

# Application of the RAFLS model for integrated water resource management for the Itezhi-Tezhi/Kafue river system

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## Abstract

The modelling system could be a tool for predicting the flow regime in water management operations. The modified RAFLS model has exhibited a profound accuracy in the simulations of the Itezhi-tezhi/Kafue River system. The simulated flows and reservoir levels portrayed the dynamics in terms of time and magnitude.

The use of the RAFLS model for water management in the subcatchment will result in flood protection, less evaporation from the shallow and wide natural reservoir, the Kafue Gorge Reservoir, available grazing grounds for the local communities, reclaimed fertile flood plains for farming by the local people, favourable flow regime for the ecological system, land use and efficient release of water from the reservoirs that would enhance conservation for drought situations.

**Keywords:** modelling, prediction, water management, Kafue Gorge Reservoir, Zambia

## Introduction

Chapman et al. (1975) define flood routing or stream routing as the process of calculating the hydrograph at the downstream end of a reach given the hydrograph at the upstream end. Wilson (1974) describes flood routing as the procedure through which the variation of discharge with time at a point on a stream channel may be determined by consideration of similar data for a point upstream. Chapra (1997) recounts that a spectrum of models that are available to simulate dynamic water movement for streams are based on the St. Venant equations. The latter result from taking mass and momentum balances on a one-dimension channel.

Stakeholders including environmentalists, farmers, fishermen, wildlife department, local authorities, etc. have expressed grave concern over the water resource management of the Itezhi-tezhi (ITT)/Kafue River system in Zambia in the past three decades. Stephenson and Randell (2000) state that complex systems require computer modelling to maximise the output.

This system consists of three reservoirs, two regulated and one unregulated. The regulated are Itezhi-tezhi Reservoir with a full capacity of 6 000 000 m<sup>3</sup> and Kafue Gorge with a full capacity of 800 000 m<sup>3</sup>. The non-regulated is the natural reservoir with a capacity of about 3 000 000 m<sup>3</sup>. The average annual flow for the Kafue River is 300 m<sup>3</sup>/s (Source: ZESCO database).

Concerns hinge on the water management scenarios that have been implemented by the water managers, viz. ZESCO Limited. Some stakeholders dispute that the water level fluctuations in the reach do not mimic the natural or the previous unregulated flows; hence, this has substantially affected aquatic, animal and human lives, resulting in the following:

- **Agriculture:** The local people who rear animals complain about the persistently high water levels that do not recede,

therefore allowing no shooting of grazing grass during summer. The other problem is that they are unable to practice their traditional 'recession agriculture' with receding water levels.

- **Fisheries:** The breeding and migratory patterns of most fishes have been severely disrupted due to lack of flooding or poor timing of regulated flooding.
- **Wildlife:** The feeding and breeding grounds are known to have been lost due to low flooding during the rainy season and high flooding during the dry season (Rees, 1978; Chabwela and Ellenbroek, 1990).

A considerable number of studies have recently been conducted in the above-mentioned river system; however, the recommendations are hardly implemented. To some extent this has been due to non-inclusion of ZESCO Limited who handle the water management, in the technical deliberations, and specialists from other fields tend to be biased. Hence, some of the recommendations made prove to be unattainable because they are merely theoretical.

In 2001 World Wide Fund for Nature (WWF) initiated the Integrated Water Management Project for the Kafue Flats (the area between Itezhi-tezhi and Kafue Gorge Reservoirs, Fig. 1). The Project's main concern was the preservation of the wetlands environment of the area liable to flooding (WWF, 2004). KAFRIBA Model was one of the supporting tools in decision making for the operation of the Itezhi-tezhi and Kafue Gorge Reservoirs.

However, in order to narrow the rift between the stakeholders' expectations and the water manager's operations, a modified RAFLS Model that integrates variant interests in the water resources management on the Itezhi-tezhi/Kafue River system is presented in this paper.

## Study area

The Itezhi-tezhi/Kafue River system stretches along the Kafue River from Itezhi-tezhi Reservoir to Kafue Gorge Reservoir (Fig. 1). Downstream of the Itezhi-tezhi Dam the subcatchment

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