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CASE STUDY

MAURITANIA: *MANAGED FLOOD RELEASES AND LIVELIHOODS - LOWER DELTA SENEGAL RIVER*

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MAURITANIA: *MANAGED FLOOD RELEASES AND LIVELIHOODS - LOWER DELTA SENEGAL RIVER*

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1. Introduction

Plans to control the floods of the Senegal River have been in existence since the nineteenth century. The Sahelian drought of the seventies incited the governments of Mali, Senegal and Mauritania to create the 'Organisation pour la Mise en Valeur du Fleuve Sénégal' (OMVS) and to proceed with the construction of two major dams (Fig. 1) in an attempt to develop irrigated agriculture, hydroelectric power and river navigation. The total cost of the dams is estimated to have been 600 million $US.

The first dam to be completed (in 1986) was the Diama dam, located 27 km upstream from St. Louis (Senegal). It was built to stop the dry-season intrusion of sea water. The impoundment reservoir became fully operational in 1992, after the completion of the embankment on the Mauritanian side.

The second is the storage dam at Manantali in Mali (completed in 1990) on the Bafing, the main tributary of the Senegal River (approximately 50% of the annual flow). The reservoir is theoretically capable of stocking 11 billion m^3 of runoff from the strongly seasonal rainfall in the mountains of northern Guinea. The water can then be gradually released over a longer period than the natural flood.

The two dams should provide enough water to achieve the following development objectives:

- irrigate 375,000 hectares of former floodplain, especially for rice production;
- produce hydropower (800 Gwh per year);
- make the river navigable all year round between Saint Louis at the river mouth and Ambibédi in Mali.

So far, less than 50,000 ha have ever been irrigated in any one year and, at 3 tonnes per ha, average productivity of paddy is 4 times lower than initially envisaged. With the phasing out of direct subsidies and indirect incentives, the rate of expansion of irrigated land and the proportion of land cultivated/fallow are decreasing on both banks (OMVS *et al*. 1998). In the absence of drainage systems, much of the deltaic lands became waterlogged or saline after only few years of irrigation.

Managed flood releases from Manantali have allowed traditional recession agriculture in the floodplains to continue to some extent, especially in the years of important natural floods (1988, 1994, 1995, 1999). This compensatory measure has attenuated the negative impacts of the dams on the quality of life of the traditional floodplain users, even though there have been some problems with double peaked floods (1989 and 1991) that washed away the first recession plantings. The artificial releases were expected to be rapidly phased out as irrigation would replace traditional uses. This not being the case, and with increased understanding - within the donor community and OMVS - of the economic, social and environmental benefits of the artificial floods, it is envisaged to the perpetuate the managed flood releases.

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Hydropower production was planned to be fully operational by 1992. A 200 MW plant has now finally been completed and Mali's capital Bamako is connected. The power lines to the other two capitals, Dakar (Senegal) and Nouakchott (Mauritania) are under construction. The economic viability of this sector seems assured. However, there are some reservations with regard to the availability of water for both hydropower and managed flood releases. In the decision-making body, the "Commission permanente des eaux" traditional users and the floodplain environment have no real representatives and it remains to be seen what decisions will be taken in case of water shortage.

Donor agencies have so far be reluctant to make available the investments sought by OMVS to improve the navigability of the river and to build the associated harbour infrastructure, even though the ambitions have been downscaled considerably.

In summary, there remain some outstanding issues with regard to the original objectives for the development of the Senegal valley. The traditional uses, dependent on the flood regime, such as recession agriculture, fisheries, livestock keeping, gathering and forestry have been curtailed and adverse socio-economic (Salem-Murdock *et al*., 1994; Adams, 1999), health (Verhoef, 1996) and environmental impacts (Hamerlynck *et al*. 1999a) have been substantial.

Within the context of this vast sectoral and centralised programme an ecosystem approach (Pirot *et al*. 2000) was tested in the Mauritanian lower delta since 1993 (Hamerlynck & Duvail, *in press*). Excluded from the Senegal River floods since 1991, the Diawling National Park and its surrounding area had been confronted with a spectacular collapse of productivity, the loss of most of its natural resources and the area was characterised by emigration, especially of able young males (Hamerlynck *et al.* 1999b). Through managed flood releases an attempt was made to rehabilitate the deltaic ecosystems (Duvail & Hamerlynck, *submitted*).

2. The ecosystem approach in the Mauritanian Lower Delta

In 1994 a multi-disciplinary team, composed of representatives of the local communities, National Park staff, sociologists, hydrologists, agronomists, ichthyologists, protected area specialists and ecologists made an assessment of the priorities of the local communities. To revive the traditional activities of fishing, gathering and livestock keeping it was decided to restore the pre-dam flood regime. Other needs expressed included drinking water supply and access roads. Hydraulic infrastructure had to be built to emulate the natural system by abstracting water from the Diama dam reservoir. Quantities taken are much smaller than the natural floods and therefore have to be temporarily contained in two basins. Once the flood is established they released downstream into an artificial estuary. Managed flood releases were tested in 1994 and 1995 and their livelihood impacts were assessed through in-depth interviews with the stakeholder groups. Research and monitoring were carried out by Park and project staff, in collaboration with local users and the Science Faculty of Nouakchott University. In 1996, the information thus gathered was synthesised into a management plan which was circulated among local partner institutions for comments, presented to a wide audience of stakeholders and government institutions and approved by the Ministry of Rural Development and the Environment in 1997 (Table 1).

As more and more hydraulic infrastructure became operational (completed in 1999) flooded area and flood height were progressively increased. Concomitantly, the income of fishermen and traditional gatherers/matmakers increased substantially and the number of livestock using the restored floodplains boomed (Duvail & Hamerlynck, *submitted*). The outmigration trend was inversed. Ecologically, the rehabilitation effort resulted in a revival of the mangrove and other characteristic vegetation (saltmarshes, floodplain grasses, *Acacia nilotica* woodland). Numbers of wild animals, most spectacularly migratory and breeding waterbirds, swelled (Hamerlynck *et*

al., in press). Problems were encountered with invasive aquatic vegetation, mostly because of inadequate emptying of the basins at recession, and with increased pressure from outsiders on the local resources.

<table>
<tr><th>Theme 1:
Restoration of the hydrological functioning and of the natural resources</th><th>Theme 2:
Management of the Diawling National Park</th><th>Theme 3:
Community development</th></tr>
<tr><td>1. Restoration of hydrological functioning
1.1 Establishment of a hydraulic calendar which allows ecological functions to reproduce the pre-dam situation
1.2 Improve the knowledge base on the hydrology of the Lower Delta</td><td rowspan="4">1. Optimise the Diawling National Park management
1.1 Restructuring of the DNP organisation
1.2 Establishment of field infrastructure, equipment and budget
1.3 Development of a detailed land use plan based on environmental values
1.4 Ensure Park surveillance and the protection of the natural resources
1.5 Develop internal communication (reporting, etc.)
1.6 Establishment of a technical and scientific council
1.7 Develop partnerships with research institutions</td><td>1. Strengthening traditional resource use practices that are compatible with ecosystem restoration
1.1 Improve the quality of the artisanal produce and its marketing
1.2 Improve horticulture and the marketing of the produce
1.3 Improve fish production and marketing</td></tr>
<tr><td>2. Restoration of the characteristic vegetation of the Lower Delta, dune fixation and protection of embankments
2.1 Restoration of the woody vegetation : floodplains, estuary, dunes
2.2 Restoration of the herbaceous cover : perennial, annual</td><td>2. Development of new activities compatible with the conservation of ecosystems
2.1 Ecotourism development
2.2 Development of hay production
2.3 Test small-scale aquaculture
2.4 Test beekeeping
2.5 Find a solution for the lack of vessels for fishing, transport and tourism</td></tr>
<tr><td>3. Restoration of the fisheries potential</td><td>3. Improve the quality of life of the local communities
3.1 Find an appropriate solution to the drinking water problem
3.2 Find an appropriate solution to the road access problem</td></tr>
<tr><td>4. Restoration of the ornithological values</td></tr>
</table>

Table 1 : Summary of the operational objectives of the management plan for the Diawling National Park and its peripheral area.

3. SWOT analysis of the application of the 12 principles of ecosystem management

1. The objectives of management of land, water and living resources are a matter of societal choice.

At the local level this was a strength of the project. The cultural diversity, the traditional rights and needs of various local user groups were taken into account. Local livelihoods, being virtually totally dependent on ecosystem productivity were largely compatible with the biodiversity targets set by the international community. Still, 'society' is a complex mix where choices and information flows are impeded by vested interests, governance issues, etc. Therefore a number of obstacles were encountered at intermediate societal levels, perhaps enhanced by the avant-garde nature of the approach.

2. Management should be decentralised to the lowest appropriate level.

This also was a strength of the project. The appropriate, and initially the only workable, level was dealing directly with the natural resource users and their traditional, informal organisations (twize, jeema, clan or tribe). The municipal council, the lowest formally elected institutional level was initially hostile to the project's approach. The council was a strong proponent of building a

dam on the planned artificial estuary for the development of 20,000 ha of irrigated rice on highly saline soils. Still, once the benefits of the ecosystem restoration approach were filtering through to the municipal council from the traditional user organisations, collaboration became possible. In general, decentralisation encounters a lot of obstacles of a similar nature as those listed under principle 1.

3. Ecosystem managers should consider the effects (actual or potential) of their activities on adjacent and other ecosystems.

Within the lower delta this was certainly a strength of the project. Strictly speaking, the project was concerned with the establishment of the Diawling National Park (16,000 ha), its management plan explicitly treated all areas that could be influenced by the flood releases (some 50,000 ha in the lower delta and the connected coastal lagoons to the north) and the adjacent drylands.
However, in the valley as whole the absence of ecosystem management and, therefore, the failure to consider effects downstream of the dams has been a major cause of the environmental and social disruption. More specifically in the lower delta, the whole restoration effort in the Diawling was necessary because the recommendations of the Environmental Impact Assessment of the Diama dam were not perceived as a priority, in comparison to the infrastructure needed for irrigated agriculture, and therefore not implemented. As long as highly centralised and sectoral management prevails in the valley this approach remains a threat to the valley ecosystems. It also implies that the outside pressures on the relatively small restored area can easily become exacerbated. The opportunity here is to apply the ecosystem approach to restore areas where irrigated agriculture has been attempted. If successful that model could, with local adaptations, be applied to the entire river valley.

4. Recognising potential gains from management, there is usually a need to understand and manage the ecosystem in an economic context. Any such ecosystem-management programme should:
   (a) Reduce those market distortions that adversely affect biological diversity;
   (b) Align incentives to promote biodiversity conservation and sustainable use;
   (c) Internalise costs and benefits in the given ecosystem to the extent feasible.

The principle is sound but the project did not have the capacity to apply it fully and therefore it is has been weakness. Building hydraulic infrastructure for an artificial wetland is an onerous undertaking and the recurring costs of operation and maintenance are not negligible. A high priority should be put on an evaluation of the extent to which the maintenance costs of the hydraulic infrastructure can be internalised (e.g. through access fees for fisherfolk, gatherers, livestock keepers, development of ecotourism, etc.). Considering the economic and social crisis the system was in at the start of the project, it would have been very hard to charge residents for activities they had always practised on communal lands now ‘privatised’ for conservation. In fact the joint management agreement is that local users, in exchange for their contributions to the development of the management plan (through their local knowledge) and their role in policing keep their resource use rights. Local tenure systems preclude physical land ownership but guarantee user rights to clans, tribes and other traditional organisations. Moreover, in a country of eminently nomadic traditions, distinguishing ‘local users’ from ‘outsiders’ might prove rather tricky with regard to the livestock keepers. Logically, most of the recurrent maintenance and monitoring costs should be borne by OMVS, as the causative agent of the disruption of ecosystems and livelihoods through the infrastructures they built and the way these are managed. In practice, because of the failure of most of activities of the organisation to generate a surplus, corrective or compensatory measures are cash strapped. In spite of the current shift in favour of the maintenance of artificial floods in the valley it is not unlikely that the expenditure priorities of the organisation will still be towards the realisation of its primary objectives. Making them aware of and committed to an ecosystem approach can be expected to be a long and

difficult process. At national level, the nursery function for shrimp, mullets and other exploited marine animals could justify central government support (e.g. through taxes, collected from fish product exports) for the maintenance of infrastructure.
At a broader level, had the principle be applied to the valley prior to the construction of the dams and had the true costs of the conversion to irrigated agriculture been internalised (using reliable hypotheses on productivity, etc.) – and had there been no economic crisis in the North favouring a less stringent evaluation of lending for large infrastructure whose cost-effective was doubtful – it is unlikely that the dams would ever have been built or at least that the sectoral approach of OMVS would have been acceptable. Economic valuation of the traditional floodplain uses might also have led to the conclusion that an integrated or ecosystem based approach, with an emphasis on strengthening traditional uses and a much more gradual, bottom-up introduction of irrigated agriculture, would have been a viable alternative.

5. Conservation of ecosystem structure and functioning, in order to maintain ecosystem services, should be a priority target of the ecosystem approach.

This was certainly a strength of the project. The whole management plan was constructed around functions, with the expectation that biodiversity would return under favourable conditions. This hypothesis proved correct but it should be emphasised that the estuarine ecosystems in a Sahelian context have few restricted range, highly specialised endemic species. In general, because of the high variability, the Sahelian floodplain and deltaic ecosystems are characterised by opportunistic and highly adaptable species. Therefore, in this case productivity (functional aspect) and biodiversity (structural aspect) are not contradictory.

6. Ecosystems must be managed within the limits of their functioning.

The cautious approach of the project, gradually increasing the height and duration of the artificial flood releases to observe the reactions of the ecosystems was a strength. However, in a society where water is in very short supply (Sahel droughts of 1972-73 and 1982-83) there is an obvious tendency to think that as much water as possible for as long as possible is the optimal management system. At recession, when the basins of the Diawling National Park should have been emptied, there were ‘pirate’ closures of the outflow sluicegates of one of the park’s basins, permitting local fishermen to harvest the fish that would have migrated to downstream areas. This retention of fish, and fresh water, favoured the establishment of invasive weeds, the replacement of high quality pasture by sedges and resulted in insufficient die-off of vegetation during the dry season for effective nutrient recycling. It also entailed increased risks for parasitic diseases of humans and livestock. A weakness of the project has therefore been not to succeeded to convince all stakeholders of the need for the recession to also resemble the natural flood. A large scale awareness campaign on the risks of prolonged flooding, illustrated by the deterioration of low lying areas in the irrigated agricultural zones nearby, could be an opportunity.

7. The ecosystem approach should be undertaken at the appropriate spatial and temporal scales.

The drafting of the management plan through a participatory approach allowed the stakeholders to operationally define the appropriate scale. The management plan was for an initial five year period and is to be revised soon.

8. Recognising the varying temporal scales and lag-effects that characterise ecosystem processes, objectives for ecosystem management should be set for the long term.

Because of the flood related strong seasonality of the Sahelian floodplain and delta ecosystems many species groups reacted very rapidly to improved management, i.e. flood release, notably

fish and annual and perennial grasses important for local livelihoods. Still, because of the careful and progressive way in which the releases were effected, it was necessary to implement immediate 'compensatory' measures to secure livelihoods during the 'waiting' period for full implementation (and to establish constructive relationships). Also, some communities had lost their traditional rangelands now absorbed into the Diama reservoir, managed by OMVS with the objective to lower pumping cost for irrigated agriculture upstream. They would therefore not benefit from improved management in other parts of the delta. The promotion of market gardening, the labourers employed for the building of the infrastructure (including the Park's field station), the local recruitment of 'guards', etc. allowed some of the immediate needs to be addressed without increasing the pressure on the ecosystems under rehabilitation. The mangrove and floodplain woodland ecosystems obviously needed longer for functional and structural revival. The same held for breeding colonies of piscivorous birds (especially the ones nesting in trees). Some initial restrictions have therefore had to be put on harvesting techniques for Acacia seedpods used in leather tanning and on the exploitation of juvenile cormorants for food. As these constraints were addressed in an early stage it can be classified as a project strength. However, the need for interannual variation in the flood release regime, including (relatively) dry years, to emulate the natural system and therefore to accept lower productivities and to forego tourist revenue (less waterbirds) has been a difficult concept to introduce, even at the protected area manager level. The tendency to target more 'produce' every year may have contributed to the expansion of less desirable vegetation (sedges, reed-mace). The issue therefore remains a threat.

9. Management must recognise that change is inevitable.

The need for adaptive management was incorporated in the progressive implementation and the close monitoring of the results, ecological and livelihoodwise, of the managed flood releases. As the project's ambition was restoration, change was in fact the desired outcome but predictable only in the most general terms (more water, more resources). However, once full implementation was achieved and direct donor supported technical advice downscaled, without the local scientific advisory board having become fully operational and because of rapid turnover of key staff, the flexibility and adaptability of the initial stages was weakened. As already stated under principle 8, the need for an occasional 'drought' to reset the clock for aquatic vegetation was also not completely assimilated.

Getting a written management plan approved by a wide range of stakeholders and many hierarchical levels is a complex (and expensive) task and can be an obstacle to the required adaptability. Therefore, after each flood season there should be local stakeholder feedback sessions, to assess if adaptations to flood release calendar, as expounded in the written text, are required. The issue can therefore be seen as a weakness with an opportunity.

10. The ecosystem approach should seek the appropriate balance between, and integration of, conservation and use of biological diversity.

This was possibly the main strength of the project. The presidential decree that created the National park explicitly allowed sustainable resource extraction by local users in certain areas and also gave mandate to the protected area managers to promote sustainable resource use and target livelihood enhancement in all areas covered by the management plan, independent of their status. The emphasis in the role of the Park 'guards' has been more advisory and awareness rising rather than repressive and often unsustainable practices were denounced by the resource users themselves. The current phase of the project, which has as its goal the participatory development of a biosphere reserve, will create a patchwork of areas with variable (and seasonally varying) levels of protection.

11. The ecosystem approach should consider all forms of relevant information, including scientific and indigenous and local knowledge, innovations and practices.

This was definitely also a strength. Very substantial time and effort were spent on collecting historical information, on in-depth interviews with the village elders, on transect walks with resource users, etc. the close cooperation with the Wetlands Research Group (GREZOH) of the Science Faculty of Nouakchott University (which has a membership covering most natural sciences plus agronomy, geography and socio-economics), the inputs of a substantial number of local and foreign students on topics identified as knowledge gaps in the management plan (hydrodynamics, groundwater fluctuations, salinity and water quality, botany, fisheries, livestock, reptiles, birds, mammals, economic aspects of resource use, etc.). This combination of intensive contacts between observant locals and young dynamic scientists of various origins and disciplines contributed to the formalisation of the traditional knowledge. The perseverant questioning by all these researchers, trying to tease out the details on the pre-dam functioning of the system and on the intricacies of resource use gave the local resource users a sense of pride, the feeling that they had an important contribution to make. Some of the research was done in collaboration with the users such as the assessment of the different harvesting techniques for perennial grasses, the selection of suitable plots for the replanting of *Acacia nilotica*, the establishment of exclosures, the replanting of mangrove, etc. Participatory research was felt to be an effective tool for the facilitation of the implementation of management decisions.

12. The ecosystem approach should involve all relevant sectors of society and scientific disciplines.

Strength of the project: a good mix was always sought between natural and social sciences. Capacity in the different disciplines was built with Park staff, locals, members of the municipal council and the decentralised administrations. Involvement of a wide range of gender groups (ethnic group, tribe, caste, age, sex) in project activities, monitoring and research was actively pursued. At national level, a major step forward came through a field visit with all the relevant ministries and technical departments involved in the drafting of the Integrated Coastal Zone Management Plan. This brought some of the important decision-makers of the nation into contact with the ecosystem restoration and livelihood enhancement approach. As part of the communication strategy, project results were presented at a wide range of workshops and the networking by the GREZOH, an influential group in the new urban middle class, contributed to broaden the constituency to politicians and economic leaders. Champions for wetland management were identified and encouraged. A guided tour of the area, especially targeting “the hard to convince”, i.e. key people from the rice-farming lobby, OMVS staff, etc. was organised in 1999 and changed some perceptions.

4. Lessons learned

The Diawling experience has shown that:

- involving local communities in the management of a protected wetland is feasible and beneficial (see also Sherbinin & Claridge, 2000) and the ecosystem approach (Pirot *et al.* 2000), applied to managed flood releases to restore the structure and function of a severely damaged wetland ecosystem, can have positive impacts on biodiversity and livelihoods.

Fundamentals of the approach have been:

- an open-minded and respectful listeners’ attitude, permeated by an appreciation of the local historical and socio-cultural background.
- development issues have to be taken as seriously as environmental issues.
- the management plan development process targeted the entire Lower Delta, links with, rather than boundaries of, the protected area were emphasized.

- continuous presence in the field is a prerequisite. In this way, the signals, emitted by both the ecosystem and the stakeholders, can be read and flexible responses provided.

In the relationships with the local communities, key concepts are trust, benefits and the integration of indigenous knowledge.

Trust

- to build a relationship based on trust, a project has to move slowly and carefully. Confidence can only be gained through proof of assertions by actions and achieving results takes time. Mistakes are not corrected easily. Similarly, the identification of key actors, possibly absent from the public stage, requires ample time.
- set out clearly what can be achieved through the ecosystem restoration, but make clear also that some things are unlikely or impossible. In this manner the stakeholders know what to expect. The rule of thumb here is, in public, to predict less than you expect and let the stakeholders triumph when they tell you it was even better (or worse) than predicted.
- make no false promises with regard to what the project entails. If confronted with an expectation that cannot be fulfilled, answer that you will try to interest another development partner in this particular aspect and do so. Only in these circumstances can one be perceived as an “honest broker”.
- conflict avoidance may seem attractive, but managed conflict is better than simmering resentment. Within and between the communities, some black boxes, containing unresolved natural resource use conflicts and historical inequities, may have to be opened. A certain level of confrontation may be necessary to explore the limits of project intervention.

Benefits

- local community adhesion to sustainable resource use is proportional to their share in the benefits. Long-term benefits accruing to the communities are the sustained and increased availability of resources, the improved mastery of marketing channels and some measure of exclusive use rights. Ecosystem rehabilitation takes time and, under economic duress, immediate stakeholder needs have to be addressed

Integration of indigenous knowledge

- local stakeholders have had a long relationship with the ecosystem. Though at times, their explanations of the phenomena may seem far-fetched or even mythical, scientific arrogance, should be avoided. Patiently teasing out the experience of observant locals can be highly beneficial.
- local knowledge has to be formalised through scientific investigation. The facilitation, by the project, of the interactions between the two knowledge systems has been an important stimulus to the development of the management plan. Joint monitoring and participatory research increased awareness and local capacity, scientific results contributed to the consensus flood scenario debate.

For the institution charged with the ecosystem management it is important to:

- value individual competence, responsibility and creativity while emphasizing that these should find expression through team effort.
- get input from a wide range of disciplines, with an emphasis on the social sciences (the sociological constraints being the most difficult ones to tackle).
- build a constituency at national level including decision makers, other institutions, and the scientific community through networking, field visits, workshops, etc.

In the relationships with development partners it is necessary to:

- emphasize the need for the project to show flexible responses (which implies flexible funds). As the local communities responded very rapidly to the new hydraulics, the project must be able to accompany the local dynamics, often in an opportunistic way.
- explain that building the social capital, needed for sustainable results through participative processes, takes more time than the building of infrastructure. Creating a new protected area with a functional joint management system can be expected to take a generation.
- design an exit strategy, which progressively hands over responsibilities, in step with the increases in local capacity.

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