5. RELOCATION AND RESETTLEMENT

Koenig D, 1986

The Manantali Resettlement Project. The first year move.
Working-Paper,-Cooperative-Agreement-on-Human-Settlements-and-Natural-Resource-Systems-Analysis,-Clark-University-Institute-for-Development-Anthropology,-USA. 1986, No. 29, 33 + [12]pp

Abstract:
The Manantali Resettlement Project, designed to facilitate the relocation of villagers whose upstream homes and lands were to be flooded by the construction of a high dam at Manantali, Mali, had planned to move approximately half the population of the Bafing reservoir by the rainy season of 1986 (late June and early July), and this goal was essentially reached by early July 1986. The report discusses some of the important socioeconomic issues that have appeared in the process of resettlement. The short-term issues which require an immediate solution are identified as: (1) incentives to farming in the region; (2) health and nutrition problems; (3) the question of alternatives to the 1986 pattern of house construction; and (4) how to encourage fishing among the local population. In addition, longer term implications have become clear which need to be studied by the monitoring team: (1) the problem of economic changes, including the effects of monetarization of the economy and of new entrepreneurial activities; (2) trends in demography in order to understand patterns of migration; (3) the effect of changes on women, particularly the availability of water and of wild food products.

Voh JP; Atala TK; Mortimore M (ed.); Olofin EA (ed.); Cline-Cole RA (ed.); Abdulkadir A, 1987

Problems of resettlement in dam construction projects: the Tiga Dam experience.
Perspectives on land administration and development in Northern Nigeria: proceedings of the workshop on land resources, Kano, September 25-28, 1986. 1987, 153-160

Abstract:
Resettlement of large numbers of rural people has inevitably followed the construction of dams in Nigeria. The Tiga Dam project in Kano State resulted in the displacement and relocation of about 12,000 people. This paper examines the resettlement problems which these people encountered in their new villages. Data were obtained by a survey of 344 randomly selected household heads, resettled in four new villages. It was found that the major problems faced were in land clearing, building houses, individual and community welfare, and farming, including shortage of farmland. Implications for resettlement policy and implementation are drawn.

Grimm C, 1988

Relocation and change in Manantali, Mali.
IDA-Development-Anthropology-Network. 1988, 6: 1, 10-15

Abstract:
The case study is concerned with the radical transformations that have occurred during the last 10-15 years in the Manantali area, the most dramatic change being the recent relocation of 10 000 people as a result of construction of a major dam across the Bafing River during 1981-88. Changes prior to dam construction were also found to contribute to the present situation. Preliminary results of data collected over a 22-month period during the relocation process indicate that the combined effects of

resettlement and a previous increased involvement in export crop production have led to changes in domestic organization and the development of new forms of socioeconomic stratification. An examination of changes in trading practices and the emergence of other non-farm sources of remuneration, such as wage employment and resettlement project compensation, demonstrates how capital accumulation is restructuring social relations in the region. In particular, a few men are capitalizing on these changes and rising to new levels of wealth through commercial entrepreneurship and capitalist agriculture, invoking new relations of production and exploitation.

Koenig D; Horowitz MM, 1988

Lessons of Manantali: a preliminary assessment of involuntary relocation in Mali.
1988, 16pp.; Cooperative Agreement on Human Settlements and Natural Resource Systems Analysis,

Abstract:
The paper reports on the relocation of some 10,000 persons in western Mali whose former villages and productive lands have been flooded out in the impoundment of waters by the Manantali Dam. Since the relocation began in 1986, and the dam was first closed in 1987, it is too early for a definitive evaluation of the impacts of resettlement on the ecology, society, and economy of the region. Although the US Agency for International Development (USAID), which funded the resettlement, does not have a formal relocation policy, the project was based on a formal review of relocation theory. Rejecting an earlier proposal to agglomerate relocatees in a few large towns whose size justified establising schools and health facilities, the project sought to resettle villages as units, to involve the people in the choice of new locations, and to reestablish existing production systems. A project socioeconomic monitoring unit was created in association with a US rural development research institution. The project was found to suffer from the lack of a coherent development plan for relocatees and host communities; a lack of adequate settler and host population participation in all phases of project planning and implementation; and inadequate land over the long term to sustain local needs for fallowing and pasture. The project also seemed to suffer from government and donor inability to provide timely and quality site

Soemarwoto O; Charoenwatana T (ed.); Rambo AT (ed.); Jintrawet A (ed.); Sornsrivichai P, 1988

Dams as agents of rural development.
Sustainable rural development in Asia. Proceedings of the SUAN IV regional symposium on agroecosystem research, held at Khon Kaen University, July 4-7, 1988. 1988, 115-124

Abstract:
The Saguling dam is located about 40 km west of Bandung, West Java. Its construction started in 1980 and was finished in 1985. The reservoir inundated an area of about 5600 ha and displaced 2974 households which affected 13 737 people. The construction was based on the government policy to satisfy the increasing demand for electricity due to population growth and industrialization; to reduce the consumption of oil; to improve the supply of water for the capital city, and for irrigation of rice in West Java; and to have better flood control. The case of the Saguling resettlement scheme shows that it is possible to use dams as agents of rural development and to prevent the collapse of the rural ecosystem because of population growth and the negative impacts of the construction of the dam. Consideration was also given to the residents above the high water level, since they were also affected by the dam. The electric energy generated was used to

create new jobs in the non-agricultural sectors in the watershed, thus reducing the dependence of the people on land and, by doing so, reducing the population pressure.

Hirsch P, 1989

Settlement and resettlement on marginal land: a case study from Thailand.
Australian-Geographer. 1989, 20: 1, 80-87

Abstract:
A case study of a Thai resettlement scheme on land settled spontaneously illustrates the wider concern of heightened competition for marginal land. State policy and practice as revealed in the Tab Salao Dam and Resettlement Project show that the state is one of a number of actors in the local political economy of resource competition. Ambiguous tenure underlies the immediate problem of resettlement, but it also reflects the problematic role of the state as arbiter and manager of resources hitherto under vernacular forms of tenure. It is concluded that recognition by officials of the moral perspective of farmers over rights to land and greater consistency in compensation policy would overcome some problems. Special account needs to be taken of the difficult period of adjustment to prevent settlers from falling into heavy debt or seeing their compensation payments frittered away. Timing of resettlement is important; many of the immediate problems to Tab Salao arose due to the seven-year gap between survey and resettlement. More employment of local people in dam construction and for extraction of timber would increase commitment to the project. Allowing local people to benefit more directly from the longer-term benefits of the project would enhance involvement and lessen conflict.

Ferradas CA, 1994

The encounter between planning agents and the population in relocation processes.
Development-Anthropology-Network. 1994, 12: 1-2, 38-44.

Abstract:
The paper discusses some of the issues that arise when considering the displacement of local people in preparation for a dam, or other large development project. Some of the issues raised reinforce the claims of the Scudder and Colson model, which notes that the stress caused by relocation may increase morbidity and mortality rates, particularly among older people. This connection has also been made by people in the displaced population in Posadas, Argentina, studied for the paper, interpreting deaths and diseases as signs of the relocation agency's power. However, the paper also notes some of the shortcomings of the model, suggesting that the relocatees in Posadas are enmeshed in a web of relationships that are crucial for understanding the dynamics of the relocation process. The paper considers some other resettlement cases in the context of the Yacreta development; discusses the relocation agency and population as comprising parts of the same system; the positive and negative effects of resettlement; crises and identity formation; and mediators and the larger system. The paper concludes that only by looking at the way agency and people interact with each other, in a context that is already shaped, but gets transformed in the ongoing process, will development projects be properly evaluated.

Gray A; McDowell C; McDowell C. 1996

Indigenous resistance to involuntary relocation.
Understanding improverishment: the consequences of development-induced displacement. 1996, 99-123.

Abstract:
The consequences of large-scale dams are examined, and, in particular, the resistance

of those targeted for forced resettlement is described. The strategies of resistance by the victims and the attempts by the World Bank to ameliorate the effects of their projects provide a gulf between two perspectives on development which have rarely, if ever, been bridged. The focus is on the effects of hydro-electric and irrigation construction on indigenous peoples, because they illustrate this clash of perspectives particularly clearly. Information is presented on: Kaptai Lake, and the long-term effects of dam construction; the social and environmental effects of large dams; World Bank efforts to ameliorate the inevitable; forms of indigenous resistance; successful campaigns of resistance; unsuccessful campaigns of resistance; and the differences between success and failure for campaigns.

Lassailly Jacob V; McDowell C; McDowell C, 1996

Land-based strategies in dam-related resettlement programmes in Africa.
Understanding improverishment: the consequences of development-induced displacement. 1996, 187-199.

Abstract:
Resettlement programmes that apply a so-called 'land-for-land' strategy, which replaces lost land with new land of equal potential are discussed. In these government-sponsored resettlement schemes, new 'settlers' have received, in compensation, land and assistance to help them regain self-sufficiency or even raise their standards of living. Data are presented from a few major dam-related resettlement operations that took place in Africa during the 1960s and 1970s (Volta, Kossou, Kainji, Kariba, Aswan). Drawing lessons from these previous resettlements, and examining the production-based components of the projects, an analysis is presented as to why most resettled communities encounter difficulty reattaining self-sufficiency through the allocated land and new farming programmes. Preserving cultural values and self-sufficiency means giving the resettled community clear and full title to an adequate, well-defined territory which will serve as the basis of its production system and as new grounds for its cultural and social values.

Tamondong-Hein SD; McDowell C; McDowell C, 1996

State power as a medium of impoverishment: the case of the Pantabangan dam resettlement in the Philippines.
Understanding improverishment: the consequences of development-induced displacement. 1996, 169-183.

Abstract:
The case of Pantabangan resettlement, Philippines is illustrated, wherein state power can be seen as an efficient way for a government, such as the Philippines, to deliver goods, such as a dam, for its constituents; but it can also be a devastating medium of impoverishment in the affected community, as experienced by the people of Pantabangan town. Pantabangan, one of the oldest and most historic towns in the country, was totally inundated due to a dam project during the early 1970s, resulting in the resettlement of 1,300 people from a valley location to a mountain top. Two particular conclusions are drawn: that planning, involving the project-affected people in all stages to ensure appropriateness, must be guaranteed, and include the full provision of infrastructure; government responsibility through its moral obligation should not end with the project's completion when a displaced population results from it.

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SPECIAL FEATURE

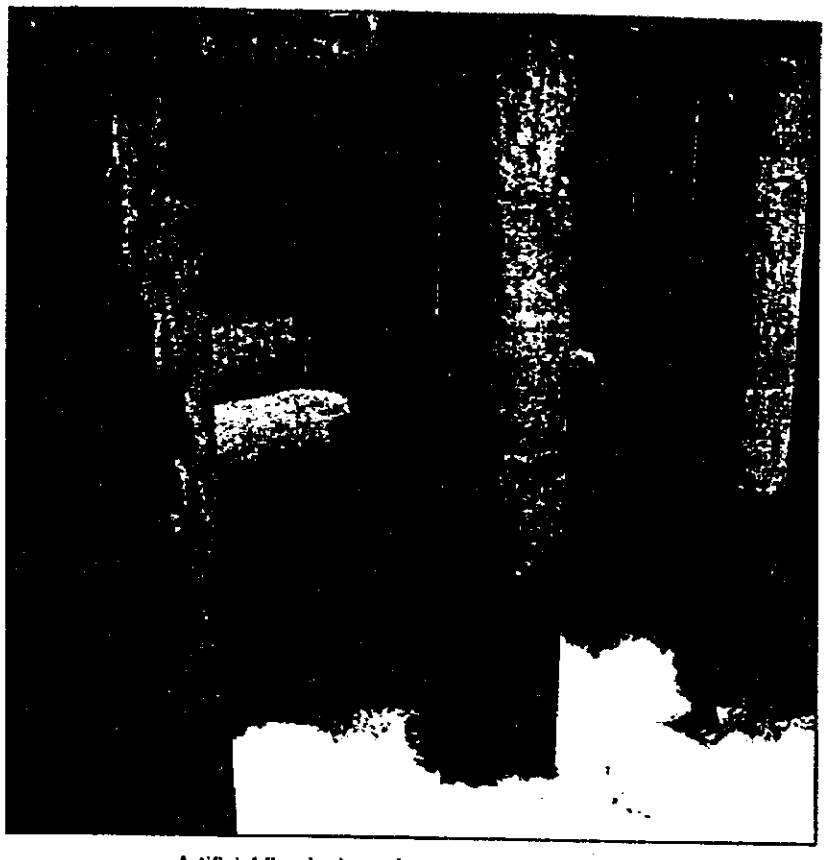
The use of artificial floods for floodplain restoration and management in sub-Saharan Africa

Introduction

Floods are truly the Jekyll and Hyde of environment processes. In recent years flooding along major rivers such as the Mississippi and Rhine have brought many deaths and destroyed property and infrastructure. In contrast flood waters can be the life blood of the environment and rural communities. As a result of periodic inundation, the floodplains of the major rivers of sub-Saharan Africa, including the Zaire, Senegal, Niger and Zambezi support wetland ecosystems of exceptional productivity, particularly in comparison with the surrounding arid and semi-arid rangelands, where the dry season is long and arid. For centuries, these floodplains have played a central role in the rural economy of the region providing fertile agricultural land which supports a large human population. The flood waters provide a breeding ground for large numbers of fish and bring essential moisture and nutrients to the soil. Water which soaks through the floodplain recharges the underground reservoirs and supplies water to wells downstream and beyond the floodplain. As the flood waters recede arable crops are grown, but some soil moisture persists to the dry season to provide essential grazing for migrant herds. The floodplains also yield valuable supplies of fish, timber, medicines and other products and provide essential habitats for wildlife, especially migratory birds.

In recent years drought, increasing populations of people and livestock and rising poverty have combined to put pressure on the floodplains and have led to over exploitation of their resources. In the face of such pressure, hydrological management was seen as the key to development through the implementation of major river engineering schemes, such as dams, for hydro-electric power generation and to provide water for irrigated cereal cultivation. Similar schemes have stimulated food production in other parts of the world. Dams can provide an all year supply of water in a highly seasonal climate and intensive rice plantations in southeast Asia give high yields. However, few schemes in Africa have ever realised their full

potential and many are facing serious environmental, technical, administrative, socio-economic, political and environmental problems. Salinisation and water logging are particularly prevalent as many schemes were built without adequate drainage. Added to this, the reduction in floodplain inundation caused by the retention of flood water behind the dams, has had disastrous effects on the rural economy which relies on wetland products and functions. Thus, in some cases, these schemes have diminished rather than improved the living standards and economy of the region as a whole. There is clearly a need for the integrated management of river basins and their floodplains to combine the best of both intensive and extensive floodplain farming systems and of customary and modern techniques. To make sound use of existing dams, operational management plans need to be adapted to release water at certain times of the year to produce an artificial flood, to inundate the floodplain and thus rehabilitate the indigenous farming system, whilst retaining sufficient reserves for power generation and irrigation. This article assesses the potential, limitations and implementation difficulties of creating artificial floods in sub-Saharan Africa.



Artificial flood release from a dam in West Africa

The economic case for an artificial flood - the Hadejia-Nguru wetlands, Nigeria

In northeast Nigeria, where the Hadejia and Jama'are rivers combine within the Komodugu-Yobe basin, an extensive floodplain of around 2000 km^2 used to be inundated annually. Since 1971, a series of dams have been constructed on the main tributaries and during recent droughts the area inundated has been reduced, with only 300 km^2 flooded in 1984 (Hollis *et al.* 1993). The dams are used primarily to provide water for cereal irrigation. In 20 years the Nigerian Government spent US$ 3 billion in irrigation development, though by 1991 only 70,000 hectares had been farmed making an investment of US$ 43,000 per hectare (Adams, 1992).

It is clear that the yields from intensive irrigation schemes are higher per hectare than from floodplain agriculture, although the high operational costs of the schemes reduce the benefits substantially. However, because the economy is limited by water, it is more appropriate to express the benefits of various development options in terms of water use. Barbier et al. (1991) undertook an economic analysis of the Kano River project, a major irrigation scheme in the headwaters of the Hadejia river. They showed that the net economic benefits of the floodplain were at least US$ 32 per 1000 m^3 of water (at 1989 exchange rates), whereas the returns from the crops grown on the Kano river project were only US$ 0.15 per 1000 m^3 and when the operational costs are included, this drops to only US$ 0.0026 per 1000 m^3! Further analysis has recently started to value the groundwater recharge function of the floodplain.

At a meeting in Kuru in 1993, representatives from the responsible authorities including state water boards, River Basin Development Authorities, members of research institutes and government departments met to discuss the water resources of the Komodugu-Yobe basin. They agreed unanimously that artificial flooding should have a central role in the integrated development of the basin to maintain the production of rice, dry season agriculture, fuel-wood, timber, fish, wildlife and groundwater recharge (HNWCP/NIPSS, 1993). Currently, the adequacy of outlets for making artificial flood releases from existing dams is being assessed.

Artificial flooding to restore a degraded floodplain – the Logone River

Flood waters from the River Logone in northern Cameroon inundate annually a large floodplain wetland, originally around 6000 km^2. Up to the 1960s, fishing was the primary economic activity amongst the local Kotoko people who could earn US$ 2000 in four months. In the flood season, the entire floodplain became a vast fish nursery. The Fulani name for the floodplain is 'yaeres', which means "dry season pasture," and annually some 300,000 cattle and 10,000 sheep and goats grazed on the floodplains. Pastures became accessible when surrounding savanna grasses withered and their protein content was depleted. The wetland has a high biodiversity with large herds of giraffe, elephant, lions, and various ungulates (including antelope, reedbuck, gazelle and kob). Part of the floodplain has been designated as the Waza National Park which attracts around 6000 tourists per year.

Since 1979, the area inundated has been reduced, partly by climatic factors, but primarily due to hydrological management following construction of a barrage across the floodplain which created Lake Maga to supply water to the Semry II irrigation project. Flooding is now insufficient in large areas to grow any floating rice and fish yields have fallen by 90 percent. The potential to release water to rehabilitate the floodplain, whilst retaining enough to maintain rice production, has been identified.

A hydrological model of the floodplain has been developed to assess the effect on floodplain re-inundation of various options for releasing water from Lake Maga and through the embankments. In addition, a socio-economic model has been used to determine the benefits of each option in terms of improved fisheries, agriculture and herding (Wesselink and Drijver, 1993). Even though substantial investment was required to re-engineer the embankments, the expected benefits exceed the estimated costs (over 30 years) by 1300 million CFA (c.US$4.5 million). A pilot release was made in 1994 and the hydrological and socio-economic data collected are now being analysed to help verify the predictions.

Poorly coordinated artificial floods – the Senegal River

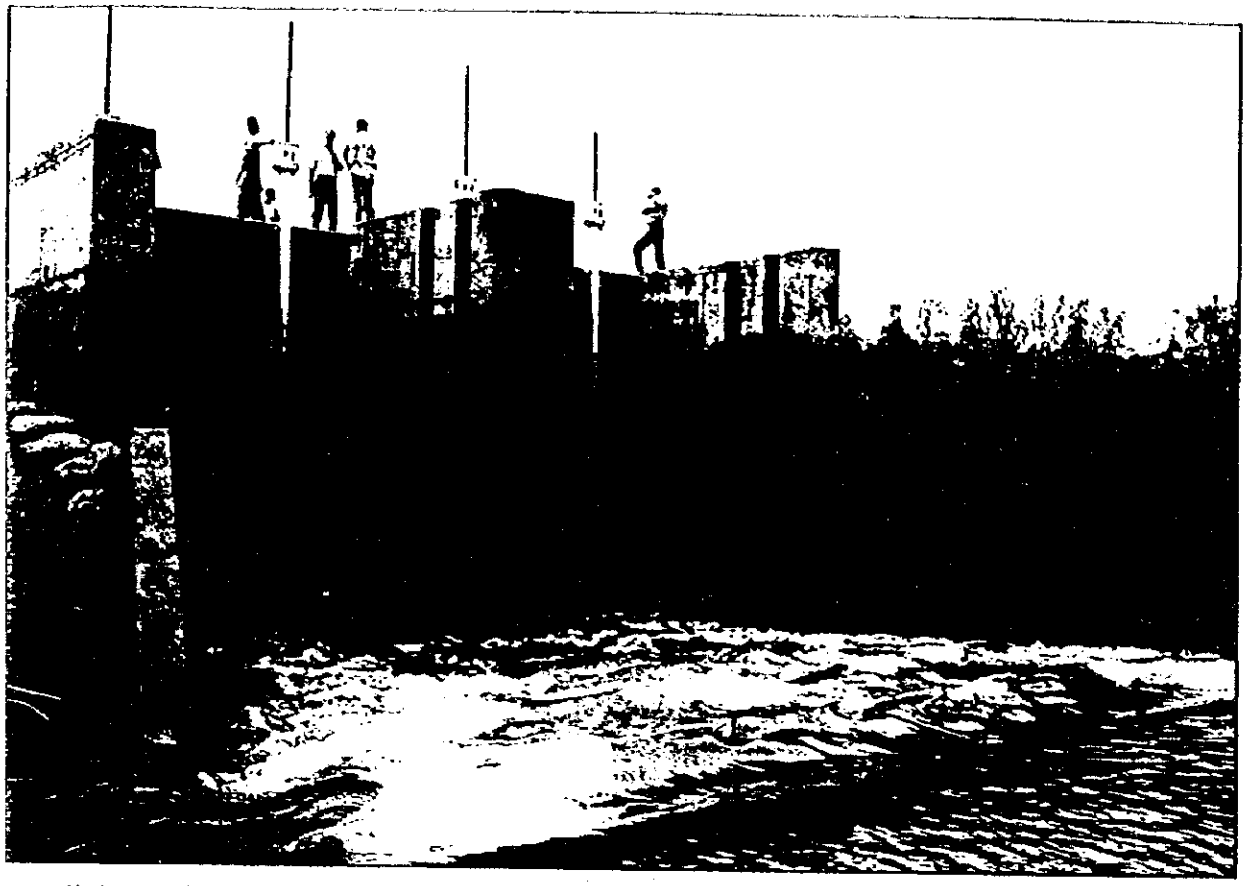
As part of the development of the Senegal River basin the Organisation pour la Mise en Valeur du fleuve Senegal (OMVS) was established, with representation from three of the four riparian states (Mali, Mauritania and Senegal). Two dams were constructed: Diama, near the river mouth, which inhibits seawater intrusion into the river to allow its use for irrigation and regulates water levels to facilitate transport; and Manantali in the headwaters, which was built to generate hydro-electric power and to regulate flows in the river.

Prior to the dams construction which began in 1986, natural inundation of the floodplain of the middle Senegal valley supported up to 250,000 hectares of flood recession agriculture, forests (which provide fuel-wood and construction timber) and wildlife habitat. Because of the recognised delay between dam construction and development of irrigation schemes and the installation of turbines, OMVS agreed that artificial floods should be released for a transitional period of ten years. However, the releases made were ill-timed. At best they inundated only around 50,000 hectares - at worse they flooded out newly planted crops - even though the turbines have not yet been installed. OMVS claimed that releasing floods resulted in 25 percent less electricity being generated and is therefore not cost effective. In a much more comprehensive cost-benefit analysis, however, the Institute for Development Anthropology (IDA) calculated that the best economic option is to use the Manantali dam both to release an artificial flood to conserve the floodplain ecosystem, and to generate hydro-power and provide for commercial irrigation (Horowitz and Salem-Murdock, 1990). Any decision is politically sensitive since electricity benefits the urban elite, commerce, and industry (there being little rural electrification) and provides income for loan repayment, whilst floods benefit rural poor. Both the Government of Senegal and the World Bank accepted the IDA position. OMVS did not.

Community based decision making for artificial flooding – the Phongolo River

In the late 1960s the Pongolapoort dam was constructed on the Phongolo River in north-east South Africa, with a view to irrigating 40,000 hectares of agricultural land for white settlers (Poultney, 1992). No assessments were undertaken of impacts of the impoundment on the floodplain where 70,000 Tembe-Thonga people were dependent on recession agriculture, fishing and other wetland resources nor on the biodiversity of the Ndumu game reserve. The dam changed the whole flooding regime of the river which led to a reduction of wetland habitat and reduced the productivity of agriculture and fisheries.

In 1978 a workshop was held on the Phongolo floodplain to



Hydraulic infrastructures such as this one in the Komodogu-Yobe basin in Nigeria are often built without adequate environmental, health and economic impact assessments

review the future of irrigation and how to manage the floodplain. This led to a plan for controlled releases to rehabilitate the indigenous agricultural system and for the benefit of fisheries and wildlife. Initial releases of water from the dam were made at the wrong time of the year and crops were either washed away or rotted. In 1987 the Department of Water Affairs and the tribal authorities agreed to experiment with community participation. As a result, water committees were established, representing five user groups: fishermen, livestock keepers, women, health workers (both new primary health care workers and traditional herbalists and diviners) who were given the mandate to decide when flood waters should be released. These committees were very successful at implementing people's views and have led to improved management of the river basin to the benefit of the floodplain users.

This is a unique example of where floodplain users are participating directly in the decision making process and influencing the management of the floodplain.

Practicalities of artificial flood releases – the Kafue River

The Kafue river drains 154,000 km^2 of north-east Zambia. The basin possesses some of the most valuable agricultural land in Central Africa (Howard and Williams, 1982) and includes three national parks, as well as a pioneering project to foster community management of wetland resources. Of particular importance are the Kafue flats, a wetland of international significance which supports fisheries, livestock grazing and recession agriculture. Local residents dependent on the Flats, and hence on annual flooding, number over 100,000.

The river has been developed to harness its considerable potential for hydro-power generation. The Kafue Gorge Dam immediately below the Flats was completed in 1972, followed by a regulatory dam at Itezhitezhi 250 km upriver. Both were essentially single-purpose "least cost" schemes to provide electricity. However, Itezhitezhi is significant because it was the first major dam in Africa that was designed and constructed to release an artificial flood for the maintenance of wetlands and the support of people dependent on them. The results of research undertaken before construction led to an agreement to release an artificial flood of 300 m^3/sec from Itezhitezhi during low flow years for a four week period in March.

Unfortunately, this artificial flood has not produced the benefits intended. Not only does the artificial flood come later and recede earlier, but water levels are

maintained at a significantly higher level throughout the rest of the year. The operators of the dam observe their own priorities when they are incompatible with flow regimes that will benefit riverine habitats and populations and ecologists have not maintained their pressure on the authorities to apply or improve these provisions.

Designing dams to make flood releases – examples in East Africa

Although many countries, including the USA, have decided not to construct any major new dams due to negative effects, there are numerous projects around the world where smaller dams are planned. In East Africa, two good sites for hydro-electric (and multi-purpose) dams are upstream of major floodplains. The Tana River is the largest in Kenya and has a mean flow of 180 m^3s^{-1}. It rises in the highlands near Nairobi and Mt Kenya and then flows for more than 250 km over the flat, dry coastal plain to the Indian Ocean. The Tana has an extensive floodplain and delta, which is the mainstay for thousands of people who use the results of the floods for their survival through subsistence agriculture, fishing, livestock rearing and horticulture. The wetlands of the lower floodplain and delta are the main refuge of livestock and wildlife from a wide area that is extremely arid for most of the year. Planning is underway to dam the Tana upstream of the floodplain at Mtonga (or Grand Falls) to accommodate several hydropower plants to meet the increasing electricity demand within Kenya. Investigations by the designers and developers have shown that the floodplain and its floods are a very significant resource both locally and nationally and that they should be retained if possible. Consequently, a dam is being designed that will store enough water to produce a flood downstream through substantial releases as well as produce the necessary electricity. Furthermore, recognising that silt is as important as water for the maintenance of the productivity of the floodplain, the dam designer s are looking at the potential for releasing sediment with the flood water. Apart from the engineering details, the main problem faced by the engineers is inadequate knowledge of the amount of water required to simulate a flood and the timing of this in relation to upstream and local rainfall. The lower Tana is not a simple channel that overflows onto the floodplain. The contribution to flooding from parallel channels, from short-lived local streams and from subsurface flows is still poorly understood. However a modelling study is currently underway to address these limitations using data from historical and recent floods. It is anticipated that the final design will result in a dam which meets the demand for electricity and respects the needs of its floodplain downstream.

The Rufiji River is the largest in Tanzania and has an ideal site for a multipurpose dam at Steigler's Gorge on the edge of the Selous Game Reserve. The Rufiji derives most of its flow of around 900 m^3s^{-1} from the highlands in the western part of the country. Downstream of Steigler's Gorge, however, there is an extensive floodplain and a very large delta where the river meets the Indian Ocean coast. The floodplain and delta are highly productive areas that support more than 100,000 people through freshwater fisheries, flood-driven paddy rice, recession agriculture and transport as well as many contributions of the delta in the form of mangrove products, molluscs, crustaceans and fin-fish - which contribute to both local and offshore fisheries. It is the recognition of the value of these wetland systems and their needs for continued flooding that has prevented the development of the proposed dam for several decades. Studies are now planned, however, to calculate the needs for a floodplain and delta to see if these can be accommodated in a

Tiga Dam, main release

dam specifically designed to make artificial flood releases.

Conclusions

Artificial floods clearly have great potential for floodplain restoration and management but many implementation difficulties exist. The vast majority of African dams have not been intentionally designed to allow release of an artificial flood. Indeed, some have been constructed in ways that preclude such flooding on a regular basis since spillways or outlets are designed to pass water only during extreme floods, such as the Kariba dam on the Zambezi. Likewise, inspections of the dams in the Komodugu-Yobe basin in northern Nigeria suggests that sufficient water can not be released. Even where artificial floods can be released there are certain prerequisites for success. First, political will, as illustrated by the attitude of the OMVS to controlled releases from the Manantali Dam. Second, technical hydrological expertise, a detailed understanding of the land use and ecology of the floodplain as shown by the Kafue cases. Third, participation of floodplain users as exemplified by the Phongolo river experience. Forth, it is necessary for the needs of the floodplain to be known in relation to the amounts and timing of water and sediment as well as local rainfall and runoff before such artificial floods can be considered. The requirements of the floodplain ecosystems for flooding are poorly understood and this adds to the reluctance of dam designers to consider floodplain-friendly impoundments.

International attitudes are changing with the realisation that a dynamic flooding pattern is essential for the development and sustainability of African floodplain systems, for the short term economic importance of fisheries, agriculture and pastoralism and the longer term importance of soil fertility and biodiversity. Artificial flooding is thus becoming an important element in the river basin management strategy. ●

References

Adams W.M. (1992) *Wasting the rain: rivers people and planning in Africa*. Earthscan, London.

Barbier, E., Adams, W.M. & Kimmage, K. (1991) *Economic valuation of wetland benefits: the Hadejia-Jama'are floodplain, Nigeria*. London Environmental Economics Centre Paper DP91-02. IIED, London.

Hadejia-Nguru Wetlands Conservation Project/National Institute for Policy and Strategic Studies (1993) *Proceedings of the workshop on the management of the water resources of the Komodugu-Yobe basin*. National Institute Press, Kuru, Nigeria.

Hollis, G.E., Adams, W.M. & Aminu-Kano, M. (1993) *The Hadejia-Nguru Wetlands: environment, economy and sustainable development of a Sahelian floodplain wetland*. IUCN Gland, Switzerland.

Horowitz, M. and Salem-Murdock, F. (1990) *Senegal River Basin Monitoring Activity Synthesis*. Institute for Development Anthropology, Binghampton, New York.

Howard, G. & Williams, (1982) *The consequences of hydroelectric power development on the utilisation of the Kafue flats*. Kafue Basin Research Committee, University of Zambia, Lusaka, Zambia.

Poultney, C. (1992) Water committees take action. *ILEIA Newsletter*, 1, 92, 18-20

Wesselink, W.J. & Drijver, C.A. (1993) *Waza-Logone flood restoration study. Identification of options for reflooding*. Report to IUCN by Delft Hydraulics/University of Leiden, The Netherlands.

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