

TRANSBOUNDARY ISSUES ON SUSTAINABLE HYDROPOWER DEVELOPMENT IN THE ZAMBEZI RIVER BASIN IN THE EYES OF THE ZAMBEZI RIVER AUTHORITY

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Abstract

The Zambezi River, Africa's fourth largest river after the Congo, the Nile and the Niger, holds the largest installed and potential hydropower capacity in Southern Africa. The estimated hydropower potential of this trans-boundary River is of the order of 20,000MW of which about 5,000MW has been developed (Tumbare, 2004). Herein lies the Region's opportunities for tapping this environmentally sustainable cleaner energy source.

This paper discusses some of the issues and "best practice approaches" in the management and possible development of the Zambezi River's hydropower base in the context of the Zambezi River Authority. Issues considered include trans-boundary water resource allocations at the Kariba Complex, meeting the region's energy deficit, dealing with overlapping and/or conflicting trans-boundary water resource policies and legislation, basin-wide Integrated Water Resources Management (IWRM), and conjunctive hydropower system operation.

1. Introduction

Southern Africa's longest trans-boundary river, the Zambezi, rises at 1,585 meters above sea level in north-western tip of Zambia. The River flows for some 2,700km through plains, gorges, rapids and cataracts before spreading out in deltoid form as it enters the Indian Ocean in the East Coast of Mozambique. The River carries more than 75% of the mean annual runoff of the region's interior, and drains more than 40% of the landmass. Demand for water is increasing with population and economic growth. Along its meandering journey to the Indian Ocean, nurturing life in its waters, along its banks and beyond, the Zambezi is not only a source of water but also of food, electricity, transport, communication and recreation for millions of people.

The Zambezi River Basin (Fig. 1) is the fourth largest river basin of Africa, after the Congo/Zaire, Nile and Niger basins. The Basin covers some 1.3 million square kilometres spread over eight countries, namely, Zambia (40.7%), Angola (18.2%), Zimbabwe (18%), Mozambique (11.4%), Malawi (7.7%), Botswana (2.8%), Tanzania (2%) and Namibia (1.2%). Almost 33% of the total population of the riparian countries live in the basin.

The Zambezi Basin holds an enormous potential in hydropower and water supply development for the 38.4 million people (Zambezi Basin State of the Environment 2000) who live and depend on its resources, not mentioning the other millions from outside its boundaries who too, directly or indirectly, depend on it in one way or another. The estimated hydropower potential of this trans-boundary River is of the order of 20,000MW of which about 5,000MW has been developed (Tumbare, 2004). The two major hydropower installations are the famous Kariba (1,266MW) and Cahorra Bassa (2,000MW) schemes on the common Zambia/Zimbabwe border and Mozambique, respectively.

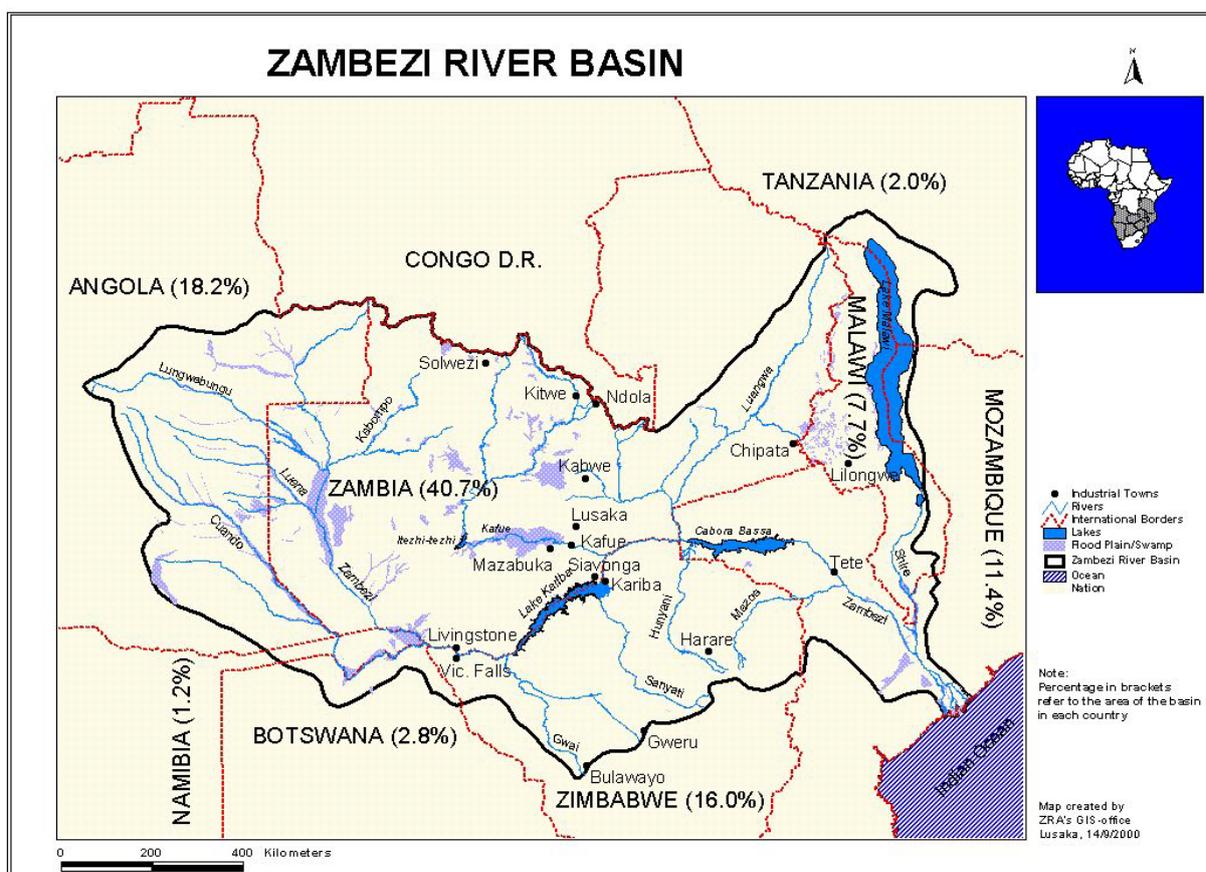


Figure 1. The Zambezi River Basin showing Major Water Courses and Area Coverage (%) by Country

2. Trans-boundary Issues relating to Hydropower Development – the Kariba Case

The Zambezi River Authority (ZRA), a corporate body owned by the governments of Zambia and Zimbabwe, is set up to administer the Kariba Complex (Kariba Dam and attendant infrastructure) and the stretch of the Zambezi River shared by the two countries. As a quasi-government institution, ZRA is governed by a Council of Ministers and a Board of Directors represented by Ministers and Permanent Secretaries holding respective portfolios in the Ministries of Energy and Finance.

From its inception the ZRA was given the mandate to improve and intensify the utilisation of the Zambezi waters for the production of energy and for any other purposes beneficial to the two countries. Under the ZRA Act of 1987 (Act No. 17 and 19 of the Republics of Zambia and Zimbabwe, respectively), ZRA serves as a secretary and executing agency for the:

- Operation, monitoring and maintenance of the Kariba Dam complex (i.e., the dam itself and data collection infrastructure network)
- Investigations of new dam projects
- Collection and processing of hydrological and environmental data
- Liaison with utilities of water and related resources of the Zambezi River common to both countries
- Various administrative functions required for the implementation of the above activities

The creation of the Zambezi River Authority is undoubtedly the most significant undertaking in addressing the trans-boundary challenges of harnessing the hydropower potential of the Zambezi River common to the two countries. Through the ZRA Act, both the political and technical avenues of cooperation between nations have been pooled together for the common good.

Notwithstanding this landmark development, the Authority has experienced and, to a large extent, managed a number of challenging issues relating to hydropower development – the major ones of which are the subject of this paper and are discussed below.

2.1 Staff Equalisation

Whereas the establishment of the Zambezi River Authority as a bi-national institution is premised on equal sharing of resources and benefits from the shared Zambezi River and Kariba Dam, legislation in both countries prior to 1999 could not allow for equalisation of staff at junior levels. This led to a situation where the ZRA Operational Station in Kariba, Zimbabwe had more Zimbabwean nationals in the junior bracket than Zambians.

This situation has however, been rectified following the passing of parallel legislation by way of Zambezi River Authority Amendment Act, 1999 which gave effect to the recruitment of more Zambian nationals in junior positions at Kariba. The process of staff equalisation is still ongoing.

2.2 Water Allocations for Hydropower at Kariba

From inception, the Authority's annual budget was being financed by way of payments made by the Contracting States through the two Power Utilities, Zimbabwe Electricity Supply Authority (ZESA) and Zambia Electricity Supply Corporation (ZESCO) in equal shares. This arrangement, however, was eventually seen to create some imbalances in cases where, for various reasons, one country would utilise more water to generate power than the other but still contribute equal amounts to the operations of ZRA. Further, the Utilities did not feel obligated to pay Authority invoices that did not have direct deliverables attached to them.

In addressing this challenge, the Authority, through its Council of Ministers, implemented a tariff structure that takes into account the quantity of water used by the respective Utilities to generate electricity. In this regard, the two Governments of Zimbabwe and Zambia gazetted both the Zambezi River Authority Amendment Act, 1999 and the Zambezi River Authority (Water Tariff) By-laws, 1999 (Statutory Instruments No. 302 and 109 of 1999, respectively). The Amendment Act gave effect to allowing the Authority to allocate “water” instead of energy to the Contracting States as this is easier than to have to convert energy to its water equivalent.

Accordingly, therefore, the Authority then proceeded by installing flow meters at Kariba to measure the actual quantities flowing through the turbines. Through this tariff structure, ZRA allocates an equal amount of water from the Kariba Reservoir (based on the flow/energy forecasts) to each Utility for each ensuing year and charges a tariff on the actual amounts used. The By-laws also provide for incentives for efficient utilisation and penalties for over-utilisation of water by the Utilities. The Authority executes these By-laws through tri-annual reviews of a Water Purchase Agreement between ZRA and the Utilities. However, the Water Tariff itself is reviewed annually by a Joint Operations Committee comprising ZRA, ZESCO and Zimbabwe Power Company (ZPC, a subsidiary of ZESA Holdings).

2.3 Meeting the Region's Energy Deficit

The energy shortages being experienced in the region (which are poised to continue in the next 10-20 years) are definitely raising the profile of the Zambezi River Basin in the area of (re)investment in this sector. For ZRA, the challenge of pioneering Basin initiatives finds a foothold on its long (out)standing experience of managing the Kariba Complex.

Apart from this, ZRA is promoting the development of a number of identified potential hydropower schemes on the Zambezi mainstream, namely,

- 1600 MW at Batoka Gorge
- 1240 MW at Devil's Gorge, and
- 1000 MW at Mupata Gorge

Of the three sites, the Batoka is a priority, considering that economic feasibility and environmental/social impact (re)assessments have already been completed (1992 and 2000, respectively).

Regional cooperation in the development of such new hydropower schemes is more crucial now than ever before. Riparian countries that are upstream and / or those outside the borders of the potential sites have the opportunity to share the benefits of the Zambezi River water under the 'virtual water' concept. Moreover, the global changes in climatic conditions dictate conjunctive operation of hydropower developments in order to optimise water utilisation.

2.4 Overlapping (and sometimes Conflicting) Legislation

In both countries, there are several pieces of legislation that give mandate to different institutions to manage various water-based activities on the common water resource. These pieces of legislation may not only overlap but in a number of cases conflict each other on the ground. For instance, while the 1946 Zambian Water act (presently under revision since over five years ago) is silent about the Zambezi River, the Zimbabwean Water Act of 1998 considers the Zambezi River as being part of 'inland' waters whose management responsibility lies with three riparian Catchment Councils.

Considering the difficulty in harmonising these bi-national pieces of legislation, the Authority has proposed a set of 'guidelines' for water usage both as a 'quick fix' solution in the short-to-medium term and a proactive measure to forestall potential conflict in the long term. These guidelines have since been submitted to the two national water agencies for their input.

Further to this, a Working Group under the auspices of the ZRA was established in 2006 through the signing of a Memorandum of Understanding between Zambian and Zimbabwean water and environmental monitoring institutions on collaborative implementation of water resources and environmental management initiatives in the Basin.

2.5 Pollution and Invasive Water Weeds

There are clear signs that nutrients (Nitrogen and Phosphorus) in some of the watercourses are reaching levels enhancing eutrophication. This means increased algae blooms, reduced transparency and enhancement of proliferation of water weeds. Water abstracted directly from streams for urban use will need more expensive treatment, fisheries will be affected and biodiversity will be reduced. Already a number of alien invasive weed species, including the water hyacinth, have been observed in several water bodies on the catchment.

Water weeds thrive when nutrients are present in comparatively high concentrations and are therefore a problem closely related to eutrophication. In some watercourses, e.g. Lake Chivero in Zimbabwe, Kafue Gorge Reservoir in Zambia and indeed Lake Kariba, this had once become a critical factor. Without the pragmatic mitigation measures that were undertaken, the tendency would have been increased proliferation today.

Attention is therefore being focused on causative factors such as landuse on the upstream catchment. The complexity of such an intervention though, lies in resolving the conflict between increased production (food security) to alleviate poverty through heavy usage of, say, chemical fertilisers and irrigation on one hand and controlling pollution loads at source on the other. Further, advocacy to streamline legislation on who should be responsible for the management of invasive weeds on the shared watercourses is being intensified both nationally and regionally.

ZRA has developed an Environmental Monitoring Programme for the Zambezi River between Chavuma (North-Western Zambia) and its confluence with the Luangwa River (Zambia/Zimbabwe/Mozambique border). Through this programme, the Authority is strengthening synergies among the various stakeholders in the water and environment sectors through the establishment of a ZRA-coordinated Environmental Working Group. One of the major outcomes of stakeholder involvement is development of Water Quality Guidelines (2002) for the shared stretch of the Zambezi River / Lake Kariba pertaining to aquatic biota, irrigation and livestock watering.

3. Conclusion

The Zambezi River, a trans-boundary River straddling eight countries in South-Central Africa, can be said to hold a major stake in providing the most needed energy demand in the region for many years to come. The Zambezi River Authority has proved that trans-boundary issues surrounding sustainable hydropower development can be resolved through continuous dialogue among the concerned stakeholders. The case of the Kariba Scheme will forever stand out as a masterpiece of cooperation between nations.

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