The Niger, a lifeline

THE NIGER, A LIFELINE

Effective water management in the Upper Niger Basin

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Preface

Water, a source of life, forms a unique resource as well for several concurrent exploitations.

Considering this, the complexity of basin management appears to be a challenge in view of which the soundness of decisions whether taken by administrators or communities involved constitutes the best guarantee for stability and harmonious development.

The Niger River Basin covering practically all administrative and economical regions, represents for Mali what a vascular system means for the human body.

In view of this, every study which helps to understand an economic, social and cultural phenomenon in this geographical area, is considered by the Malian Government as a contribution to national edification.

In this context the present work describing the life of certain Niger River communities in detail, comes as a contribution by a Son of Mali, to the joint management of this major resource.

Therefore, in my capacity as executive water manager, we appreciate this quality achievement as a contribution to obtaining the objectives and to the investigation of interactions between the ecosystem and the socio-economic activities in the Niger River Basin.

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Ministre des Mines, de l'Energie et de l'Eau
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1 INTRODUCTION

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Water shortage has been identified by the United Nations Environment Programme (UNEP) as one of the most serious problems of the new millennium. For many decades, however, it has already been a dire problem for millions of people living along the southern fringe of the Sahara desert. For the communities living in the semi-arid, western Sahel zone the Senegal and the Niger rivers are a lifeline. Indeed, Mali is a classic case of a 'river-dependent economy' that is subject to enormous seasonal variation in rainfall and river flow. A popular solution to this climate dependency in the western Sahel zone has been the development of hydroelectric and hydro-agricultural irrigation schemes (Fig. 1.1).

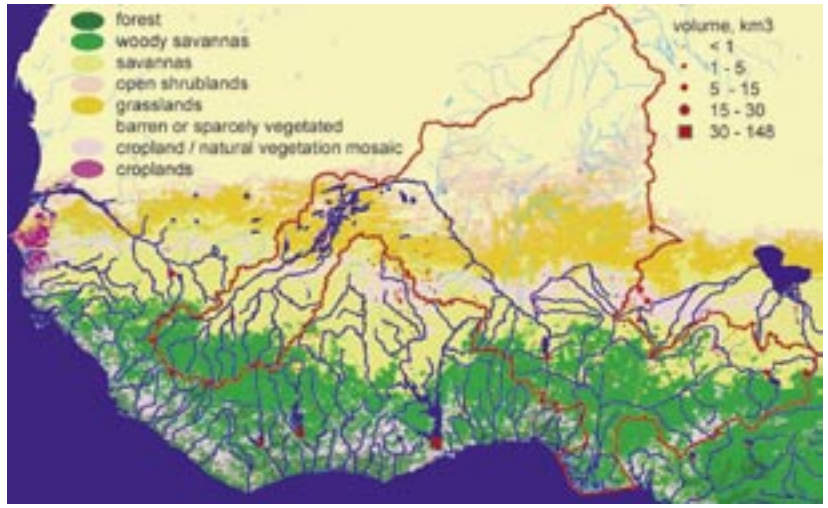

Fig. 1.1. The Niger Basin (red outlining) and the existing dams in western Africa (red dots).

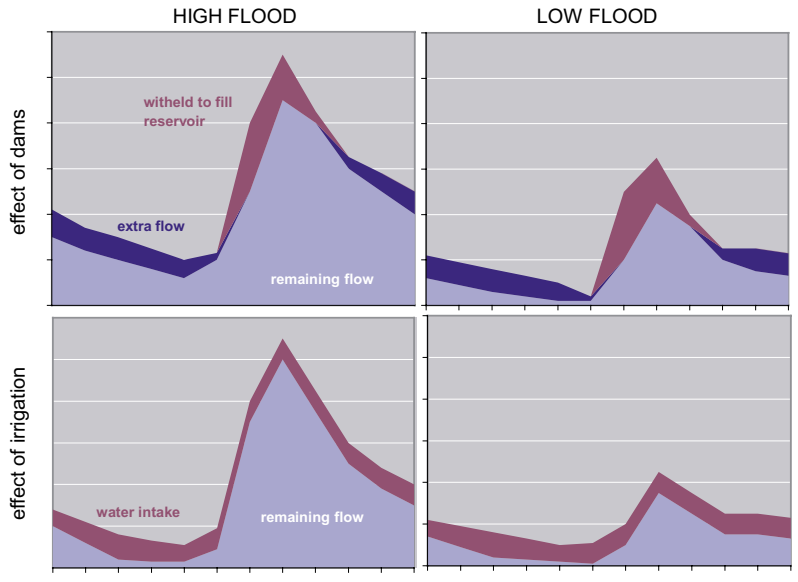

Fig. 1.2. Schematic hydrological effects of dams and water intake for irrigation during the flood cycle in years with a high and low flood. The flood cycle in the Western Sahel zone runs from June to December. Lowest flood levels occur from March to May.

Poverty Reduction Strategy Paper

The Poverty Reduction Strategy Paper (PRSP) of Mali constitutes the sole framework for Mali's development policies and poverty reduction strategies (GoM 2002). This influential document highlights the need to exploit the country's hydroelectric potential in the order of 5,000 GWh/annum. So far, high costs of both energy equipment and distribution networks have prevented expansion on such a scale. Mali's potential hydro-agricultural capability is also substantial, estimated at 2 million hectares. A review of the PRSP by the International Development Association (IDA) and the International Monetary Fund (IMF) confirms this, stating that "further development of Mali's untapped hydrological potential for agriculture and drinking water purposes is a critical need, as it directly addresses one of Mali's core vulnerabilities, that of the temporal and spatial variability in rainfall, as well as the uncertainty of climatic conditions" (IDA & IMF 2003).

Although Mali's hydroelectric and hydro-agricultural potential has yet to be fully realised, it is widely questioned whether the costs and benefits of such mega-investments are properly estimated. Besides the economic feasibility (i.e. direct costs and benefits) of additional dams, it is still unclear what the indirect effects of hydroelectric and hydro-agricultural schemes are on downstream beneficiaries of rivers. These beneficiaries include fishermen, cattle breeders, shipping companies and farmers, as well as the biodiversity of the river and connected floodplains.

Balancing interests

Hydrological interventions (i.e. dams and irrigation schemes) aim to increase economic independence and food security in the unstable Sahel environment. Tapping the Niger's flow, however, is not without consequences. Fig. 1.2 shows how irrigation takes a fixed amount of water throughout the year, while hydroelectric structures store water at peak flood levels and subsequently release it. The hydrological effects of both are felt most profoundly during the dry season and in years with low floods.

The following explanation helps to illustrate this: a natural river discharge of 10 to 20 km3 varies annually by a factor of 2. When extracting 5 km3, the downstream discharge fluctuates between 5 to 15 km3, in other words, by a factor of 3. Would this increasing downstream instability also lead to a decrease in food security? A long-term, sustainable management of the water system and it surrounding should be based on an integrated approach, where the trade-off between water quantity and reliability are taken into account.

Especially in the Sahel where water is so scarce, it is essential to optimise the use of the water, since nearly each use has an effect on the (potential) use downstream. Wise use of water would be even more important if the newly planned dams in the Upper Niger (Fomi), the Bani (Talo) and the Niger downstream of the Inner Delta (Tossaye) would be operational (Fig. 1.3).

Fig. 1.3. The Upper Niger Basin with three existing dams (Sélingué, Sotuba, Markala), one in construction (Talo) and three still in study (Fomi, Djenné and Tossaye).

Scope of this study

The merits and shortcomings of costly hydrological structures have to be carefully balanced. In this study we incorporate downstream interests into our analysis. Downstream outcomes are inherently difficult to quantify, and are therefore often omitted in similar enquiries.

The aim of this study is to develop a decision-support system for effective river management in the Upper Niger, in which ecological and socio-economic impacts and benefits of dams and irrigation systems can be analysed in relation to different water management scenarios. Multidisciplinary in nature, this study draws on the fields of hydrology, ecology and environmental economics.

To assess the impact of the three man-made structures in the Upper Niger region, four hypothetical scenarios were simulated and analysed. These scenarios are used as central reference points throughout this study:

- Scenario 0. Without Office du Niger (ON) & Sélingué (Sél): In this scenario, neither Sélingué nor Office du Niger are present in the Upper Niger. This hypothetical situation acts as a 'baseline', illustrating the natural hydrological state more than 50 years ago;

- Scenario 1. Without Office du Niger & with Sélingué: In this scenario, Sélingué is still present but Office du Niger is absent;
- Scenario 2. With Office du Niger & with Sélingué: This scenario reflects the present situation, in which Sélingué and Office du Niger are in full operation in the Upper Niger;
- Scenario 3. With Office du Niger, Sélingué and Fomi: This scenario is similar to the present scenario but includes the existence of the proposed Fomi dam. The main purpose of this scenario is to evaluate the impact of this planned dam.

In this stage, the study will ignore three other dams: Talo, Djenné and Tossaye (Fig. 1.3).

Impact pathway approach

To determine the costs and benefits, a wide range of information is required. A consistent way to organise this information is to pursue the sequence of underlying processes, starting with the cause of an impact, on to the physical impact and ending with the social, economic and ecological effects. This so-called "impact pathway approach" is a methodology that proceeds sequentially through the pathway, linking causes to impacts, and valuing these impacts subsequently. The framework of the impact pathway represents the physical and socio-economic processes resulting from water management in the Upper Niger.

The evaluation of the physical effects of the dams is possible since the daily variation in water level and river discharge has been registered at many different stations along the Upper Niger for many decades. In combination with remote sensing data, this allows for statistical analyses to reveal the downstream effect of the dams and irrigation. The same data are also entered into a water balance model. These results permit to approximate the main effects of each scenario on the various benefit categories and evaluate the changes for the various stakeholders (i.e. local, national and international agents) and the involved regencies (i.e. upstream and downstream).

Having established and tabulated the full range and significance of the effects, changes are valued in monetary terms. The main impact pathways that will be covered include agriculture, fisheries, livestock, biodiversity, energy supply and transport.

Outline of the report

The impact pathway approach requires a substantial input of data from various disciplinary. In that sense, the study can be considered to be truly multidisciplinary. This is reflected in the outline of the report (Figure 1.3).

Chapter 2 summarizes the available hydrological information on seasonal and annual variation in river discharge and rainfall patterns. The chapter includes a model simulating the behaviour of the river basin under various hydrological conditions and infrastructures and in this way offers a tool to evaluate a variety of measures related to infrastructure. The information from Chapter 2 is used in Chapter 3 to describe the effect of the infrastructures on the flooding of the Inner Niger Delta. The flooding itself is described in detail, using remote sensing techniques.

The next six chapters describe the relationship between, on the one hand, the flooding of the Inner Niger Delta and, on the other hand, people (Chapter 4), fisheries (Chapter 5), vegetation (Chapter 6), livestock (Chapter 7), agriculture (Chapter 8) and ecological values (Chapter 9). The collected data are used to indicate the impact of upstream infrastructures.

The following two chapters deal with the existing upstream infrastructure itself. The chapters describe the economic and ecological values of the Sélingué reservoir (Chapter 10) and the irrigation area of Office de Niger (Chapter 11).

All information from chapter 9 to 11 is combined for an ecological evaluation of the direct and indirect impact of the man-made infrastructures (Chapter 12). One of the side effects of the hydropower reservoir and irrigated rice fields is the creation of an artificial wetland. Chapter 12 investigates whether this gain is sufficient to compensate for the evident ecological losses downstream.

Chapter 13 analyses the effect of the infrastructures on the transport and integrates all information given