.

<sup>5</sup>Jean Albergel, Jean-Claude Bader, Jean-Pierre Lamagat, and Luc Séguis. 1993. "Crues et sécheresses sur un grand fleuve tropicale de l'Ouest Africain: application à la gestion de la crue du fleuve Sénégal." *Sécheresse* 4: 143-152.

<sup>6</sup>Michael M Horowitz and Muneera Salem-Murdock. 1993. "River Basin Development Policy, Women and Children: A Case Study from the Senegal River Valley." In *Women and Children First: Environment, Poverty, and Sustainable Development*, edited by F.C. Steady. Rochester, VT: Schenkman Books.

<sup>7</sup>J.P. Digoutte and C.J. Peters. 1989. "General Aspects of the 1987 Rift Valley Fever Epidemic in Mauritania." *Research in Virology* 140(1): 27-30; P. Handschumacher, J-P Hervé, and G Hébrard. 1992. "Des aménagements hydro-agricoles dans la vallée du fleuve Sénégal ou les risques de

maladie hydriques en milieu sahélien." *Sécheresse* 3(4): 219-226; W.R. Jobin. 1989. "Rift Valley Fever: A Problem for Dam Builders in Africa." *Water Power and Dam Construction* 41: 32-34; I. Talla et al. 1990. "Outbreak of Intestinal Schistosomiasis in the Senegal River Basin." *Annals de la Société Belge de Médecine Tropicale* 70: 173-180.

<sup>8</sup>In the mid-11th century, the Andalusian historian al-Bakri wrote that the inhabitants of what is believed to be the middle Senegal Valley "sow their crops twice yearly, the first time in the moist earth...during the season of the...flood, and later in the earth [that has preserved its humidity]." Abu 'Ubayd 'Abd Allah b. 'Abd al 'Aziz al-Bakri. 1981. Selections from *Kitab al-masalik wa'l-mamalik*. In *Corpus of Early Arabic Sources for West African History*, edited by N. Levtzion and J.F.P. Hopkins. Cambridge: Cambridge University Press.

<sup>9</sup>"On a retenu la situation de production avec une crue artificielle de 7 milliards de m<sup>3</sup> à Bakel, la plus contraignante pour les productibles... Tous les scénarios présentent une bonne rentabilité économique." Tractebel, Hydro-Québec International, Dessau, and Electricité de France International, *Projet Manantali Energie: Etude Economique Complémentaire de Réseau 225kV Associé à la Centrale. Rapport de Phase 3. Volume 1*. Washington, DC: The World Bank, Industry and Energy Department, 1991, pp. 2-3.

<sup>10</sup>Memorandum from the acting Vice President for the African region, Praful Patel, 25 June 1997, entitled "Mali/Mauritania/Senegal Proposed Regional Hydropower Project" (emphasis added).

<sup>11</sup>The Senegal Valley Development Authority has organized a "Programme d'Atténuation et de Suivi des Impacts sur l'Environnement (PASIE)" which is concerned with the social, environmental, and health impacts of the dams and associated works. With the support of the Government of France, it published *Etudes de l'Optimisation et la Gestion des Aménagements de l'OMVS*, January 1999. It is hoped that PASIE will confront the concerns outlined in this Brief.