



MALI: FLOOD MANAGEMENT - NIGER RIVER INLAND DELTA

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Abstract. Information is provided about flood management practices in the Niger River Inland Delta of Mali, which are based on a mix of over two hundred years old traditions very specific to the geo-morphological characteristics of the delta and the activities of its inhabitants. These practices are supported by structural measures and by a series of laws and regulations for the water sector. The information about "lessons learned" is still to be provided by the authors

1. Location

The Niger River Inland Delta constitutes one of the largest wetlands in the world and is situated in the sahelian zone in Mali. It is located between 13° 30' and 17° 00' latitude North and 2° 30' and 5° 30' longitude West. The Delta has an area of more than 60,000 km².

Besides being inhabited by about 1 million people, the Delta represents one of the major producing areas of the country; the three main production systems relate to livestock, agriculture and fisheries. About 2 million cows graze every year for almost 8 months in the Delta area (and as much sheep and goats). The agricultural production (besides the one produced by irrigation) covers during wet years an area of about a 100,000 ha in the natural flood plains and 30,000 ha in the polders developed by the government. Fisheries constitute an important source of revenue for the inhabitants of the Delta and contribute 4.2 % to Mali's GDP; its annual production varies between 45,000 to 100,000 tons.

2. Nature of floods

The inundations in the Inland Delta follow the hydrograph of the Niger River and its tributaries, produced by monsoon rains in the upper catchment areas of the neighbouring countries. The seasonal inundations, from August-September to December-January, are caused by the flat slopes in the Delta area, leading to a large spread of the water. The hydrographical network in the Delta is relatively complex; besides the Niger river, there are a number of lakes, three main tributaries and a multitude of secondary rivers and streams diverting water to, or draining water from different lakes and plains.

The Delta comprises two parts distinguished for their geo-morphological characteristics: its southern part is constituted by a vast alluvial plain subject to wide-spread flooding, where the water is mainly contained in large flood plains (each one of them covering several hundreds of km²), filled during the flood season and emptying themselves during the recession of the floods; in wet years more than 20,000 km² are inundated. In the northern part the floods mainly affect the major beds of rivers and channels in between sand dunes; in addition, a number of temporary lakes on both banks of the Niger River are filled during high floods, which can then cover a maximum water area of some 14,400 km². The water reaching these lakes is not returned to the river during flood recession due to the presence of some sills.

Since 1950 the extent of the annual floods fluctuates with a factor 1 to 5; in very dry years like 1984 only 3,600 km² were inundated, while in wet years this exceeds 20,000 km². The floodwater plays a determinant role in the regeneration of the Delta's natural resources, which form the basis of the different production systems. In addition, it makes the navigation on the major rivers and

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channels possible, thus facilitating the access to the different rural areas. While exceptional high floods may cause damage to habitats and irrigation, and in cases loss of lives, extremely low flows like those in 1984 can be qualified as disastrous due to the famine and the loss of livestock they may cause. During the years of the Sahelian droughts, the scarcity of the natural resources have led to several conflicts between the different users.

The hydrological regime, the dynamics of the natural resources and the human activities are closely associated. The production of natural resources is sometimes linearly related to the extent of the floods. This makes it a rather variable production environment. On the other hand, the ecosystem of the delta is resilient and used to large inter-annual fluctuations in the availability of water resources. Its natural resources have adapted to these fluctuations.

The Inland Delta plays the role of a natural buffer for the populations and countries downstream. Any excessive flood event is levelled off as the excess water is channelled off to the main lakes in the northern part of the Delta. During the dry season it releases part of the water stored in the flood plains to the Niger River, providing drinking water and irrigation supplies to riparian populations in Mali and Niger. This functioning ensures a natural management of exceptional floods liable to cause substantial damage.

3. Flood management measures

The use of water and land in the Delta was established in 1818 and is managed through an access to these resources in time for different uses. Inundation plains may be exploited by fishermen during the floods, taken over by farmers and herdsmen upon recession of the water. These traditional systems have evolved over time and adapt relatively quickly to outside events. The location of villages, hamlets and temporary camps takes the flood levels into account.

The *structural measures* that can be observed in the Niger River Inland Delta depend on the geomorphological characteristics of its spatial entities and have either been locally constructed and managed or have been constructed by the government with exogenous material and construction methods. The following constructions for regulating the floods are found: (i) traditional dikes without intake or outtake structure delimit a low-lying area or temporary lake; these are destroyed by the population after the floods whenever they want to evacuate the water for agriculture; similar dikes are also constructed by fishermen - they will evacuate the water after the flood recession in order to capture the fish; (ii) traditional dikes with intake or outtake structure, generally constructed with the help of NGO's; when correctly designed and constructed these structures help to regulate the inflow and the outflow of flood plains, temporary lakes etc.; (iii) large dikes, which protect about 30,000 ha of agricultural land; some of these dikes are also used for the protection of urban areas; and (iv) two reservoirs, constructed on the Niger River and its tributaries; however, they do not play a very important role in the flood management of the Niger River.

The *non-structural measures* relate mainly to the forecasting and early-warning system. Two types of systems can be distinguished: (i) traditional forecasting systems based on climatic and biological indicators (intensity and direction of winds, the timely appearance of migrating birds, the flowering of herbs, the proliferation of insects etc.) allow the local population to anticipate the yearly flood season; (ii) hydro-meteorological analyses, introduced in West-Africa since 1998 through a multi-partite collaboration in the context of PRESAO (programme for seasonal forecasting in West Africa), have largely improved forecasting of floods.



4. Flood and water management instruments

With regard to the mechanisms in place for information/data collection and exchange, this is carried out by the *National Hydraulic Administration* (DNH-Direction Nationale de l'Hydraulique). DNH manages the national network of hydrological stations, constituted of 90 stations on the Niger and Senegal Rivers. Water level readings are done by observers, with the transmission of data by radio or telephone to the DNH in the capital, Bamako. 24 stations are equipped with a telemetry system through the HydroNiger project (although not all of them operational). Recently, under a hydro-ecological project on the upper part of the Niger River (Ghenis) 8 automatic stations were installed; it constitutes an early warning system for floods and pollution in the upper Niger River basin.

In addition to the traditional customs and rules of 1818 governing the life and production activities of the Delta inhabitants, there are state laws and rules concerning the protection, the use, the development and the conservation of water resources. A law instituted in 1990 defines water as state property and indicates that individuals, local administrations and public and private enterprises cannot purchase the right to use water resources. However, this law recognises and guarantees the customary rights to use "public" water. The law further defines the standards for surface and groundwater intake, the measures to guarantee maintaining the water quality and the standards for hydraulic infrastructure. The application texts and the water code are currently being elaborated.

5. Institutions responsible for flood management

There are a number of national institutions responsible for different components of the water resources management; by a decree in 2000 their specific attributions were established. Amongst these can be mentioned: (i) *Ministry of Rural Development* - responsible for the elaboration and implementation of the national policies in the sectors of agriculture and animal production; it plays an important role in the use of water resources, particularly related to fisheries and pisciculture; (ii) *Ministry of Equipment, Territorial Planning, Environment and Urbanism* - elaborates and implements national policies in the field of basic infrastructure, territorial planning, protection of the environment and nature, and urbanism and habitat; (iii) *Ministry of Industry, Commerce and Transport* - elaborates and implements national policies in these fields; it is also responsible for the production, the processing and the dissemination of meteorological data; this ministry includes the *National Administration of Meteorology* (DNM) and the *National Administration of fluvial transports*; (iv) *Ministry of Territorial Administration and Local Communities* - elaborates and implements policies aiming at the administrative organisation of its national territory and the development of communes; (v) *Ministry of Mines, Energy and Water* - elaborates and implements the national policies related to the development of mineral, energetic and water resources; this ministry includes the *National Administration for Hydraulics* (DNH).

A cell for the implementation of the concept of Integrated Water Resources Management (IWRM) was created in 2002 by the DNH; it is mandated to co-ordinate and facilitate the process of initiating and following through on the implementation of IWRM in Mali. That same year the *Niger River Basin Agency* was created to safeguard the Niger River; amongst others, it is responsible for contributing to the prevention of natural risks (inundation, droughts, erosion), and the fight against pollution and nuisances;

For the co-ordination between the different national administrations, an *Inter-Ministerial Co-ordinating Committee for the Water Sector and the Sewerage* was established in 1995.

As regards the involvement of interest groups in flood management activities, *regional and local water councils* are mandated to give their opinion on all water related issues that are submitted by the Administration responsible for water resources. In addition *water (sub-) basin committees* are entrusted to guarantee a concerted management of water resources at these levels. The



population through village organisations, management committees of drinking water supply pumps, water users associations are generally active at the local level and may interact with municipalities, communes, etc. Finally, *development partners* (NGOs, donors) are involved in the financing and execution of works related to water resources development.

5. Policy

The *national water policy* has been defined in the *Master Plan* on the uses of water resources approved in 1991. Through the exploitation of water resources it aims to improve the food security, living conditions, environmental protection, and the regional integration with neighbouring countries. The policy covers the management and prevention of flooding by means of the following measures envisaged: (i) reinforcement of the hydrological forecasting and early warning system to avoid damage to vulnerable zones, related especially to the effects of flooding and droughts; the system will also allow to determine the role of the main reservoirs for a rational water management for upstream and downstream users; and (ii) identification and mapping of flood-prone areas and the development of an early warning system for inhabitants of these risk zones. As already indicated, a new national water policy is currently being elaborated and will be based on the principles of IWRM.

The *Water Code*, promulgated in 2002, is inspired by the objectives of the National Water Policy. It is a legal instrument that covers all aspects of management, territorial planning and development of the national water resources. It defines the principles of a global, sustainable and equilibrated water resources management. The recent changes in the Water Code indicate that the flood water management is not only a state responsibility, but may also be (partly) the responsibility of decentralised units such as communes, district councils and regional councils. It is expected that these units react rapidly to extreme flood events and organise a general mobilisation to limit the extent of the damage caused by these floods.

6. Main lessons learned (*pending - to be completed by authors*)

- The ecosystem of the Niger River inland delta, as well as the traditional farming systems that exploit its natural resources in the flood plains and the lakes, depend directly on the extent of the annual river floods. Any extension of planned irrigation schemes upstream of the delta or the installation of dams is going to have an impact on the ecosystem and thus on the traditional farming systems.
- The structural measures are efficient in ensuring to a certain extent the agricultural production, but are not always adapted to the highly variable hydro-climatic conditions of the Delta. Improving the design and concepts of this infrastructure constitutes a big challenge for the rural development of this area.
- The droughts, but also the relative abundant floods of the middle and late nineties, have brought about an increasing demand for information from the administration as well as the populations regarding flood forecasting and an early warning system; it is expected that shortly these systems can be made operational for the Delta.
- Existing legislative texts and rules related to the management of water need to be adapted to provide a more comprehensive and integrated view of the constitution and the uses of water resources. In addition, the on-going process of decentralisation with the creation of *communes* will modify some of the responsibilities related to water resources management, which needs to be reflected in the laws and regulations.