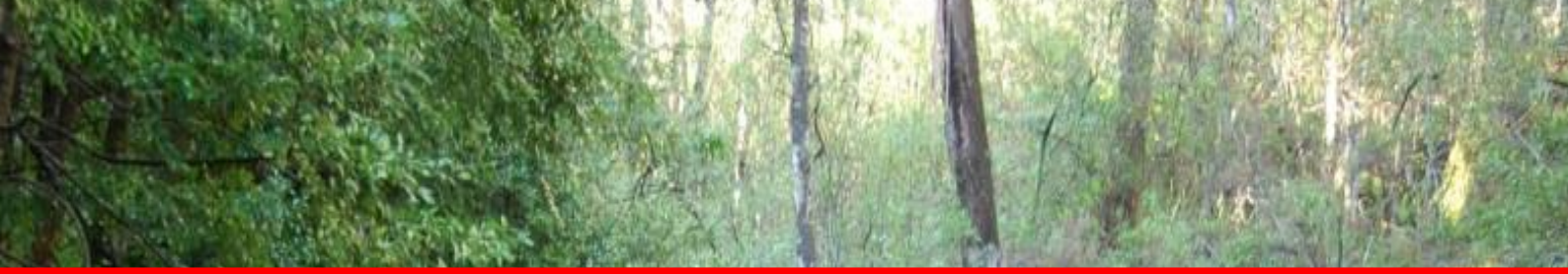
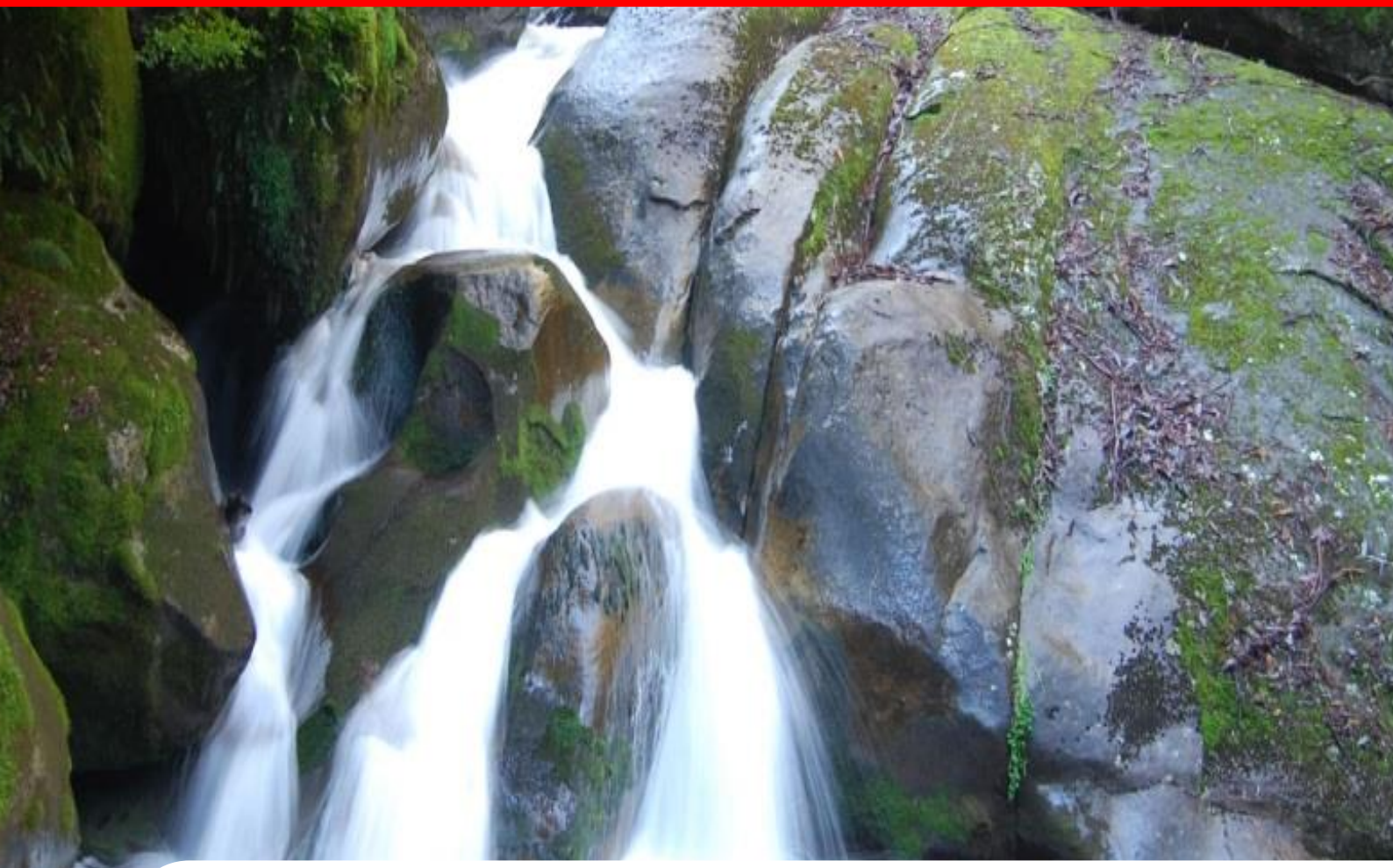


Zambia

Country Water Resource Profile



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Zambia

Country Water Resource Profile

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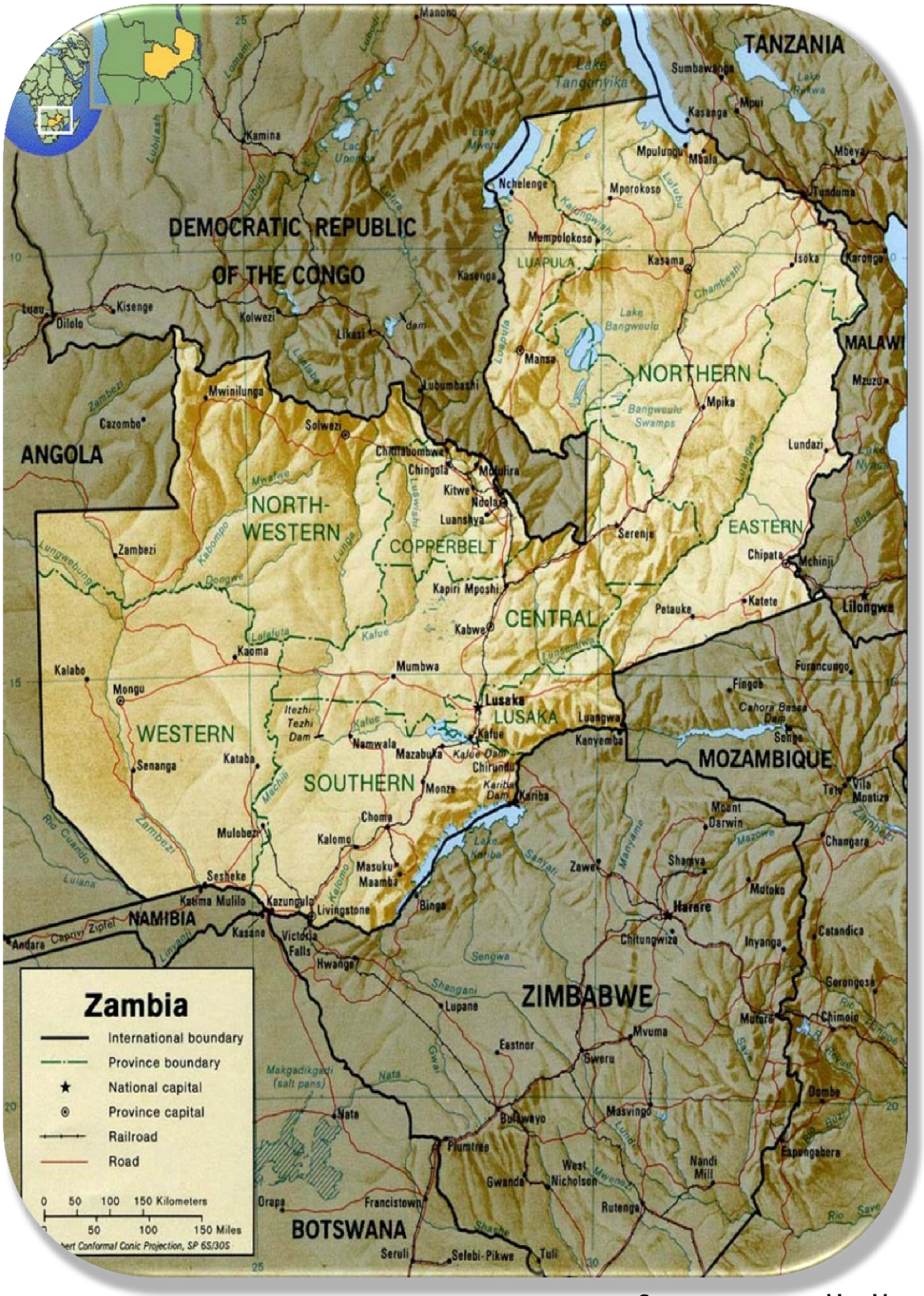
UNIVERSITY OF ZAMBIA

UNIVERSITY OF
KWAZULU-NATAL

AMCOST	African Ministers Council on Science and Technology
AMCOW	African Ministers Council on Water
AU	African Union
CSIR	Council for Scientific and Industrial Research, South Africa
CU	Commercial Utilities
CWRP	Country Water Resources Profile
EC	European Commission
FET	Further Education and Training
GWP-SA	Global Water Partnership, Southern Africa
JRC	Joint Research Centre
IWMI	International Water Management Institute
JLP	Joint Learning Programme
MDGs	Millennium Development Goals
MMEWD	Ministry of Mines, Energy and Water Development (Zambia)
NEPAD	New Partnership for Africa's Development
NISIR	National Institute for Industrial and Scientific Research (Zambia)
NRDC	National Research Development Colleges (Zambia)
RWSSU	Rural Water Supply and Sanitation Unit
SANWATCE	Southern African Water Centres of Excellence
SADC	Southern African Development Community
R&D	Research and Development
S&T	Science and Technology
UB	University of Botswana, Botswana
UEM	University of Eduardo Montlane, Mozambique
UN	United Nations
UNESCO	United Nations Education, Science and Cultural Organisation
SU	Stellenbosch University, South Africa
TAC	Technical Advisory Committee
UKZN	University of KwaZulu-Natal, South Africa
UNIMA	University of Malawi, Malawi
UNZA	University of Zambia, Zambia
UWC	University of Western Cape, South Africa
WIN-SA	Water Information Network - South Africa
WISA	Water Institute of Southern Africa
WPT	Water Project Toolkit
WRC	Water Research Commission (South Africa)

MAP OF ZAMBIA



Source: www.geographicguide.net

Acknowledgements

The AU/NEPAD SANWATCE would like to thank the European Commission (EC) Joint Research Centre (JRC) for making the Country Water Resources Profiles possible. This profile was put together by Prof. Daniel CW Nkhuwa, Ms. Carol Mweemba and Mr. Joel Kabika at the University of Zambia (UNZA) in April 2013.

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Our Origins: Network for Water Centres of Excellence

In September 2000, African countries and the international community adopted the Millennium Development Goals (MDGs) at the United Nations (UN) Millennium Summit. African leaders identified water scarcity and related insecurity due to water stress as one of the sources of the continent's underdevelopment and increasing social and economic decline.

To combat these developments and *"ensure sustainable access to safe and adequate clean water supply and sanitation, especially for the poor",* the African Ministerial Council on Science and Technology (AMCOST), a body of the African Union (AU), decided in 2003 that science and technology (S&T) is to constitute one of the flagship programmes of its implanting agency, the New Partnership for African Development (NEPAD).

AMCOST decided that S&T will play an important role in water development, supply and management and that S&T is crucial for assessing, monitoring and ensuring water quality. The flagship programme should strengthen the continent's capabilities to harness and apply S&T to address challenges of securing adequate clean water as well as managing the continent's resources to become a basis for national and regional cooperation and development.

Three years later, in 2006, the AMCOST and the African Ministerial Conference on Water (AMCOW) met in Cairo, Egypt to reiterate the importance of S&T. By resolution, the delegates committed themselves to establishing an African Network of Excellence in Water Sciences and Technology Development. Along AU/NEPAD policy, the water centres of excellence are to be established on a regional level, as of 2013, the Southern African Network of Water Centres of Excellence (SANWATCE) is constituted of eight institutions across Southern Africa:

- University of Botswana (UB),
- University of Zambia (UNZA),
- University of Malawi (UNIMA),

- University of Eduardo Mondlane (UEM) in Mozambique, as well as
- In South Africa: Stellenbosch University (SU) which also serves as the network Hub, University of KwaZulu-Natal (UKZN), University of the Western Cape (UWC), and the Council for Scientific and Industrial Research (CSIR).

The Ministerial Mandate, as instituted in Cairo (2006), provides the AU/NEPAD SANWATCE with the following executive mandate:

1. Facilitate, and where applicable, conduct selective research on water issues;

2. Serve as a Higher Education (PhD; postdoctoral; staff exchange) soundboard to the Southern African Development Community (SADC) region on regional water matters;

3. Collaborate with other networks and institutions in specialised areas;

4. Set the SADC water research agenda;

5. Establish a continental water research agenda which is based on / derived from the SADC regional water agenda.

This can be achieved, amongst other means, through one-on-one engagement with AMCOW and AMCOST through the SADC Technical Advisory Committee (TAC), in order to observe political direction and engage so as to provide evidence-based research.

Various research and capacity development initiatives, institutions and networks can be found within the SADC-region, most notably the SADC Water Division; WaterNet; Global Water Partnership-Southern Africa (GWP-SA); the International Water Management Institute (IWMI); the Water Research Commission (WRC); Cap-Net; Water Institute of Southern Africa (WISA); the Water Information Network-South Africa (WIN-SA); Africa Portal; United Nations Educational, Scientific and Cultural Organization's (UNESCO) Framework Programme for Research, Education and Training in Water (FETWater) and the UNESCO initiatives, including Chairs, as well as Category I and II centres.

It has been established, through the assessment of the Research and Development (R&D) value-chain, that the AU/NEPAD SANWATCE has an important role to play within the high-end scientific research and capacity sphere (M.Sc.; PhD; postdoctoral and Staff Exchange taking into consideration current Masters Programmes being offered by partners, such as WaterNet).

The AU/NEPAD SANWATCE is one of the African regional networks. The regional Hub and Secretariat is currently being hosted by SU in South Africa. Membership to the Network is open to all countries in the Southern African sub-region and current members are: Botswana, Malawi, Mozambique, South Africa and Zambia.

AU/NEPAD SANWATCE's vision statement:

The AU/NEPAD SANWATCE will contribute to the improved human and environmental well-being through research and development in water and sanitation.

Importance of the Country Water Resources Profile

The five Country Water Resources Profiles (CWRPs) have been prepared by the respective AU/NEPAD SANWATCE country teams in 2013 as part of a regional workshop series.

Each CWRP combines physical hydrology [water resource and its exploitation] with a look at water service delivery [infrastructure], the social setting of the country and the management of water, in terms of allocation and distribution. To some extent it also investigates international obligations and relationships related to shared transboundary water resources. It tries to get the base of water information in place, so that there can be a realistic assessment of what gaps there are in S&T and R&D.

With the country's educational resources and institutions also identified, the AU/NEPAD SANWATCE country team and other national stakeholders can use these profiles as a starting point to assess and characterize: i) Where the meaningful applied knowledge in the country's water sector exists and ii) what needs there are beyond that for future cross-sectoral social developments and economic growth.

As this approach cross cuts the essential six Policy Principal Areas outlined in the EC JRC's Water Project Toolkit (WPT) [Social, Economic, Technical, Information/Education/Communication, Environmental and Institutional/management], it should stimulate a more integrative and sustainable approach towards exploitation and management practices resulting in increased efficiency and more equitable water use strategies, as well as more pertinent infrastructure development choices.

Executive Summary

Zambia is located on the Central African plateau at an altitude of between 1000 and 1600 above mean sea level (amsl). This means that it has a moderately cool sub-tropical climate with three seasons, namely (i) a cool dry season between April and August; (ii) a hot dry between August and November; and (iii) a hot wet season between November and April.

In recent years, Zambia has observed intensifying competition for water resources by agricultural, industrial, and domestic users which will continue to put mounting pressure on water resources. There are numerous causes for this situation; (i) the country not being able to challenge its scientists to solve some water-related developmental issues, and (ii) research not receiving adequate attention, which has led to policy and decision-making remaining uninformed. Further, the report identifies several research and development gaps in the water sector, which must be addressed in order *'to ensure that every Zambian has fair access to the resource and related services regardless of their economic and social status'*.

Zambia: Water Profile

Zambia is located on the Central African plateau at an altitude of between 1000 and 1600 above mean sea level (amsl). This means that it has a moderately cool sub-tropical climate with three seasons, namely (i) a cool dry season between April and August; (ii) a hot dry between August and November; and (iii) a hot wet season between November and April.

Hydrology

The country experiences an average mean annual rainfall of 1,020 mm. This ranges from about 700 mm, 910 – 1,300 mm and more than 1,300 mm in the southern, central and northern parts of the country, respectively (Figure 1A). Rainfall distribution in the country coincides roughly with the agro-ecological zones.

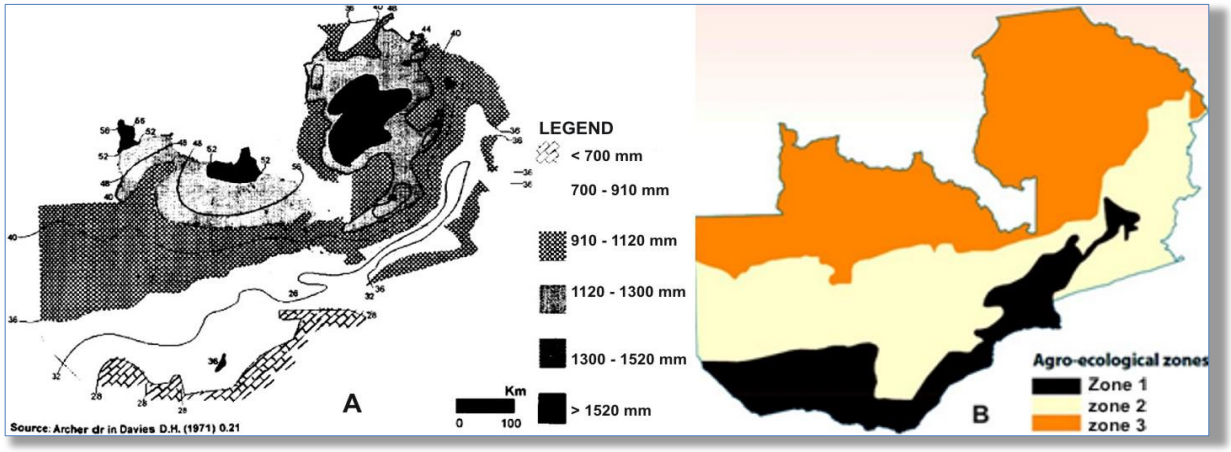

Figure 1. (A) Mean Annual Rainfall Distribution
(B) Agro-ecological Zones of Zambia
Source: Archer dr. in Davies D.H. (1971)

Surface Water Potential

Rainfall variation from the south to north, depicted in Figure 1A, also makes river flows to experience seasonal variations with peaks between March and April and the lowest flows being experienced between October and November.

Generally, Zambia considers itself abundantly-endowed with water resources. The potential of its available surface water is relatively well understood. The Zambezi and Congo River Basins (Figure 2) are the main surface water contributors. The Zambezi Basin covers three-quarters of the country and comprises three sub-basins – Zambezi, Kafue and Luangwa.

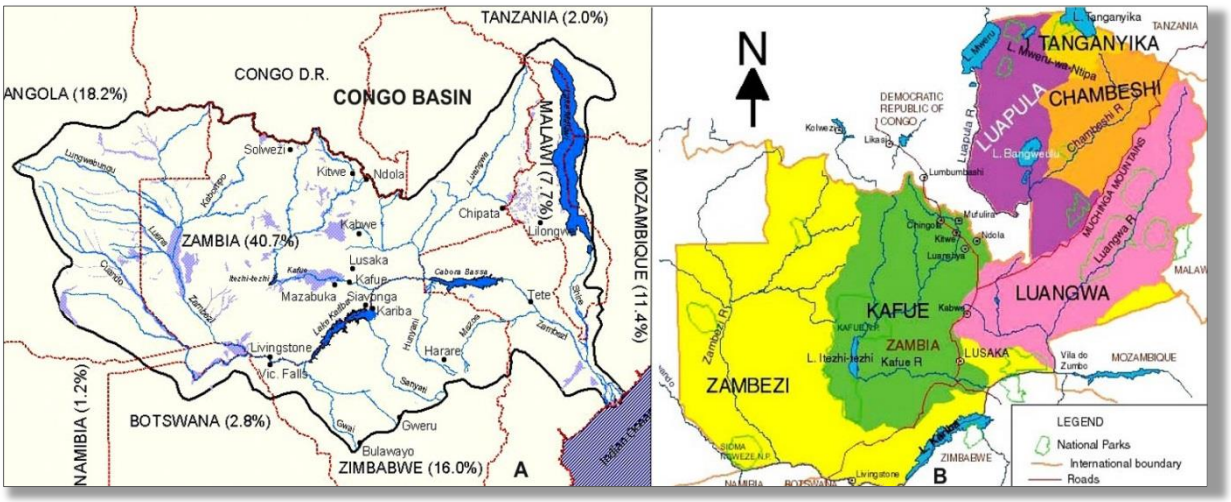

Figure 2. (A) the Zambezi and Gongo Rivers
(B) the Zambezi and Gongo Basins' Sub-basins in Zambia
Source: (A) http://www.eoearth.org/article/Zambezi_River?topic=78166 (B) JICA-MEWD, 1995

The different sub-basins in the Zambezi and Congo Basins have different contributions to the country's surface and groundwater resources. Table 1 shows their lengths in Zambia; their total area (in Zambia and outside Zambia); each of their contribution to surface water potential, and their annual run-off.

Table 1. Length, per cent contribution to surface water potential, and annual run-off within Zambia, and area (total, within and outside Zambia)

Source: JICA-MEWD, 1995

Sub-Basin	Length in Zambia (km)	Basin area (km^2)			% contribution to surface water potential	Annual Run-off (km^3)
		Total	In Zambia	Outside Zambia		
Zambezi	1,700	687,049	268,235	418,814	36.36	41.75
Kafue	1,300	156,995	156,995	-	8.40	9.88
Luangwa	850	147,622	144,358	3,264	19.44	22.32
Chambeshi	560	44,427	44,427	-	7.62	8.75
Luapula	615	173,396	113,323	60,073	26.25	30.14
Lake Tanganyika	250	249,000	15,856	233,144	1.73	1.99
Total	**5,272**	**1,458,489**	**743,194**	**715,295**	**99.8**	**114.83**

In a high rainfall hydrological year, annual runoff can be as high as 130 Km^3 per year, on the contrary, during severe drought years it can drop to as low as 68 Km^3, in turn affecting the amount of surface water.

Groundwater Potential, Main Aquifers and Typical Yields

Groundwater constitutes one major source of water supply in many parts of the country. It also sustains flows for many perennial rivers and streams during the dry season.

The country's aquifers are classified into three main types, namely, ***(i) aquifers, where groundwater flow is mainly through fissures / channels / discontinuities***, which are classified as either highly or locally productive; (ii) ***aquifers, where intergranular groundwater flow is dominant,*** which occur mainly in alluvial soils; and (iii) ***Low yielding aquifers with limited potential*** (Figure 3)

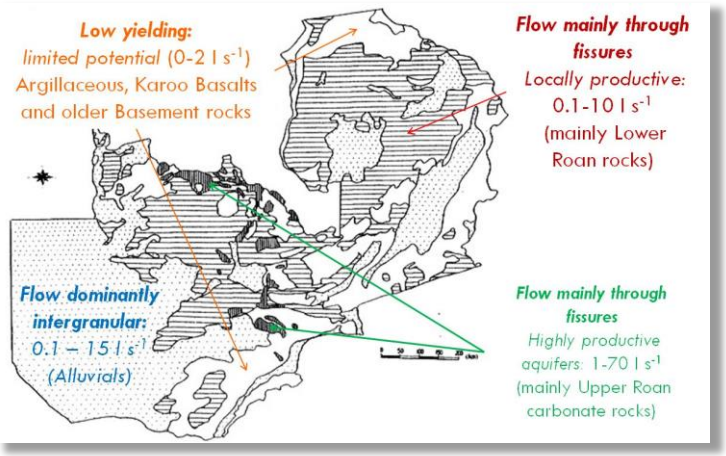

Figure 3. Map of Zambia Showing the Three Main Types of Aquifers

Source: National Water Resources Master Plan for Zambia, JICA-MEWD, 1995

Water Use by Sector

Total water withdrawal in 2000 was 1,737 * $10^6 m^3$, with agricultural water use accounting for 1,320 * 10^6 m^3 (76 percent), or more than three-quarters of the total domestic water use claiming 286 * 10^6 m^3, and dwindling, industries taking 131 * 10^6 m^3 (Table 2 and Figure 4).

Table 2. Water Use by Sector

Source: FAO (2005)

Sector	Year	Withdrawal (10^6 m^3 $Year^{-1}$)
Total water withdrawal by all sectors	2000	1,737
Agriculture	2000	1,320
Domestic	2000	286
Industrial	2000	131
Per inhabitant	2000	167

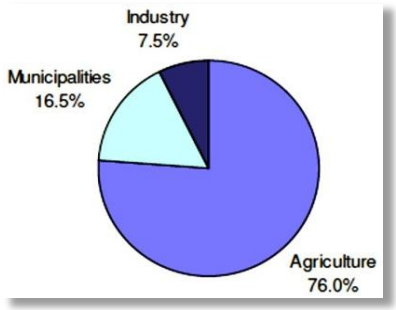

Figure 4. Water Withdrawel (Total Withdrawal: 1,737 * 10^6 m^3 in 2000)

Source: FAO (2005)

Major Water Management Issues

Some of the major issues in water management in Zambia include:

- The uneven distribution of water resources across the country,
- High climatic variability (resulting in frequent floods and droughts) made worse by climate change.
- Degrading water quality is increasingly undermining the important role of water in the country's economic development,
- Water resources infrastructure is poorly developed and maintained (Figure 6).
- Growth in water demand, especially for agriculture and hydropower,

Figure 6. Poorly Maintained Water Infrastructure

Source: FAO (2005)

- Low access to safe and adequate water supply and sanitation,
- Country is dependent on international water courses,
- No coordinated development in the water supply and sanitation sector,
- Rate of urbanization exceeds infrastructure developments,

Further, the Kafue River sub-basin, which supports about 45% of the country's population, has been subjected to many different activities that benefit from its waters. These range from mining, commercial farming, hydropower generation, industrial storage sites, in-situ sanitation, farmyard drainage, wastewater lagoons, leaking sewers, etc. that pose great risks of polluting both surface and groundwater resources.

From the aforementioned facts, it can be concluded that continuous economic growth and a steady increase in the population increases the pressure of different sectors on the water resources, particularly in the Kafue Basin. As such, Zambia faces several challenges in harnessing the potential of its relatively abundant water resources.

Main Policy and Strategy Documents

a) **Revised National Water Policy of 2010** provides that:

- The Ministry of Mines, Energy and Water Development (MMEWD) is the lead institution in the Zambian water sector.
- Current **institutional framework** is **fragmented** and **lacks capacity to** effectively **deal with water resources** management issues.

b) **Water Resources Management Act of 2011** which provides principles of water resources management, among them:

- The environment is a water user and shall enjoy second priority of allocation and use to the human need.
- Efforts to create wealth shall be reflected in all decisions made in relation to the use of water.
- The basic management unit shall be the catchment in recognition of the unity of the hydrological cycle.

- There shall be no private ownership of water and no authorization for its use shall be in perpetuity.

It is hoped that these will provide adequate legal (and institutional) framework for effective management, development and utilisation of the country's water resources.

Water Services and Water Resources

a) **The Urban areas** are served by Commercial Utilities (CUs), Local Authorities and other providers. However, within the urban areas, only 47% receive services from CUs, while 43% are not served at all (Figure 7).

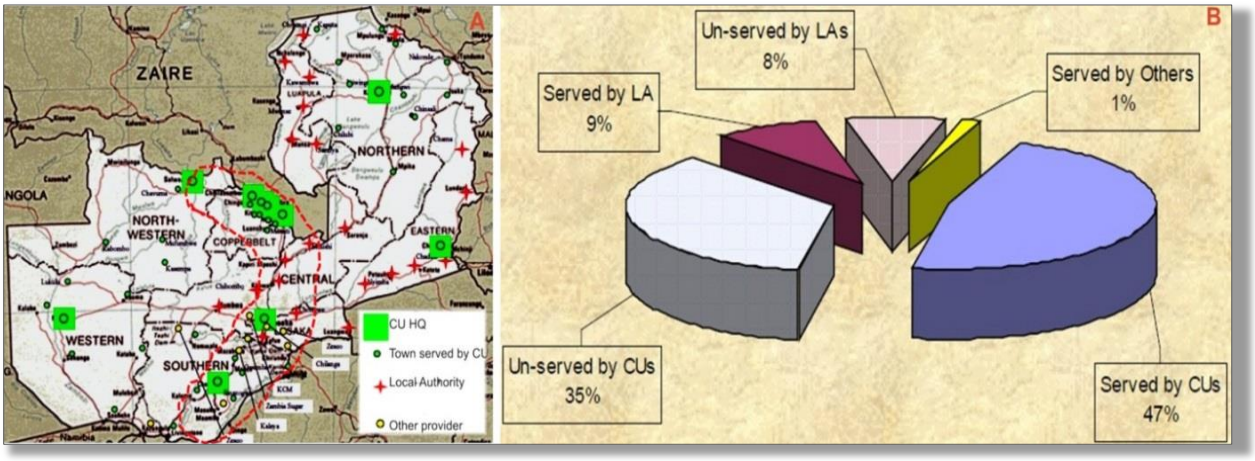

Figure 7. (A) Water Service Provision in Urban Areas of Zambia, And (B) Levels of Water Service Provision in Urban Areas of Zambia.

Source: (A) NWASCO, 2002/03 and (B) NWASCO 2011/12

Driven by continuous economic growth and steady increase in population, the pressure of different sectors on water resources, particularly in the urban centres of the Kafue Basin, is rising. Since the CUs cannot cope with demand for water supplies, most of the new structures being constructed at the moment have their own boreholes and septic tanks (Figure 8).

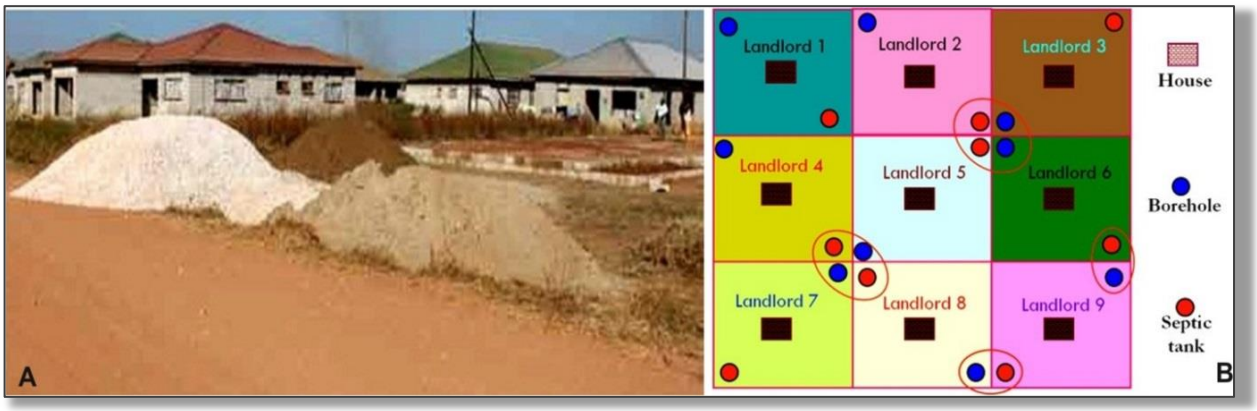

Figure 8. (A) Construction of Houses in New Settlements, and (B) Envisaged Configuration of Boreholes and Septic Tanks for Each Dwelling in Lusaka's New Low-Density Settlements.

b) **Rural areas** are generally serviced by the local authorities**.** However, even where local authorities provide water supply services, their provision has had a particularly poor record, with coverage levels actually declining. As such, most local authorities are being replaced by CUs to provide service delivery to some rural areas in the North-western, Western, Southern and Northern Provinces to improve coverage and increase cost recovery (Figure 7).

Recognizing this institutional weakness of most local authorities, Zambia is strengthening local capacity through the Rural Water Supply and Sanitation Unit (RWSSU). The Zambian government may require the implementation of a clearer cost recovery sharing policy with RWSSU service providers, in order to maintain rural service growth, especially with regard to sanitation coverage.

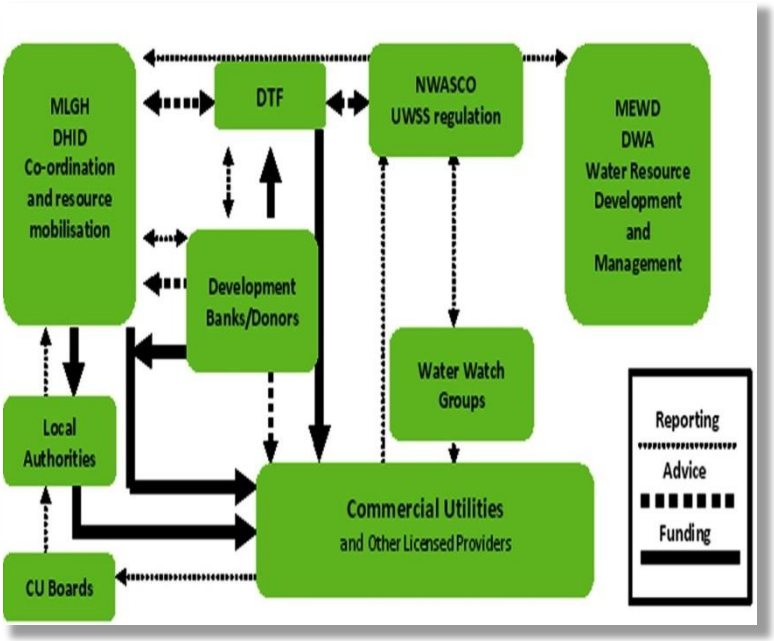

Figure 9. Government Institutions in the Water Sector.
Source: Mulambo (2011)

However, the major challenge with

water (and sanitation) provision to the country's rural areas is the unclear institutional and legal framework. Ascan be seen in Figure 9, the institutions responsible for water supply and sanitation services appear quite clear for urban areas, but not for rural areas.

Therefore, the recommendation for this scenario is for the government to clarify the legal and institutional roles in water supply and sanitation services to rural areas.

Water Resources Research and Development Institutions

In the coming decades, no natural resource may prove to be more critical to human health and well-being than water. Yet, even with the abundant evidence that the condition of water resources in Zambia is deteriorating, institutions responsible for managing these resources appear to have limited capacity to manage water-based habitats to maintain and improve species diversity and provide ecosystem services, while concurrently delivering to human needs.

Currently, intensifying competition for water resources by agricultural, industrial, and domestic users has put a lot of pressure on Zambia's water resources. Since some of these mechanisms are little understood, solutions to avert these pressures have not been easy to formulate. In spite of having highly qualified staff in the country's research institutions of higher learning, they have remained unchallenged to provide solutions to such important issues of national development. In other words, research in our country has not been considered as an important tool for informed decision-making and policy formulation.

Research in water and other water related fields are undertaken at the three public universities – University of Zambia, Copperbelt University and Mulungushi University – the National Institute for Industrial and Scientific Research, (NISIR) and the Natural Resources Development College (NRDC). However, research activities are marginal because of lack of funds put aside to support it. The research that has been undertaken has mainly been funded through international research projects. As such, the country has not had large scale basin- or catchment-wide research activities, which has resulted in a paucity of data at basin/catchment scale since project-driven projects have often targeted "hot spot" areas.

Because of lack of support for research, there has been:

a) A continuous programme to develop a pool of skilled water professionals in the country to augment those that have retired or passed on.
b) For those still undertakingwater research, no platform for research results' dissemination to meaningfullycontribute to national development is available.
c) As a result of (b), there is no incentive by policy-makers to use research results.
d) As a result of all of the above, no research policy direction has been formulated for the country. Instead, research continues to be directed by individual initiatives, drive and capacity. Consequently, research has remained aimless.

Having identified that water scarcity and related insecurities are some of the sources of the continent's underdevelopment and increasing economic decline, African leaders placed the development, utilisation and management of water high on the NEPAD agenda. Under the NEPAD framework, African leaders have committed themselves to *"ensuring sustainable access to safe and adequate clean water supply and sanitation, especially for the poor"* and *"[to] plan / manage water resources to become a basis for national and regional cooperation and development."* Through this perspective, it is hoped that some of our countries will be *compelled* to look to research institutions to provide them with information that assists them to view the resource as such and give it the attention it deserves so that it can be managed sustainably for the benefit of its citizens now and in the future.

Documented Water Sector Capacity Development Needs

Zambia currently hosts only three public universities – University of Zambia, Copperbelt University and Mulungushi University – that offer water and water-related courses. Although the country also has a number of private universities, these generally concentrate on social sciences programmes. Further, the University of Zambia is the only institution that offers Masters and PhD programmes in water resources and water-related fields across the Schools of Mines (Department of Geology) and Engineering (Department of Civil and Environmental Engineering). Other Departments that offer water-related programmes include Geography, Chemistry and Biology (School of Natural Sciences) and Soil Science, Agricultural

Engineering and Crop Science (School of Agricultural Sciences), as well as and Health Science programmes at the School of Medicine.

A good indication that the government is beginning to give some attention to water issues was manifested in 2007 when it undertook a *Sector Capacity Study for Water and Sanitation.* The study identified staff gaps as shown in Table 3.

Table 3. Annual Additional Staff Requirements (all converted to full-time positions).

Source: GRZ/MLGH & Royal Danish Embassy (2007)

Sub-sector/areas	Public sector/parastatal	District/Municipal Councils	Commercial Utilities	Private Sector
Rural water supply and sanitation (RWSS)	Ministry of Local Government and Housing (MLGH)/ Department of Infrastructure and Support Services (DISS) Central: 5 MLGH Accountants Central:2-3 MLGH/DISS Regional: 8	District Councils: 108 Municipal Councils : 10		**Consultants** First 3yrs: 12-18; After 3yrs: 8-14 **Drilling:** 10-15 rigs with staff **Borehole siting:** 4-10 teams **Drilling supervision:** 10-15 supervisors **Test pumping supervision**: Some technicians **Local well-diggers and masons:** Significant number
Urban water supply and sanitation (UWSS)	MLGH/ DISS Central: 1 DTF: 1		More staff with degrees/diplomas If 25% of total staff = 136	Consultants: 18 Contractors Skilled and unskilled labour
Water Resources Management (WRM)	1999/2003 scenario: 195-220 mainly provincial + district level officers 2005 scenarios: No staff increase, but more WRM planners etc.			**Consultants**: 8 **Contractors** Skilled & unskilled labour
Water Quality Laboratories	Upgrading of lab. facilities and staffing		Upgrading of lab. facilities and staffing	Upgrading of lab. facilities and staffing
Research and Development	UNZA WRM Centre: 5 NISIR/ WRRU: 5 RWSS Centre: 5			

In addition to skills gaps or additional staff required, as shown in Table 3, there was also a need to replace some of the staff that existed within the sector at the time because of retirement, resignations and illness/ death.

In addition, another survey was undertaken in 2011/12 by Stellenbosch University– a node of the SANWATCE – under the auspices of the EC JRC. This study comprised (AU/NEPAD SANWATCE, 2012):

- ✓ Joint Learning Programme (JLP) 1.1 – A survey on requirements in higher education and within training for practitioners in the water sector
- ✓ JLP 1.2 – A study on how the Water Centres of Excellence could better address

sector expertise consultancy and advocacy needed for sector development in the region.

The Zambian sector capacity report and water sector experts provided some inputs, especially to the JLP 1.1.

The JLP1.1 and JLP1.2survey concluded that:

- The majority of the skills were in higher education and research institutions.
- The knowledge base in the sector producing research outputs further indicated a major gap between South Africa and other SADC countries with research capacity.
- Major gaps in crucial areas e.g. water law, groundwater, eutrophication, energy, floods, erosion, infrastructure, sanitation, floods, and governance – thus reflecting major challenges in terms of water management.
- Many organizations support training provided within formal education structures such as Further Education Training (FET) Colleges; capacity building strategies; mentorships and Higher Education Training and support the different types of training being used.
- Further, there are at least one Higher Educational Training programmes in each SADC country, but is unclear in which areas they specialise in.
- In Zambia, over 600 people were required in the following sectors: Rural Water Supply and Sanitation, Urban Water Supply and Sanitation, Water Research Management, Water Quality Laboratories and Research and Development.
- The survey excluded utilities, networking organisations, and water service providers that form a very important part of the water sector and should be included in any follow up survey.

One of the recommendations from this study was that research driven capacity building should become a major focus of future investment in the SADC region in order to address the major backlog in terms of research output in the relevant priority areas for specific countries. These could be determined through consultation at a high governmental level and further be identified using more search criteria using software programmes like SciVal Spotlight and SciVal Expert.

Conclusion

The CWRP has observed that intensifying competition for water resources by agricultural, industrial, and domestic users will continue to put increasing pressure on Zambia's water resources. The causes for this situation was identified as; (i) the country not being able to challenge its scientists to solve some water-related developmental issues, and (ii) research not receiving adequate attention, which has led to policy and decision-making remaining uninformed. Further, the report identified the following research and development gaps in the water sector, which must be addressed in order *'to ensure that every Zambian has fair access to the resource and related services regardless of their economic and social status'*. The report has also noted that there is inadequate research being undertaken in the country to:

- Determine the impact of land use changes in areas of rapidly growing populations on the country's surface- and ground-water resources.
- Assess capacities of wastewater treatment plants in the country's major cities (environmental audit of the treatment plants).
- Assess the amount of available water resources in the country, especially groundwater.
- Assess effects of climate change scenarios and drivers on the country's surface water and groundwater resources.
- Seek solutions to some existing societal challenges, including those that utilize indigenous knowledge.

In this regard, the report concludes that for Zambia's water to sustain lives and meet the socio-economic needs of the country's citizens there is need to (i) support research activities in the acquisition of water data through continuous monitoring, (ii) analyse and assess data and information, and (iii) provide relevant feedback to decision makers and stakeholders. To attain these noble causes, the Government of the Republic of Zambia should recognise the importance of, and support research and research institutions with adequate resources and challenging them to provide

solutions to some or most of the identified issues/challenges and gaps in the country's water sector.

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