

# River basin planning and management of wetlands

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## Summary

The Rufiji River basin has wetlands with economic functions that require conservation; these functions have hitherto been taken for granted. Mismanagement of this basin would have direct effects on these various functions and their values. The execution of large projects (e.g. hydropower and irrigation) may have effects which need to be evaluated. Coordinated planning and management at the river basin level is required for the sustainable utilisation of wetlands.

## Introduction

To illustrate river basin planning, the catchment of the Rufiji River has been used as an example in this paper. The Rufiji Basin (Figure 1) is the largest catchment basin in Tanzania, covering 177,420 km<sup>2</sup>, and has the highest potential for hydropower in Tanzania. The Rufiji Basin Development Authority (RUB ADA) was established in 1975 by an Act of Parliament. Its primary functions are the generation of electricity by hydroworks, the undertaking of flood control measures, and the promotion and regulation of activities in the sectors of industry, agriculture, forestry, fisheries, tourism and transport. Since RUBADA's establishment, its major activities have been in the research and planning of the energy sector.

The planning of the Stiegler's Gorge Hydropower Project was developed to tendering level but, unfortunately, the project was not implemented due to the high costs involved. A pre-feasibility study, carried out by RUBADA on irrigated agriculture in the Lower Rufiji, recommended wetland rice as the main crop for both large scale and small scale irrigation. RUB ADA has two irrigation projects in the Rufiji Basin; *KOTACO*, in the Kilombero Valley, and *TAN/IRAN JKARUDEP*, in the Lower Rufiji Valley. These are being executed in collaboration with the Governments of Korea and Iran respectively.

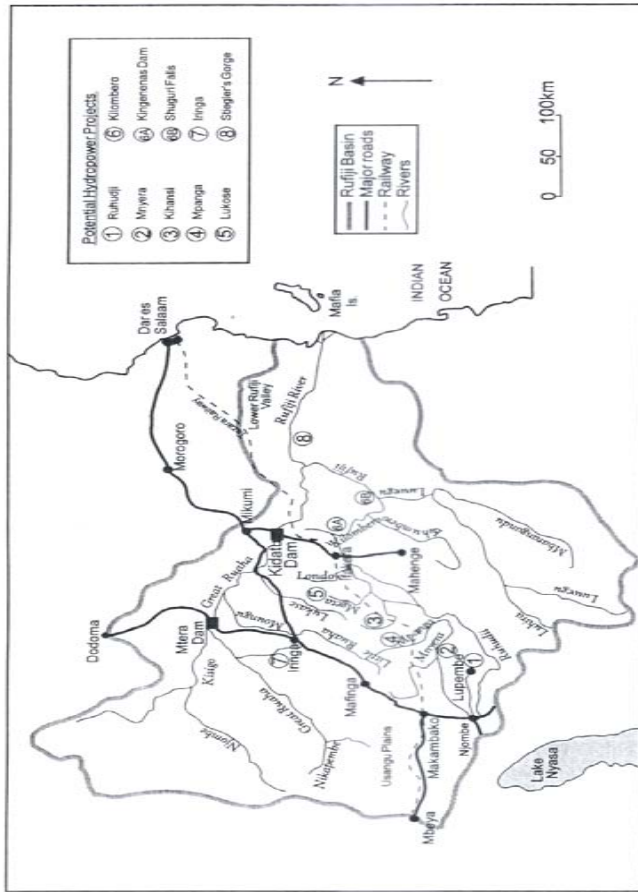


Figure 1 Rufiji Basin showing hydropower potential

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## **The importance of wetlands**

Wetlands are important resources which include freshwater swamps, floodplains (Kilombero and Rufiji Rivers), coastal swamps and mangroves (Rufiji Delta).

The Selous Game Reserve, within the Rufiji Basin, covers 21,000 km<sup>2</sup> and is one of the largest game reserves in Africa with approximately 750,000 large mammals. The wetlands therein provide habitats for a wide range of animals. If communication is improved, the Selous Game Reserve offers an alternative environment for tourists compared with the commercialised tourism of the northern circuit. Hitherto, most of the tourist activities have been concentrated in the northern circuit but there are now plans to include the Selous Game Reserve in beach and safari holiday packages. It should be emphasised that one of RUB ADA's functions is to promote tourism.

The total mangrove area of Tanzania is approximately 50,000 ha, of which 32,000 ha are concentrated in the Rufiji Delta. Mangroves are harvested mainly for export to the Gulf States. There is a need to conserve the mangroves and minimise the destruction of the resource by non-sustainable activities.

The importance of wetlands can be further appreciated when the floodplains are taken into account. Tanzania is a net importer of food and these areas are potential 'bread baskets' for the country. However, floodplains experience both flooding and drought, and agricultural developments, especially in the Lower Rufiji Valley, must address these related but diverse problems.

Wetlands are also the sites of rich fisheries and professional fishermen depend on these areas. Some farmers become fishermen at certain times of type year when they fish for home consumption and for sale.

## **Wetlands of the Rufiji River basin**

The Rufiji River basin covers 20% of the area of Tanzania, has 10% of Tanzania's population and 30% of its surface water. The basin can be conveniently divided into three parts, the Lower Rufiji Valley, the Kilombero Valley and the Usangu Plains.

### **The Lower Rufiji Valley**

In the Lower Rufiji Valley, 114,000 ha of land were identified as suitable for irrigation, of which 57,000 ha were highly suitable for irrigated agriculture (especially rice production). Some 33,000 ha were rated as moderately suitable and the balance of 24,000 ha, mostly in the delta, was marginally suitable due to potential salinity problems.

In the Lower Rufiji floodplain there are a number of small, permanent or temporary, lacustrine ecosystems (Figure 2). Three of the main lakes are situated south

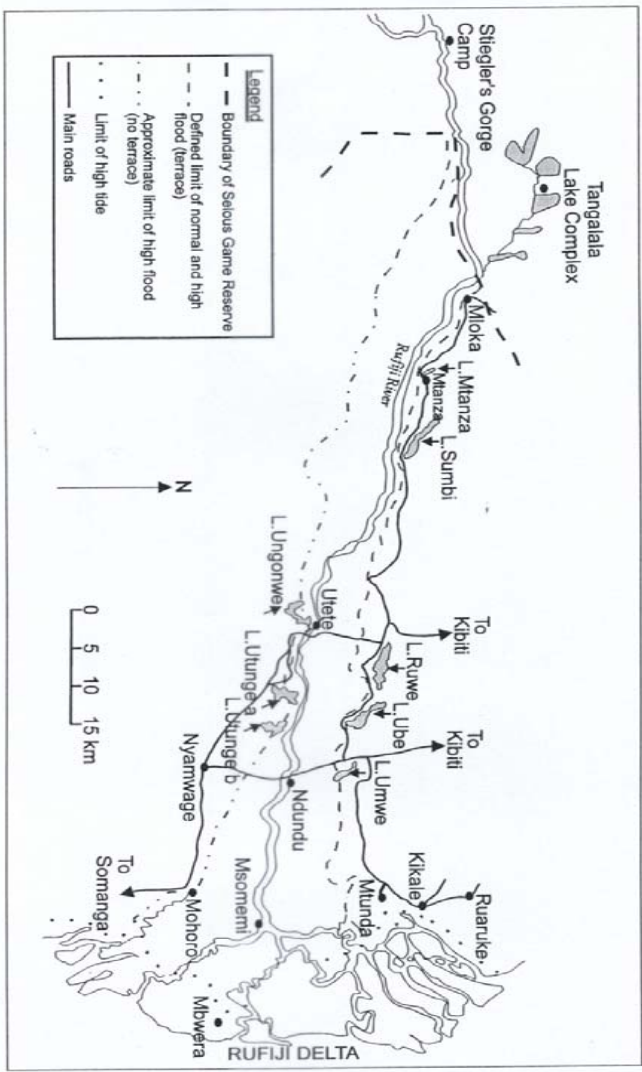


Figure 2 Lower Rufiji Valley and floodplain showing lacustrine wetlands and the delta

of the river and ten lakes lie to the north of which five belong to the Tangalala lacustrine wetlands.

Within the Rufiji Delta are found marine sediments of the Jurassic and Cretaceous periods. These are overlain by recent alluvial deposits (mainly sand, silt and clay) transported from the Rufiji Basin as suspended sediment in rivers. Deposition of this sediment produces a deltaic region of shifting river channels where the Rufiji River distributaries fan out from a line drawn between Kikale in the north and Mohoro in the south (Figure 2). The water level in the channels is affected by ocean tides. A substantial mangrove forest (320 km<sup>2</sup>) has developed, making the Rufiji Delta one of the largest compact mangrove areas on the east coast of Africa.

## **The Kilombero Valley**

Approximately 38,750 ha of the Kilombero Valley (Figure 1) were designated to be suitable for irrigated agriculture. The majority (60%) of the Kilombero Valley is prone to flooding. Floods can be controlled by constructing protection banks on both sides of a cultivated area and arable land can be drained by ditches running down the slopes to remove excess water into the flood zones. The Kibasira Swamp is found on the Kilombero River.

## **The Usangu Plains**

The Usangu Plains are extensive alluvial plains located to the northeast of Mbeya town (Figure 1). They cover 1.5 million ha of which 208,000 ha are considered irrigable. In the Usangu Plains are wetlands known as Utengule Swamps.

## **River basin planning**

River basin planning must be carried out within overall national objectives such as self sufficiency in food production. Projects can be planned on the basis of existing natural resources (such as land, hydropower and forests) but unsustainable exploitation of resources can lead to serious problems. The costs and benefits of exploiting a resource must be determined before implementation because projects may also have negative impacts. A simple and commonly used rule in project assessment is that the total (overall) benefits should always exceed the costs. Economists usually speak of a project cycle which means the various stages of gathering data and decision making between the project's inception and completion. To illustrate some of these stages, examples from RUBADA's activities will be used.

## **Project identification**

Project identification is usually based on the existence of a certain resource and/or as the result of an existing problem. As the prices of fossil fuels increased steadily

from 1973, many governments, including Tanzania, looked towards cheaper sources of power, such as hydroelectricity. In the Rufiji Basin, there is an estimated hydropower potential of approximately 3,700 megawatts.

Because of food shortages in Tanzania, it was necessary to utilise the abundant land resource in the Rufiji Basin which has soils suitable for crop production. The KOTACO rice project arose from this line of thinking.

RUBADA has identified a problem of watershed mismanagement of the Rufiji River at Usangu Plains and therefore has initiated a project to redress the situation.

### **Pre-feasibility study**

At pre-feasibility level, some rough projections and costs are made but further work will be needed to determine whether the project is viable. At this stage a team of specialists (engineers, agriculturalists, agronomists, economists, environmentalists, sociologists), covering a wide range of disciplines, work together.

RUB ADA engaged Agrar- und Hydrotechnik GmbH (AHT) to do a pre-feasibility study on irrigated agricultural development in the Lower Rufiji Valley. AHT recommended a large scale irrigation project of 65,000 ha, divided into 9 blocks (RUB ADA, 1980). Ikwiriri block (15,500 ha) was recommended for initial development because of its superior soils and accessibility. Due to the high cost, complications and environmental problems of large scale irrigation projects, RUBADA has recommended a study of small scale irrigation projects.

Also at pre-feasibility level, RUBADA had commissioned the Ardhi Institute to produce the Usangu Land Use Plan. The consultants have collected data on the existing situation in the Usangu Plains, detailed trends in development, and identified areas of conflict. This study could not be continued due to lack of funds.

### **Feasibility study**

At the feasibility study stage, the economist narrows down the range of project options to the few that are most promising and recommends appropriate projects and courses of action. For the Stiegler's Gorge Project, a large hydropower project, a wide ranging study was carried out on the multi-sectoral development of the Lower Rufiji Basin, including the impact of the project on the development potential of agriculture, fisheries, forestry and tourism in the area. In addition, a series of environmental studies were commissioned which focussed on ecological and demographic impacts and covered wildlife, water quality, vegetation clearance, human settlements and health problems.

### **Aspects of river basin projects**

Projects in the Rufiji River basin involve the sectors of energy, agriculture, forestry, fisheries and watershed management. The projects must be evaluated to

ensure the environmentally sound management of water resources. In general, a good project has the following attributes:

1. The resource itself is maintained and adverse effects on other resources are considered and, where possible, reduced. The development should be self-sustaining and other resources, for example wetlands which have certain ecological functions, are maintained or effects on them minimised.
2. Options for future development are not foreclosed. This is important because some actions are irreversible.
3. Efficiency in the use of water and capital are key criteria in strategy selection. All projects require monitoring and evaluation. Monitoring is, surveillance over the implementation period of the project to ensure that work schedules, inputs, targeted outputs and other required actions are progressing according to the plan. Evaluation determines, systematically and objectively, the impact, effectiveness and relevance of project activities. It ensures that the project objectives are met and that lessons learned are used to rectify problems or to assist in the design and management of similar projects.

## **Hydropower**

Hydropower projects do not have a major impact on environment. The summary of the environmental impacts of smaller hydropower projects, identified by RUB ADA Consultants, is shown in Table 1. Besides the provision of inexpensive power, hydropower projects make a significant contribution to the fishery resource, have little impact on tourism and may improve the agricultural potential in some areas.

## **Agriculture**

The Rufiji Basin has a high potential for irrigated agriculture. A number of large irrigation projects, growing sugar and rice, are operating in the Kilombero Valley and Usangu Plains. Other projects, such as KOTACO, are still in the construction stage.

## **Forestry**

There are 92 forest reserves in the Rufiji Basin, covering approximately 10% of the total basin area. These forests are very important for the regulation of water resources. Unsustainable forest exploitation or clearance leads to reduction in quality and quantity of water resources. While there is awareness of the need to protect water sources, there are not enough financial and manpower resources to effect that protection.

The Rufiji Basin has suitable areas for industrial plantation forests. Afforestation has taken place in the highlands using exotic pines and cypress. RUB ADA does not have the financial resources for afforestation at either industrial plantation or village level.

Table 1 Summary of impacts of smaller hydropower projects in the Rufiji Basin

Project	Settlements	Infrastructure	Agriculture	Health	Fisheries	Wildlife/tourism
Ruhudji	Minor resettlement may be necessary	Some relocation	Minor	Minor	None	None
Mnyera	Some resettlement may be necessary	Road access to Taveta may be cut. Alternative route <i>via</i> dam wall must be provided	Minor	Minor, but control measures may be necessary	Minor	None
Kihansi	None	Minor	Minor	Minor	None	Minor
Mpanga	None	None	None	None	None	None
Lukose	Some resettlement may be necessary	Some road relocation may be necessary	Minor	Minor, but control measures necessary due to high population	None	Minor
Kingenenas	Some effects of inundation on settlements. Measures must be taken to protect Ifakara from flooding	Ifakara-Mahenge ferry service terminated. Alternative route <i>via</i> dam wall must be provided	40,000 ha farmland submerged, leading to resettlement of 10,000 people	Severe adverse affects on Ifakara unless control measures initiated	No negative impact on commercial fisheries	Minor impact on present hunting areas. Control of poaching will be necessary
Shuguri Falls	None	None	None	Measures necessary to protect construction and operating staff	None	Minor impact on present hunting areas. Control of poaching will be necessary
Iringa	Major resettlement	Considerable impact on Tanzam highway, 220kV power system, Tazara pipeline and local roads	Considerable loss of land leading to extensive resettlement	Adverse impacts will be considerable due to high population	Minor	None

5" ... 5'



## **Fisheries**

During the flood period, oxygen rich water spreads over vegetation. Fish move into the shallow water of floodplains to feed on the masses of insects, worms, decaying plants, fallen fruits and mineralised water; during this time they breed.

One of the RUB ADA's main activities is to institute measures of flood control; therefore, a thorough appraisal of the effect of this on fisheries needs to be carried out. Limnological studies, carried out along the Rufiji system as far as the delta and Mafia Channel, show that the whole Rufiji system has commercial fishery potential.

## **Water resource management**

Hydrological studies in the Rufiji Basin are necessary to determine the availability of surface water resources for human consumption, livestock use, irrigation and hydropower generation. Planned, sustainable use of this resource must take into consideration various existing and potential conflicts in the exploitation of the water resource of the Rufiji Basin.

## **Comprehensive management planning of water resources**

Water projects are usually conceived as a result of existing or potential problems and have a specific objective to achieve. In this world of scarce resources, and as environmental considerations gain ground, alternatives must be appraised and their implications and impacts assessed.

To ensure optimal utilisation of the water resource, it must be treated as an economic good and economists must make cost/benefit analyses for water projects. It is not easy or possible to quantify all aspects of a project. Water resources have numerous potential uses, some of which compete with each other. This problem has already been identified in the Rufiji River basin.

The best use of the water resource occurs when water using activities are coordinated and planned together. The numerous water uses for the Rufiji system include hydropower generation (Kidatu and Mtera Dams), flood control (planned for the Lower Rufiji Valley) and irrigation development (Kilombero and Rufiji Valleys). It is necessary to integrate water planning with overall economic and social planning. Hydropower and irrigation projects are usually expensive and therefore must be in line with the economic and social conditions existing in the country.

Water resource development affects other resources, for instance wetlands, and there is need for coordination between agencies representing all aspects of water resource development. An obvious coordinating agency would be a river basin development authority. To ensure orderly and sustainable development, such an authority must have the powers to plan, monitor and control project activities taking place in the basin. The authority should also be empowered to make and enforce by-laws relating to the management of the river basin.

## **Public participation**

Public participation in river basin management has been taken for granted and there are cases where conservation programmes have been unsuccessful because of the peoples' non-involvement. Public involvement should ideally take place as early as possible in the project.

## **Environmental effects of basin projects**

Until very recently, most third world countries did not give sustainable development its due weight. RUB ADA now emphasises the use of Environmental Impact Assessments (EIAs) but it must have the financial means to commission them. In developed countries, different interest and pressure groups are consulted and involved in EIAs.

## **Social impacts**

Apart from the economic and environmental dimensions, projects have social impacts. Usually people's traditional life styles are modified as a result of large projects in their area. New towns arise and lifestyles become more urban; new economic activities begin while others are abandoned. Often products that used to be produced within the locality have to be imported.

## **Afforestation**

Water resources management essentially means watershed management. Therefore, RUBADA must encourage better land use practices in the basin. Afforestation programmes must be financed by the government and donors, as private investors will be discouraged by the long gestation period of the project. For successful afforestation projects, the villagers must be mobilised and involved at the planning stage.

## **Conclusion**

River basins contain many resources and if these resources are not exploited in an orderly way the ecological balance will be disturbed. Within the basin, it is possible to find experts giving contradicting advice and their work needs to be integrated and coordinated by one body, such as RUBADA.

The exploitation of resources is part of development. Attempts must be made to replace resources and to conserve those that cannot be replenished. Projects should be appraised for their impacts on the whole basin.

Comprehensive data should be collected on the resources of the basin and project impacts can only be determined if this data is accurate. RUB ADA needs financial and technical support to carry out these functions properly. RUB ADA further

needs to have legal powers over the basin area in order to plan, monitor and control development activities within the basin.

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