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The Zambezi River Basin: Potential for Collaborative Water Resource Research

by: Christine J. Kirchhoff and Jonathan W. Bulkley

The Zambezi River is an important natural resource for Southern Africa. The Zambezi River Basin is home to 40 million people who rely on the river for drinking water, fisheries, irrigation, hydropower production, mining and industry, ecosystem maintenance, and other uses. The river also attracts tourists from around the world, who come to see Victoria Falls and wildlife living along the river banks. Tourism supports local economies and brings much-needed foreign currency into the basin countries. Protecting and managing the sustainable use and development of the Zambezi is extremely important to the people living in the region.

Transboundary management of shared water resources has been a continuing challenge for all of Southern Africa, particularly in the Zambezi River Basin. The Zambezi River Basin (Figure 1) is the largest river basin in Southern Africa, covering some 1.37 million square kilometers across eight countries: Angola, Botswana, Malawi, Mozambique, Namibia, Tanzania, Zambia, and Zimbabwe. Water management in the basin is especially difficult because there are multiple countries with multiple and competing interests; competing issues other than water that demand time, attention, and money; inadequate basin-level institutional structures; institutional, legal, economic, and human resource constraints within each country; and poor data collection, poor communication, and inadequate training.

The eight basin countries share the Zambezi Basin watershed, but their interests in the river differ. For example, Zambia and Zimbabwe have the lion's share of the watershed within their borders; they are the only two countries that currently participate in bilateral management of the river. In addition, both countries share the Kariba Dam and Victoria Falls. Countries' needs also differ depending upon whether they are upstream or downstream and the adequacy of rainfall and water resources. Water-rich countries like Angola, Mozambique, and Zambia are less reliant on surface water for irrigation. Namibia receives scant rainfall and relies on groundwater for irrigation, a practice that is unsustainable because groundwater resources in the area are essentially nonrenewable. Table 1 summarizes the water resources available for each of the eight basin countries.

Table 1. Water resources in the Zambezi Basin (Scholes and Biggs 2004).

	Renewable Water Resources			
Basin Countries	**Total (km^3/ac)**	**Withdrawals (km^3/ac)**	**Withdrawals % of Total**	**Water 2001 (m^3/person)**
Angola	184.0	0.4	0.19%	13,620
Botswana	14.4	0.1	0.97%	8,471
Malawi	17.3	0.6	3.65%	1,641[a]
Mozambique	216.1	0.6	0.29%	11,960
Namibia	17.9	0.3	1.51%	10,022
Tanzania	91.0	2.0	2.20%	2,642
Zambia	105.2	1.7	1.65%	10,233
Zimbabwe	20.0	2.6	13.05%	1,560[a]

[a] Indicates water stress (1,700 m^3/person)

Seasonal rainfall variation is also an issue for Mozambique and other downstream basin countries due to flooding. The Zambezi has an average yearly flow of 3,600 cubic meters per second, but in the wet season the river overflows, resulting in damaging floods. These floods were once cyclical, but damming of the river has made the floods unpredictable and difficult to manage, and the issue remains contentious. In water-scarce countries, drought is always a concern, made more ominous by the risks associated with climate change. As Table 1 indicates, two countries, Malawi and Zimbabwe, are already under water stress. Climate change is expected to cause increased water stress in these areas and others as rainfall continues to decrease and evaporation rates increase with rising temperatures.

Even in areas with plentiful water resources, access to clean drinking water and sanitation remains a persistent and significant challenge across Southern Africa, particularly in rural and impoverished urban areas. Lack of access to clean water contributes to illness and death, particularly among children and those with compromised immune systems. Table 2 illustrates access to clean drinking water and sanitation for rural and urban populations in the eight basin countries. Increasing the number of people with access to clean water and sanitation is of critical importance in the region and is one of many issues competing for time, attention, and money.

Table 2. Clean water and sanitation in the Zambezi Basin (Scholes and Biggs 2004).

	Drinking Water Access		Sanitation	
Basin Countries	**% Urban**	**% Rural**	**% Urban**	**% Rural**
Angola	34	40	70	30
Botswana	100	90	88	43
Malawi	95	44	96	70
Mozambique	81	41	68	26
Namibia	100	67	96	17
Tanzania	90	57	99	86
Zambia	88	48	99	64
Zimbabwe	100	73	71	57

The lack of adequate institutional structures both within each country and at the basin level has long impeded progress on transboundary water management of the Zambezi River, though the tide may be turning. The Southern African Development Community (SADC), which encompasses all of Southern Africa from the Democratic Republic of Congo to South Africa and Madagascar, is a supra-regional body established for the purpose of integration, harmonization, and sustainable development for the region. SADC's charge is not simply economic; it is also concerned with sustainable use and management of natural resources including water. SADC's Water Division has been instrumental facilitating the development of institutions for Integrated Water Resource Management (IWRM) of the 15 shared rivers in Southern Africa, including the Zambezi River. IWRM involves integrative, collaborative planning and implementation of processes for sustainable development and management of water resources. The effort was initiated through the Zambezi River System Action Plan (ZACPLAN) in the mid-1980s. Unfortunately national sovereignty, competing water demands, human and financial resources, lack of knowledge, and power differentials have made instituting IWRM difficult. Even with

SADC in play, governance remains a key constraint to sustainable water resource management in the Zambezi Basin.

Sustainable water resource management is also impeded by poor data collection, management, and dissemination systems, inadequate training, and weak stakeholder participation. While management of the Zambezi may be a long time coming—and outsiders' ability to help alleviate the many challenges of achieving sustainable water resource management in the basin are limited—the U-M may be able to assist in some small but meaningful way if we are able to partner in research and capacity-building efforts in the region. These efforts could provide additional data and help train the next cadre of water resource management experts in Southern Africa as they wrestle with the difficult task of addressing management of a shared resource.

The authors traveled to Zambia and Zimbabwe to meet some of the key stakeholders working to establish a framework for transboundary IWRM in the basin, to explore the possibility of partnering in the basin, and to identify capacity and research needs with basin stakeholders and potential partners. A key outcome of our first visit was confirmation of the need for training and capacity building, as the lack of training and capacity continues to be a key constraint to local and regional governance of water resources. The trip also highlighted the importance of building long-term relationships with stakeholders in the basin as past, short-term efforts have had limited effectiveness. The University of Michigan, working in collaboration with a key university stakeholder in the Zambezi River Basin, has the opportunity to identify a critical water resource problem that would become the focus of a joint research effort. The water resource research topic will be selected to incorporate needs within the Zambezi River Basin and will capitalize on the expertise and talents at both institutions. Such a joint research project could yield a number of beneficial results. First, new knowledge will be produced that can be applied to present and future planning and management of the water resources within the basin. Second, students and faculty from each institution will have the opportunity to travel to each other's country to exchange ideas and learn firsthand about the issues and conditions there.

In order to effectively address the global challenges to meet human and ecosystem water resource needs in the 21st century, it is very important for higher education institutions to provide opportunities for both students and faculty from different regions of the world to work together and learn from one another. The combined impact of climate change and population growth poses a host of critical water issues, including water supply and sanitation as well as water for direct or indirect energy production. It is not only the quantity of water that is critical but the quality of the water as well. Land use and discharges into the river have adverse impacts on downstream waters. Potential diversion of waters from basins of origin to other regions need to be addressed both in this country as well as in the Zambezi River Basin. Consumptive use of water—where water is taken from its source but not returned—is a further issue of common concern. This is a brief listing of important global water resource issues that need to be explored. Students and faculty at the University of Michigan and at the stakeholder university in the Zambia River Basin could undertake this type of joint research and capacity building in a truly collaborative effort. Both institutions and the people of the Zambezi River Basin would all benefit from such a project.

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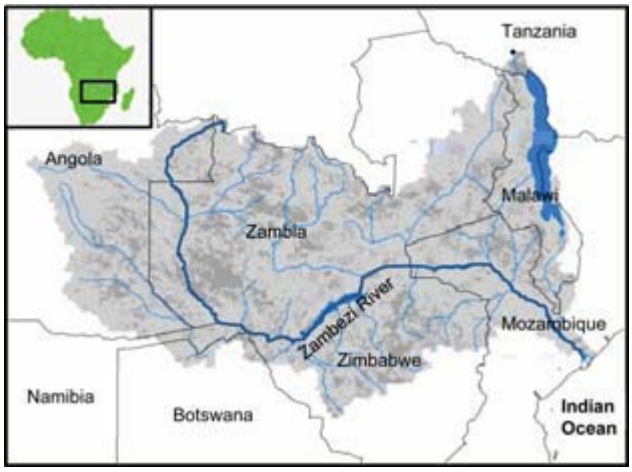

Figure 1. Zambezi River Basin, Southern Africa (Phiri 2007).