Mozambique

Country Water Resource Profile

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NEPAD Planning and Coordinating Agency
Agence de Planification et de Coordination du NEPAD

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Mozambique

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List of Acronyms

AdeM	Agua de Mocambique
AMCOST	African Ministers Council on Science and Technology
AMCOW	African Ministers Council on Water
ARA	Regional Water Administration
AU	African Union
CAN	National Water Council
CBO	Community-based organisation
CFPAS	Training Centre for Water Supply and Sanitation
CRA	Water Supply Regulation Council
CSIR	Council for Scientific and Industrial Research, South Africa
CWRP	Country Water Resources Profile
DAF	Department of Administration and Finance
DAR	Department of Rural Water
DAU	Department of Urban Water
DES	Department of Sanitation
DHR	Department of Human Resources
DNA	National Directorate for Water
DGRH	Department of Water Resource Management
EC	European Commission
FIPAG	Investment Fund and Assets for Water Supply
GDP	Gross Domestic Product
GOH	Public Works Office
GPC	Office of Control and planning
GRI	International Rivers Office
GWP-SA	Global Water Partnership, Southern Africa
HDI	Human Development Index
INAM	National Institute of Meteorology

INGC	National Institute for Disaster Management
ISPU	Higher Polytechnic and University Institute
ISTEC	Institute of Technologies and Management
ISUC	Higher Institute for Transport and Communication
IWEGA	International Centre for Water Economics and Governance
IWMI	International Water Management Institute
IWRM	Integrated Water Resources Management
JRC	Joint Research Centre
MDGs	Millennium Development Goals
MINAG	Ministry of Agriculture
MIREME	Ministry of Mineral Resources and Energy
MISAU	Ministry of Health
MOPH	Ministry of Water and Public Works
NEPAD	New Partnership for Africa's Development
NGO	Non-governmental organisation
RSAP III	Regional Strategic Action Plan (2012-2015)
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
UDM	Mozambique Technical University
UEM	University of Eduardo Montlane, Mozambique
UN	United Nations
SU	Stellenbosch University, South Africa
TAC	Technical Advisory Committee
UGB	River basin management unity
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
WRC	Water Research Commission (South Africa)

MAP OF MOZAMBIQUE

UN Cartographic Section
http://www.un.org/Depts/Cartographic/map/profile/mozambiq.pdf

Acknowledgements

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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

This study describes the Mozambican water profile in terms of current water resources supply and demand, socio-economic settings, water management issues, water policies, institutional settings, human capacity development and priorities in water sector. It can be concluded that compared to other countries located in the same climate zone, Mozambique is better off in terms of water supply.

However, the demand for water has been increasing and it will pose management challenges in near future. The socio-economic settings of the country suggest that Mozambique is heavily dependent on agriculture for food and income for the majority of its population. Additionally, agriculture sector is a major (23%) contributor in the country's Gross Domestic Product (GDP) and it presents 73% of water consumption. This implies that water has direct contribution on the economy of the country. Mozambique's GDP growth is reported to be decreasing by 5.6% points, on average, if a major water shock occurs. Consequently, access to water is key factor for the economic development of the country.

Mozambique: Water Profile

Mozambique is endowed with 104 river basins from which 13 are large basins. The amount of water generated in these large basins is approximately 216,5 km^3 (DNA, 1999). The availability of water in the country is considered good compared to other countries in the same geographical areas. However, the demand for water is expected to increase from 636 million m^3 (estimated value in 2003) to 918 million m^3 in 2015 (World Bank, 2005). The increased demand for water is in part due to increase number of water users mainly population growth. The number of people in Mozambique is expected to growth from 23 million in 2012 to 49 million in 2050. The availability of water is expected to be limited not only due to population growth but also due to climate changes as well as environmental degradation.

In order to preserve the availability and quality of water, the world has been experiencing changes in the management arrangements of water resources through the adoption of Integrated Water Resource Management (IWRM). IWRM gained acceptance through the 1992 International Conference, which took place in Dublin. The Dublin Conference was reinforced by the 2002 Johannesburg world conference in sustainable development, which emphasised the importance of good practices for the management of water.

During the past 25 years, most sub-Saharan African countries including Mozambique have adopted a comprehensive reform in the water sector towards IWRM through drafting water management policies, legislations, legal frameworks and organisational setups (Sokile, Mwaruvanda & Van Koppen, 2005). Examples of these initiatives in Mozambique are the 1991 Water Law that stipulated the main bodies responsible for the management of water resources at central and local levels (river basins) as well as the 1995 Water Policy that established water tariffs and participation of stakeholders at different levels in the management of water resources.

The implementation of IWRM in Mozambique requires basic knowledge regarding the current water resources supply and demand, socio-economic settings, issues in water management, water policies, institutional settings, human capacity as well as priorities in the water sector. This type of information is not readily available in a unique document. The main objective of this study is to summarise the profile of the water sector in Mozambique in terms of current water resources supply and demand, socio-economic settings, water management issues, water policies, institutional settings, human capacity and priorities in the water sector. This summary can serve as a guide for intervention aiming in increasing the application of IWRM in the country. Therefore, the present summary is useful for policy makers, institutions working in the water sector as well as different stakeholders.

The information reported in this summary is from secondary sources (past studies). The summary is organised as follows: After the introduction (section 1), the Mozambican water resources is presented (section 2). It is followed by water demand (section 3), socio-economic settings (section 4), water management issues (section 5), water policies (section 6), institutional setting in the water sector (section 7), existing and planned water infrastructures (section 8), priorities in the water sector (section 9), research and development institutions in the water sector (section 10) and human resource development. Finally, the concluding remarks are presented in (section 12).

Water Resources

Mozambique is relatively well endowed with water compared to countries occupying similar climatic zones. The country has 104 identified river basins that drain the central African highland plateau into the Indian Ocean. The majority of the rivers have a highly seasonal flow regime, with high waters during 3-4 months and low flows for the remainder of the year. Out of the 104 identified river basins, 13 are main basins and these basins are managed by the five Regional Water

Administration Agencies (ARA-Sul ARA-Zambeze, ARA-Centro, ARA-Centro Norte and ARA-Norte) created through the 1991 Water Law (Figure 1).

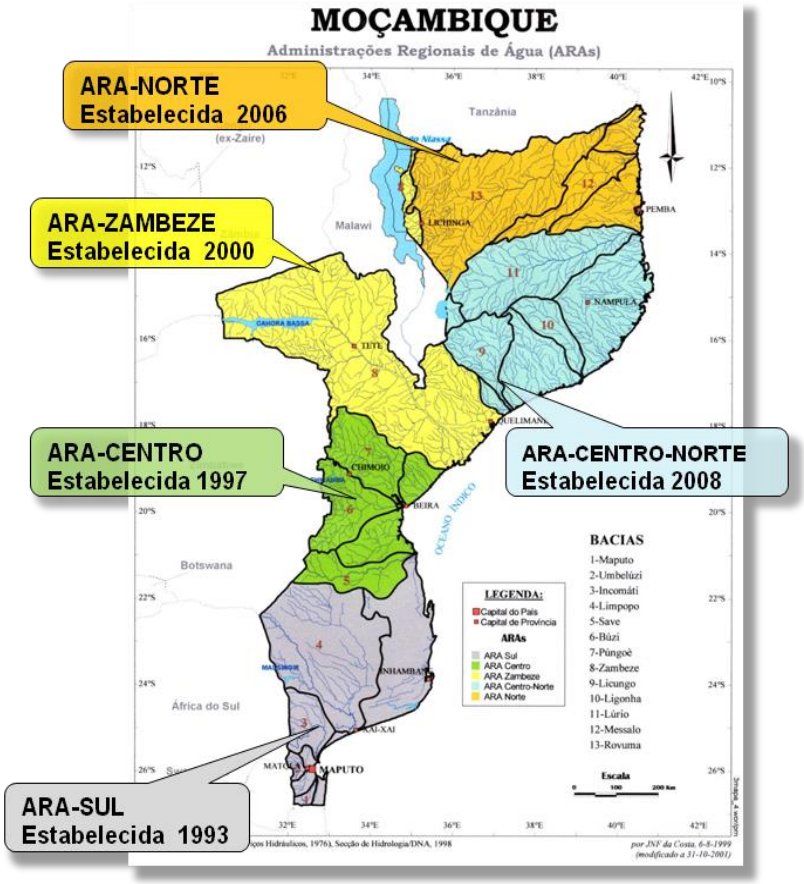

Figure 1. Main River Basins in Mozambique and Their Management Agency.

Source: Chilundo, Munguambe and Massingue (2010).

As shown in Figure 1, ARA-Sul is responsible for the Maputo (1), Umbeluzi (2), Incomati (3) and Limpopo (4) basins as well as a part of Save basin (5), which is located at the provinces of Gaza and Inhambane. ARA-Centro is responsible for a part of Save basin (5) which is located in the provinces of Sofala and Manica as well as Buzi (6) and Púngoè (7) basins. ARA-Zambeze is responsible for Zambeze basin (8). ARA-Centro Norte is responsible for Licungo (9), Ligonha (10) and Lúrio (11) basins and ARA-Norte is responsible for Messalo (12) and Rovuma (13) basins. Table 1 below shows water resources under the management of different regional water agencies.

As can be seen from Table 1 below, the supply of water for the river basins located in the southern part of the country are heavily dependent on the basins of international rivers. The increasing demand for water in South Africa, Swaziland and Zimbabwe (countries that share international rivers that supply water to southern river basins) poses a challenge for the efficient management of water resources in the country.

Table 1. Water Resources under the Management of Each Regional Water Agency
Source: DNA (1999)

Regional water agency	Area (1,000 km^2)	Mean annual runoff (km^3)			Mean annual runoff (mm)		
		Flow at border	Generated in Mozambique	Total	Flow at border	Generated in Mozambique	Total
Ara-Sul	192	17	3.8	20.8	89	20	109
Ara-Centro	84	1.2	18.4	19.6	14	219	233
Ara-Zambezi	140	88	18	106	629	129	758
Ara-Centro Norte	196	0	35.2	35.2	0	180	180
Ara-Norte	168	10	24.9	34.9	60	148	208
Total	780	116.2	100.3	216.5	149	129	278
Source: DNA (1999)							

Besides water that flows in different rivers, the country has two main lakes: Lake Niassa and Lake Chirua. The two lakes are shared with Malawi. The total surface area of Lake Niassa is 30,800 km^2, of which 21 percent belongs to Mozambique. Lake Chirua has an average total area of 750 km^2 of which no more than 29 km^2 are within Mozambique. In addition to the two main lakes, there are more than 1,300 small lakes, 20 of which have an area of between 10 and 100 km^2.

Besides superficial water, the country is endowed with groundwater. Groundwater potential is prevalent in the alluvial formations of the various rivers. A considerable portion of groundwater is in the Zambezi and Incomati basins, which makes up to 70,000 m^3/day. It is estimated that Mozambique produces about 17 km^3 of groundwater annually.

Water Demand

Water use estimates for the year 2000 indicate a total water withdrawal of 635 million m^3 (Table 2). In the same year, the main consumers of water is agriculture, accounting for 550 million m^3 (87%), followed by the municipal sector using 70

million m^3 (11%) and industry consuming 15 million m^3 (2%). The demand for water in the agricultural sector is expected to increase and reach 900 million m^3 in 2015 (Table 3). The expected increase in demand for water is also expected to increase water scarcity mainly in Umbeluzi, Limpopo and Buzi River basin (Table 4 below).

Table 2. Water Resource and Use

Source: FAO (2005)

Renewable water resources			
Average precipitation		1 032	mm/yr
		827	10^9 m^3/yr
Internal renewable water resources		100.3	10^9 m^3/yr
Total actual renewable water resources		217.1	10^9 m^3/yr
Dependency ratio		53.8	%
Total actual renewable water resources per inhabitant	2004	11 318	m^3/yr
Total dam capacity	2000	77 474	10^6 m^3
Water withdrawal			
Total water withdrawal	2000	635	10^6 m^3/yr
- irrigation + livestock	2000	550	10^6 m^3/yr
- municipalities	2000	70	10^6 m^3/yr
- industry	2000	15	10^6 m^3/yr
• per inhabitant	2000	36	m^3/yr
Surface water and groundwater withdrawal	2000	635	10^6 m^3/yr
• as % of total actual renewable water resources	2000	0.3	%
Non-conventional sources of water			
Produced wastewater		-	10^6 m^3/yr
Treated wastewater		-	10^6 m^3/yr
Reused treated wastewater		-	10^6 m^3/yr
Desalinated water produced		-	10^6 m^3/yr
Reused agricultural drainage water		-	10^6 m^3/yr

Table 3. Demand for Water in Agricultural Sector

Source: World Bank (2005)

River Basins	Irrigated Area (ha)		Water Demand (Mm^3/year)	
	2003	Projected 2015	2003	Projected 2015
Umbeluzi	850	4,000	13	60
Inkomati	10,340	23,900	155	251
Limpopo	4,000	20,000	60	210
Buzi	0	6,100	0	90
Pungoe	7,420	10,620	111	160
Zambeze	7,880	10,500	95	126
Ligonha	4,500	7,470	67	78
Messalo	0	0	0	0
Lichinga	7,360	10,520	110	110
Total	42,420	93,110	636	918

Table 4. Water Demands and Water Balances in the South and Center Regions in 2015, million m^3

Source: World Bank (2005)

River Basin/Region	Mean Annual Runoff	Water yields 2003	Water Demand 2015 (Mm3)							
			Irrigation	Livestock	Water Supply (Domes&Munici	Large Industries	Forestry	Environmental Flow	Total Water Demand	Water Balance
South										
Maputo	3800.0	1331.0	60.0	0.1	6.0			930.0	996.1	334.9
Umbeluzi	296.0	144.5	60.0	0.1	162.2			44.4	266.7	-122.2
Incomati	2677.0	908.3	251.0	1.2	4.6	17.3		401.6	675.6	232.7
Limpopo	5773.0	1003.6	210.0	4.5	59.7			866.0	1140.2	-136.6
Save	n/a							0.0	0.0	0.0
Total South	**12546.0**	**3387.3**	**581.0**	**5.9**	**232.6**	**17.3**		**2241.9**	**3078.6**	**308.7**
Center										
Buzi	6420.0	1031.6	91.5	12.0	20.4			993.9	1117.8	-86.2
Pungue	3375.0	1000.3	159.3	12.0	30.2	3.0		680.1	884.6	115.7
Zambesea	106000.0	28912.3	126.0	41.0	89.2	5.0	47.0	15900.0	16208.2	12704.0
Total Center	**115795.0**	**30944.1**	**376.8**	**65.0**	**139.8**	**8.0**	**47.0**	**17574.0**	**18210.6**	**12733.6**

Socio-Economic Settings

Mozambique's population is approximately 23 million. The majority (80%) of Mozambican people lives in rural areas and depends on agriculture for food and employment.[1] Almost half (45%) of the country is considered suitable for agriculture. However, only 4% of the total arable land is presently cultivated. The majority of cultivated land is cultivated by the family sector which experiences low productivity rates. For example, in 2004, the productivity of maize averaged 0.96 ton/ha in Mozambique compared to 1.5 ton/ha in Kenya, 1.1 ton/ha in Malawi and 2.6 ton/ha in South Africa (Uaiene, 2006). This low level of agricultural productivity is in part due to the low level of agricultural input use. For example, in 2007 only 13% of smallholders irrigated their land, 4% applied fertiliser, 12% used animal traction, 10% employed improved maize seeds, 3% used improved rice seed and 4% applied pesticides in their land (Mutondo, Tostão & Zavale, 2009).

The limited performance of the agricultural sector has been influencing the rate of poverty in the country. For example, little more than half (54.7%) of the Mozambican population live below the poverty line (MPD, 2010b). The rate of poverty is more pronounced in rural areas where 56.9% of the population live below the poverty line compared to 49.6% in urban areas. In terms of region, the central part of Mozambique presents the highest rate of poverty (59.7%), followed by the southern part (56.9%) and northern part (46.5%). Table 5 shows the incidence of poverty by province in Mozambique.

Table 5. Poverty Rate by Province (2008/2009)
Source: MPD(2010b)

Province	Poverty rate (%)
Niassa	31.9
Cabo Delgado	37.4
Nampula	54.7
Zambezia	70.5
Tete	42.0
Manica	55.1
Sofala	58.0
Inhambane	57.9
Gaza	62.5
Maputo Provincia	67.5
Maputo Cidade	36.2

[1] According to Cunguara and Garret (2011), in 2006/7 the agricultural sector was employing 76.1% of the labour force.

As shown in Table 5 above, the incidence of poverty is lower in Niassa, Cabo Delgado and Maputo Cidade province comparing to other provinces and it is highest in Zambezia province. Another indicator of well-being is the Gini coefficient. In 2008/9, Mozambique has a Gini coefficient of 0.41 with 0.48 in urban areas and 0.36 in rural areas (MPD, 2010b). The Human Development Index (HDI), an index of income, education and life expectancy, ranked Mozambique 135th out of 139 countries with an index value of 0.35 in 2000. In 2007, the Mozambican HDI had increased to 0.402 and the country was ranked 172 out of 182 countries (MPD, 2010a). The ownership of durable assets is another indicator of well-being. Table 6 below presents the ownership of durable assets in Mozambique.

Table 6. Ownership of durable assets (2008/9)
Source: MPD(2010)

Province	Bicycle (%)	Radio (%)	TV(%)	Cell phone (%)
Niassa	65.4	59.7	5.1	12.6
Cabo Delgado	42.6	45.4	4.3	11.4
Nampula	35.3	38.4	6.1	10.2
Zambezia	48.6	41.1	3.7	7.9
Tete	41.6	47.2	3.5	11.0
Manica	54.7	72.1	7.0	19.3
Sofala	44.1	53.2	14.6	29.5
Inhambane	24.0	42.6	11.0	36.4
Gaza	19.2	40.1	19.3	44.8
Maputo Provincia	10.3	42.8	42.7	67.3
Maputo Cidade	5.7	40.8	65.4	84.2
Rural	43.8	44.9	2.8	13.1
Urban	24.1	47.7	35.9	53.7
National	38.1	45.8	12.4	23.7
Source: MPD(2010)				

It can be seen from Table 6 above, that there exist differences in ownership of TVs and cell phones between rural and urban areas with rural areas experiencing low rate of ownership of these assets.

The gross domestic product is frequently also used to evaluate the economic performance of a given economy. Figure 2 presents the growth rate of Mozambican GDP over time. It can be seen from this figure that the rate of growth of Mozambican GDP does not follow a specific pattern. Climate variation, which directly affects agriculture sector, is the key factor influencing the variation of GDP in Mozambique. The Mozambican GDP decreased drastically in 2000 mainly due to floods that destroyed agricultural crops and infrastructures and in 2003 due to droughts.

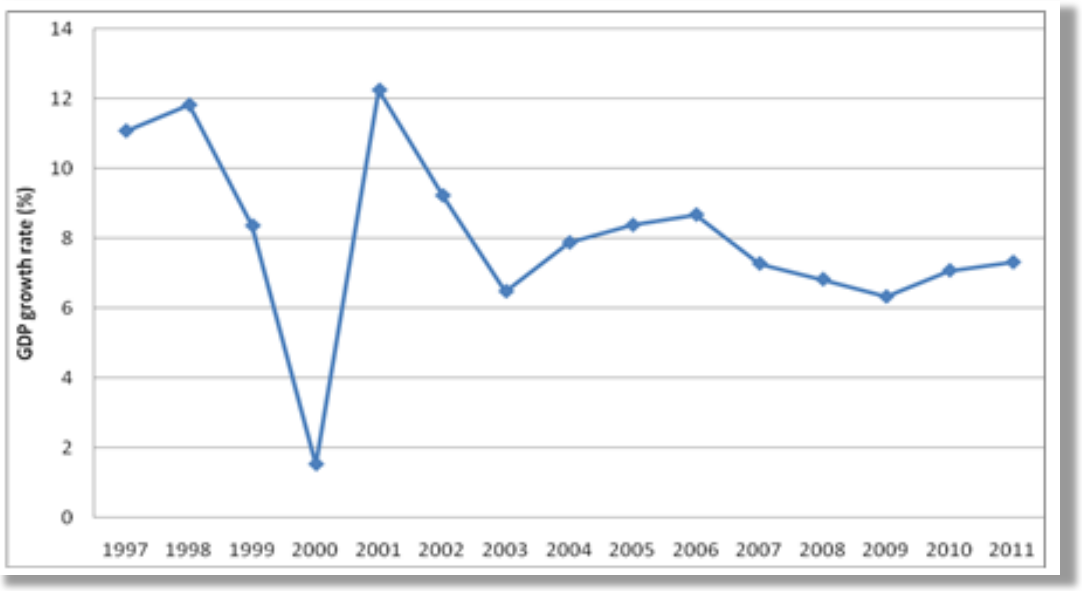

Figure 2. GDP Growth Rate from 1997 to 2011

The agricultural sector contributes with about 23% in the national GDP and presents 73% of water consumption. This fact implies that water has direct contribution to the economy of the country. World Bank (2005) reports that GDP growth in Mozambique is cut by 5.6% points, on average, when a major water shock occurs. Consequently, access to water is a key factor for economic development. In Mozambique, the availability of superficial water resource is approximately 5,550 m^3/year. However, serious water shortages occur during dry seasons in several basins mainly in the southern part of the country. The distribution of access to water also varies in Mozambique. It is estimated that more than 60% of the rural population and approximately 51.5% of the urban population do not have access to an adequate water supply (USAID, 2008).

Water Management Issues

The sustainable management of river basin resources requires the implementation of IWRM. In Mozambique, IWRM includes the usage of water resources in order to meet actual and future demands taking into account environmental and economic developments. IWRM instruments used in Mozambique include (i) evaluation of water resources, (ii) development of regulator frameworks to limit water conflicts, (iii) management and dissemination of information and (iv) water demand management (Munguambe, Chilundo & Massingue, 2010).

Regarding the evaluation of water resources, the regional water agencies have been monitoring the quantity and quality of water in their respective river basins. A specific example regarding to the evaluation of water resources is the installation of the Austrian system in 1999 in the Umbeluzi River basin, which monitors floods. Examples of regulatory framework includes the 1991 Water Law, which established the property right regime of the water resources and decentralised water governance structure, and the 1995 water policy through resolution no. 60/98 that established water tariffs. Additionally, the management and dissemination of information is relatively good and it is mainly performed by River Basin Management Units, Regional Water Agencies, National Institute for Management of Natural Calamities, National Directorate for Water and through websites of these institutions. Information disseminated includes mainly the levels of water resources at different river basins and flood alerts.

Although the country has been implementing IWRM, essential parts of IWRM are still missing. Examples include limited water allocation criteria that take into account efficiency and economic benefits; limited emphasis on groundwater; revenues from water users are still the minor part for financing the operational work of IWRM; and

the lack of cross-sectoral coordination in the field of pollution control.[2] The greatest challenges to improve IWRM in Mozambique include:

1. Flood control and management;
2. Failure to implement polluter-pays-principle and thereby control pollution mainly in the central part of the country (Save, Buzi & Pungoe);
3. Limited water allocation approaches and use efficiency;
4. Lack of financial resources for operational costs for ARAs and development of water infrastructures (e.g. dams);
5. Difficulties to coordinate management with other line ministries, such as Environment, Mining and Local Government;
6. Unwillingness by water users to pay; and
7. Difficulties in reaching small-scale stakeholders with a centralised organisation.

Water Policies

Water laws in Mozambique date back to the colonial period as described by Magaia (2009). Before 1975, year of independence, water was regulated under the Portuguese Law system. The main water regulatory documents were decrees no. 1:143 and no. 1:144 enacted in 1914. These decrees defined the legal framework and regulated the use of public water in the colonies. In 1919, decree no. 5:787 was enacted and incorporated into the 1919 Water Law. The 1919 Water Law was strengthened by the 1937 Law no. 1:949, which incorporated issues relating to irrigated agriculture.

During the colonial period, water resources were considered both public and private goods. After the independence of the country in 1975, water resources became solely managed by the government through the Ministry of Water and Public Works (MOPH), however, water resources were still regulated using the Portuguese Law.

[2] Sweco International (2008) states that "while ARA-Centro has the task to license effluent discharges, the Ministry of Environment (MICOA) has regulatory responsibilities through the right to penalise polluters for non-compliance." The limited coordination of two institutions prevent clear framework to deal with pollution control.

The first document developed after the independence related to water management is the Ministerial Diploma no. 25/87 that created the National Directorate for Water (DNA). Following the Ministerial Diploma no. 25/87, in 1988, the Mozambican government set Water Tariffs, which regulated the extraction of large amounts of water from the main two dams in the country (Massingir and Libombo).

The first national Water Law, which replaced the Portuguese Water Law, was approved in 1991 (Law no. 25/91). The 1991 National Water Law established the property right regime of the water resources in Mozambique by stating that superficial and underground water are owned by the State. In addition, the 1991 Water Law created the National Water Council (CNA) through the Decree no. 25/91. The CNA is an inter-ministerial organ composed by members from various government ministries. The CNA is an advisory board to the Ministers' Council and it is responsible for advising the government on issues related to water management and policy including the implementation of the 1991 Water Law.

The 1991 Water Law was a key legal instrument towards decentralisation of water management in Mozambique. It created five ARAs through the Act no. 26/91. The five ARAs are ARA-Sul, ARA-Zambeze, ARA-Centro, ARA-Centro Norte and ARA-Norte. These ARAs were created in order to implement integrated water resource management at river basin level across the country. The five ARAs are responsible for the management of the thirteen river basins. ARA-Sul is responsible for the Maputo, Umbeluzi, Inkomati and Limpopo basins as well as a part of Save basin, which is located at the provinces of Gaza and Inhambane. ARA-Centro is responsible for a part of Save basin which is located in the provinces of Sofala and Manica as well as Buzi and Púngoè basins. ARA-Zambeze is responsible for Zambeze basin. ARA-Centro Norte is responsible for Licungo, Ligonha and Lúrio basins and ARA-Norte is responsible for Messalo and Rovuma basins.

Following the creation of ARAs, in 1992 through the Ministerial Diploma no. 172/92, the government approved the internal regulation of the National Directorate for Water, and in 1993 through the Ministerial Diploma no. 134/93, the government approved the statutes of ARA-Sul. In order to facilitate the implementation of the 1991 Water Law, in 1995 the government approved through decree no. 7/95 the first National Water Policy. The National Water Policy put the basis for restructuring the water sector through the creation of different water organisations and policies and the development of public water supply systems. As a result of the 1995 National Water Policy, the government approved the resolution no. 60/98 on Policy for Water Tariffs.

Additionally, the government enacted the decree no. 72/98, which defines the implementation of water supply system. In this regard, two new organisations were created. Decree no. 73/98 created the Investment Fund and Assets for Water Supply (FIPAG), which is the national entity responsible for supplying potable water and decree no. 74/98 created the Water Supply Regulation Council (CRA), which has a role of aligning the interests of the domestic water user with those of private operators by ensuring a balance between the quality of the services provided by private operators and its adequacy to the interests of the water users including the economic sustainability of the water supply system.

Institutional Settings of the Water Sector

The institutional setting of the water sector is defined by the 1991 Water Law and the 1995 National Water Policy. The Water Law determines that the main bodies responsible for water resource management are the MOPH and the DNA (Figure 3). National Water Councils and ARAs were also established by the Law to enable inter-sector co-ordination based on the grounding of contiguous river basins. Therefore, there are other ministries that intervene in water resource management such as: the Ministry of Agriculture (MINAG), the Ministry of Mineral Resources and Energy (MIREME), Ministry of Health (MISAU) and the Ministry for Coordination of Environmental Action. The strategic interventions include supply of water in the main

urban, peri-urban and rural areas, sanitation and the integrated management of water resources.

The water sector in Mozambique is under on-going transformation, moving to a decentralised management system. In the past systems, the State used to be the single actor but nowadays the participation of the private sector and beneficiaries is growing fast and the impact is visible. The on-going changes aim at increasing the general acceptance of the water economic value. Therefore, the Water Law defined adjustment of the water supply fees in urban areas to gradual ensure cost recovery (DNA, 1999).

The institutional framework in place for water management includes central (National Water Council, the Ministry of Public Works and Housing, National Directorate of Waters) as well as regional/provincial and local levels. At the central level the DNA is composed by Department of Administration and Finance (DAF), Department of Urban Water (DAU), Department of Sanitation (DES), Department of Water Resource Management (DGRH), Department of Rural Water (DAR) and International Rivers Office (GRI) (DNA, 1999; Juizo *et al.*, 2012).

At regional level, the management of water resources is performed by the five regional water agencies (ARA-Sul, ARA-Centro, ARA-Zambezi, ARA Centro-Norte and ARA-Norte). At the basin level, each regional water agency is represented by the river basin management unity (UGB) and each UGB has its basin committee. From the 13 main river unities, six river basin committees were created (Umbeluzi in 2005, Incomati in 1996, Limopo in 1997, Pungoe in 2004, Zambezi in 2006 and Rovuma in 2007). At provincial level, the water management is performed by Provincial Directorates of Public Works. At local level, the municipal councils are responsible for issues related to water supply and sanitation. The existing water companies such as the Investment Fund and Assets for Water Supply (FIPAG) are responsible for water

supply in the main cities. Table 7 summarises the roles of main water management institutions in Mozambique.

Figure 3. Water resource management institutional structure
Source: Adapted from DNA (1999)

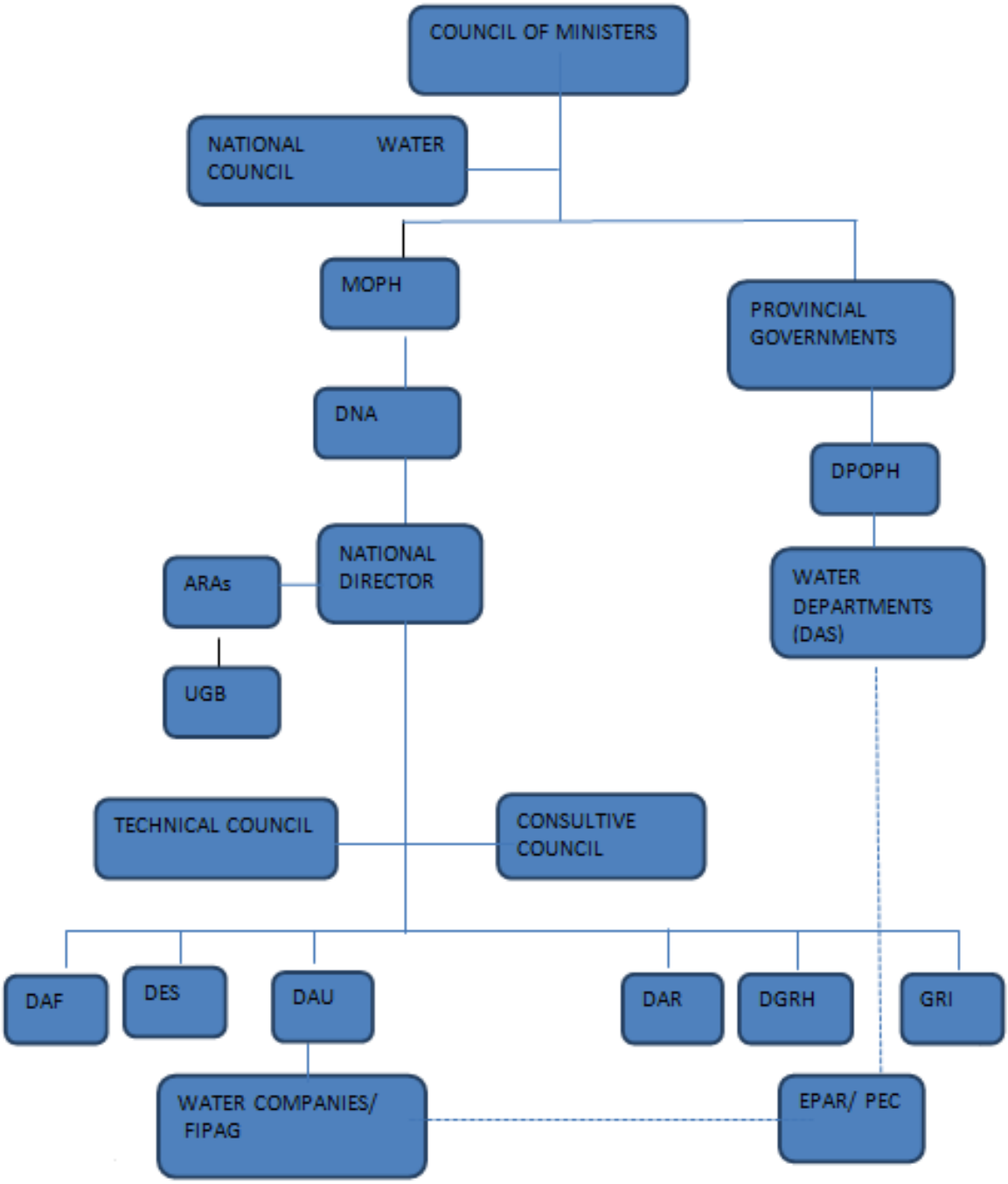

Table 7. Institutions Involved in the Water Management in Mozambique

Source: Munguambe, Chilundo and Massingue (2010) and Juizo *et al.* (2012)

Institutions	Role
1. Ministry of Public Works and Housing (MOHP) **District services of infrastructure planning** **Provincial Department of Water and Sanitation (DAS)** **2. Ministry of Transport and Communication/National Institute of Meteorology (INAM)**	Government institution responsible for all water activities, namely: promote the best use of water resources at national level, propose policies for water resources development and related implementation, propose the inventory of water resources, and to look for the equilibrium between supply and demand for water at national and river basin levels as well as to regulate the use of water resources.
3. National Water Council (CNA)	• It is an advisory board to the ministers' council which is responsible for coordinating different state and private agencies in issues related to water and produce appropriate recommendations regarding water management and policy to the Ministers' Council.
4. National directorate for water (DNA) **Department of water Supply (DAR)** **Department of Urban Water (DAU)** **Department of Sanitation (DES)** **Department of Water Resource Management (DGRH)** **Office of International Rivers (GRI)** **Public Works Office (GOH)** **Office of Control and planning (GPC)** **Department of Finance and Administration (DAF)** **Department of Human Resources (DHR)**	Main institution under the MOPH umbrella. Is responsible for water management in the country through nine specific departments, with the following tasks: • To define policies; • To put available and allocate water resources at all levels; • To elaborate and implement general systems; • To execute studies and projects; and • To prepare and reinforce the existing legislation and inspection.
5. Regional Water Administrations (ARA's) **River Basin Management Unities (UGB)**	• It is responsible for operational management of water resource at regional level, that includes hydrologic data collection and storage, dissemination of information regarding flood alerts, development of data on water users, collect water tariffs, implement basin level plans and

	strategies and promote the participation of stakeholders at the basin level.
6. Council for Regulation of Water Supply (CRA)	• Guarantee the quality of water supply services taking into account the needs of different water users and sustainability of the water supply systems.
7. Investment Fund and Assets for Water Supply (FIPAG): FIPAG (HQ, North, Centre, South, Beira	• Promote the management of water supply through efficient and rentable systems of water supply managed by private operators.
8. Agua de Mocambique (AdeM)	Provide services and urban water supply.
Academia and Education/Training Institutions **Faculty of Engineering/UEM** **Faculty of Agronomy and Forestry Engineering/UEM** **Technical Institute (Industrial Institute, ISPG, ISPM)** **Higher Institute for Transport and Communication (ISUC)** **Higher Polytechnic and University Institute (ISPU)** **National Institute for Disaster Management** **Mozambique Technical University (UDM)** **Higher Institute of Technologies and Management (ISTEG)** **Eduardo Mondlane University** **Faculdade de Economia – Faculty of Economy, Faculty of Arts and Social** **Sciences – Department of Geography** **Training Centre for Water Supply and Sanitation (MOPH/CFPAS), at Ministry of Public Works and Housing** **International Centre for Water Economics and Governance (IWEGA) – UEM** **Faculty of**	Carry out research and provide training in water and sanitation related issues at University and College education levels.

Sciences/Department of Civil Engineering **SADC Economic Accounting of Water Use Project:** **Faculdade de Veterinária – Faculty of Veterinary**	
9. National Institute for Disaster Management (INGC)	Promote research in water resource management.
10. Ministry of Science and Technology **National Institute of Irrigation**	Promote research in irrigation and water.
11. Nongovernmental organisations (NGOs) /Community-based Organisations (CBOs) **Magariro** **Ingeniería Sin Fronteras –** **Asociación para el Desarrollo** **IRD International Relief & Development** **HELVETAS** **Swiss Intercooperation (Nampula & Cabo Delgado)** **WaterAid** **Aga Khan Foundation (Cabo Delgado)**	Support provision of urban water, and related services.
12. Private Sector Service Providers **COWATER** **Consultores, Lda** **Mozagua, Lda** **WE (water &environment)**	Provide water supply in urban and peri-urban areas, sanitation.

Existing and Planned Water Infrastructures

Mozambique has 27 dams with a height of 10 m or more. The Cahora Bassa Dam on the Zambezi River is the largest hydroelectric plant in southern Africa with an installed capacity of 2 060 MW and a useful storage capacity of 39.2 km^3. In 1971, 583 small dams were registered, with a total volume of 60 million m^3. It is believed that most of them have been destroyed during the war. Table 8 below presents the existing and operational and the planned dams in the country.

The country is also endowed with irrigation infrastructures. The most important large irrigation scheme is the one located in the Chokwé district in the Limpopo River basin with approximately 25,000 ha and some sugar cane plantation irrigation schemes in the Incomati, Buzi and Zambezi River basins with a total of 34,000 ha.

Currently, a total of 118,120 ha are suitable for irrigation, of which 40,063 ha are actually irrigated.

Table 8. List of Dams in the Country.

Source: AQUASTAT (2012).

Name of dam	Administrative Unit	Nearest city	River	Completed/ operational since	Dam height (m)	Reservoir capacity (million m^3)	Reservoir area (thousand m^2)	Purpose			
								Irrigation	Water supply	Flood control	Hydro-electricity
Bué Maria	Sofala	Nhamatanda	Pungoè		53	402.0		x			x
CahoraBassa	Tete	Tete	Zambeze	1974	171	52 000.0	2 047 500	x		x	x
Chibandulire	Manica		Pungoè		44	227.0					x
Chicamba Real	Manica	Chimoio	Revué	1959	75	1 536.0	120 000			x	x
Chimoio	Manica	Chimoio	Mezingaze	1959	15	0.27			x		
Chipembe	Cabo Delgado	Chipembe	Montepuez	1985	15	24.0	7 100	x			
Corumana	Maputo	Moamba	Sabié	1988	46	1 273.0	68 000	x		x	x
Giboia	Matola	Catuane	Maputo		41	115.0		x			
Locume/Lichinga	Niassa	Lichinga	Luchiringo	1970	18	1.7			x		
Luenha 7	Tete	Tete	Luenha		45	650.0					x
Luo	Zambezia	Namarroi	Luo		63	650.0					x
Lurio o Cua	Nampula	Namapa	Lurio		40	2 500.0					x
LurioQuedas	Nampula	Namapa	Lurio		45	837.0					x
Macarretane	Gaza	Chokwé	Limpopo	1956	12	15.0		x	x		
Mapai	Gaza	Mabalane	Limpopo		65	11 200.0		x			
Massingir	Gaza	Chokwé	Elefantes	1976	48	2 256.0	150 700	x		x	x
Mavuzi	Manica	Chimoio	Revue	1953	8	1.2					x
Moamba/Major /Secongene	Sofala	Moamba	Incomati/major /Secongene		40	900.0		x			

Monte Hombe	Manica	Mavonde	Pungoè		60	1 246.0					x
Mutala	Zambezia	Alto Moloque	Molocue		42	220.0					x
Nacala	Nampula	Nacala	Moecula	1971	17	4.4			x		
Nampula	Nampula	Nampula	Monapo	1960	18	4.0			x		
Pavua	Manica		Pungoè		100	636.0					x
PequenosLibombos	Maputo	Boane	Umbeluzi	1987	45	357.0	50 000	x	x	x	
Sussudenga	Manica	Chimoio	Sussudenga	1963	45	33.0		x			
Tacuraminga	Manica		Pungoè		68	310.0					x

Priorities in Water Infrastructure

The Southern African Development Community (SADC, 2011) emphasises the development of new water infrastructure. However, these plans indicate that the greater emphasis should be considered on the emerging issues, such as climate change adaptation, ecosystem approach and the human right base approach for water. The SADC strategic plans refer to the process of developing, financing, implementing, and operating structures for irrigation, drainage, water supply and sanitation, hydro-power generation, flood management and other purposes.

According to World Bank (2005), the key elements of the proposed Water Resource Management in Mozambique include the construction of the dams and reservoirs to provide secure water supply to urban centres and rural needs including irrigation, the development of hydropower and flood control as follows:

1. Flood Protection:
    a. Construction and rehabilitation of dykes in Xai-Xai, Chokwe in Limpopo River basin and in Save and Buzi basins;
    b. Establishment of early warning system; and
    c. Development of studies on operational rules of existing reservoirs.
2. Rehabilitation of irrigation infrastructures in southern region.
3. Development of small irrigation infrastructures in the central and northern parts of the country.
4. Hydropower development in Zambezi River basin.
5. Development of basin master plan in Incomati, Maputo, Zambezi, Pungoe and Buzi River basins.
6. Inventory of existing hydraulic infrastructures.
7. Dams and transfer works:
    a. Construction of Moamba Major Dam and pipeline in Incomati River basin

b. Construction of Bue Maria Dam in Pungoe River basin;
c. Construction of third large dam (possible Mapai Dam) in Limpopo River basin; and
d. Construction of medium size dams for irrigations in central and northern parts of the country.

List of Researchers and Research Institutions in the Water Sector

The researchers and the institutions that deal with research and development in the water sector are government and private institutions, universities and technical schools as presented in Table 9 below**.**

Table 9. List of Research & Development (R&D) Institutions in the Water Sector

#	Names	Category	Institution/Organisation	Address	Phone number	Email address
1	Alciro Luis Nhacume	Government	National Directorate of Water (DNA)	Rua da Imprensa 162, Maputo, POBX 1611	823032095	anhacume@yahoo.com.br
2	Suzana Saranga	Government	National Director of Water/DNA	Rua da Imprensa 162, Maputo, POBX 1612		ssaranga@dnaguas.gov.mz
3	Cristovão Xavier	Government	Department of Water Resources Management/DNA	Rua da Imprensa 162, Maputo, POBX 1613	823032095	avier.cristovao@yahoo.com
4	António Daniel Mangue	Government	Department of Water Resources Management/DNA	Rua da Imprensa 162, Maputo, POBX 1614	823015710	tony-mangue@yahoo.com
5	Carlos Valente Mulhovo	Government	Department of Water Resources Management/DNA	Rua da Imprensa 162, Maputo, POBX 1615	824492040	cmulhovo@yahoo.com.br
6	Jose Malanço	Government	Department of Water Resources Management/DNA	Rua da Imprensa 162, Maputo, POBX 1616	823817490	zmalanco@yahoo.com.br
7	Leonard Kranendonk	Government	Department of Water Resources Management/DNA	Rua da Imprensa 162, Maputo, POBX 1617	827680023	lkranendonk@yahoo.com
8	Carlos Mbenzane	Government	Department of Water Resources Management/DNA	Rua da Imprensa 162, Maputo, POBX 1618	827898080	carlosmbenzane@yahoo.com.br
9	Anifa Somá	Government	Department of Water Resources Management/DNA	Rua da Imprensa 162, Maputo, POBX 1619	827766010	anifaismaelsoma@yahoo.com
10	Manuela Sumbane	Government	GPC/DNA	Rua da Imprensa 162, Maputo, POBX 1620	827145920	msumbane@dnaguas.gov.mz

11	Judas Macamo	Government	GPC/DNA	Rua da Imprensa 162, Maputo, POBX 1621	822887590	macamoj@yahoo.com.br
12	José Frederico Pereira	Government	Department of Water Resources Management/DNA	Rua da Imprensa 162, Maputo, POBX 1622	824323350	fredericopereira@dnaguas.gov.mz
13	José Maria Adriano	Government	AdeM/Water Supply Company	Av Eduardo Mondlane no. 1352, P.O. Box 2952 – Maputo	827992740	jadriano@aguamz.co.mz
14	Lizete Dias		ARA-Sul		823025876	ldias@ara-sul.co.mz
15	Lucas Chairuca		Department of Water Resources Management/DNA	Rua da Imprensa 162, Maputo, POBX 1622	21306729/30	chairuca@yahoo.com
16	Rute Nhamucho	Government	Department of Water Resources Management/DNA	Rua da Imprensa 162, Maputo, POBX 1623	21322191/2	rumamucho@yahoo.com.br
17	Delário Sengo	Government	Office of International Rivers/DNA	Rua da Imprensa 162, Maputo, POBX 1624	21322191/3	dsengo@dnaguas.gov.mz
18	Isabel Fotine	Government	Department of Water Resources Management/DNA	Rua da Imprensa 162, Maputo, POBX 1625	21322191/2	anafotine@yahoo.com.br or anafotine@dnaguas.gov.mz
19	Lily Nomboro	Government	(PSC) DGRH/DNA	Rua da Imprensa 162, Maputo, POBX 1626	21322191/1	alnomboro@yahoo.com.au
20	Belarmino Chivambo	Government	Department of Water Resources Management/DNA	Rua da Imprensa 162, Maputo, POBX 1627	21322191/2	chivambo1@yahoo.com.br
21	Rui Brito	Academia	Faculty of Agronomy and Forestry Engineering/Dept Rural Engineering	Av Julius Nyerere no. 3453 – Maputo	Tel: +258-21-492177/9 or Fax: +258-21-492176	
22	Mario Chilundo	Academia	Faculty of Agronomy and Forestry Engineering/Dept Rural Engineering	Av Julius Nyerere no. 3453 – Maputo	Tel: +258-21-492177/9 or Fax: +258-21-492176	
23	Joao Mutondo	Academia	Faculty of Agronomy and Forestry Engineering	Av Julius Nyerere no. 3453 – Maputo	Tel: +258-21-492177/9 or Fax: +258-21-492177	

24	Emilio Magaia	Academia	Faculty of Agronomy and Forestry Engineering/Dept Rural Engineering	Av Julius Nyerere no. 3453 – Maputo	Tel: +258-21-492177/9 or Fax: +258-21-492178	
25	Emilio Tostao	Academia	Faculty of Agronomy and Forestry Engineering	Av Julius Nyerere no. 3453 – Maputo	Tel: +258-21-492177/9 or Fax: +258-21-492179	
26	Paiva Munguambe	Academia	National Institute of Irrigation and Water	Av Julius Nyerere no. 3453 – Maputo	824332750	
27	Felicidade Massingue	Academia	Faculty of Agronomy and Forestry Engineering/ Dept Rural Engineering	Av Julius Nyerere no. 3453 – Maputo	Tel: +258-21-492177/9 or Fax: +258-21-492181	
28	Augusto Hunguana	Academia	Mozambique Technical University (UDM)	Av Albert Lithuli no. 408, 438 – Maputo	Tel: +258 21 302102/16 or Cell: +258 82 3051176/178; +258 82 3051167	ahunguana@udm.ac.mz
29	Eunice Chirindza	Academia	Training Centre for Water Supply and Sanitation (MOPH/CFPAS)	Av do Trabalho no. 1441	Telefax: +258 21 400193 or Cell: +258 82 3105500	euritsegilda02@yahoo.com
30	Stefano Farolfi	Academia	International Center for Water Economics and Governance/IWEGA/UEM	Av Julius Nyerere no. 3453, PO Box 3647 – Maputo	Tel: +258 21 49 18 82; Fax: +258 21 49 19 04 or Cell: +258 84 53 43 538	farolfi@cirad.fr
31	Dinis Juízo	Academia	Faculty of Sciences/Department of Civil Engineering	Av de Moçambique Km 1,5 – Maputo	Tel: 258 21 475330; or Cell: +258 82 5363702	juizo@uem.mz or juizo@hotmail.com
32	Atanásio Manhique	Government	Ministry of Transport and Communication/National Institute of Meteorology	Rua de Mukumbura no. 164 – Maputo	Tel: +258 21 490064/ 21 490148/21 492530	atanasio_m@inam.gov.mz
33	José Maria	Government	Águas de Moçambique (Water Supply Company)	Av Eduardo Mondlane no. 1352, PO Box 2952 – Maputo	258 21 428386/21 308855/21 303424/21 302432; Telefax: +258 21 324675;	jadriano@aguamz.co.mz

					Cell: +258 823025876	
34		Government	Fundo de Investimento e Património do Abastecimento de Água (FIPAG)	Av Filipe Samuel Magaia no. 1297, PO Box 917 – Maputo	Tel: +258 21 491529/21 498815/21 498840/21 498903 or Telefax: +258 21498881	fipag@fipag.co.mz
35		Government	Ministry of Planning and Development/National Institute of Statistics	Av Ahmed S Touré no. 2, PO Box 493 – Maputo	Tel: +258 21 490930/ 21 490035 or Cell: +258 82 3246430	
36		Academia	Universidade Politécnica	Av Paulo Samuel Kankhomba no. 1011 – Maputo	Tel: +258 21 352750/ 21 305950/ 21 314340/21 360551 or Telefax: +258 21 352701 or Cell: +258 82 3285250; +258 82 3133700	http://www.apolitecnica.ac.mz
37		Academia	SADC Economic Accounting of Water Use Project/ Faculdade de Veterinária – Faculty of Veterinary	Av de Moçambique Km 1,5 – Maputo	Tel: +258 21 475155; 21 475183 or Telefax: + 258 21 475063	
38		Academia	Faculty of Arts and Social Sciences – Department of Geography	Av Julius Nyerere no. 3453 – Maputo	Tel (Director): +258 21 493256/ 21 493376 or Telefax: +258 21 485402	
39		Academia	Faculdade de Economia – Faculty of Economy	Av Julius Nyerere no. 3453 – Maputo	Tel (Director): +258 21 493256/ 21 493376 or	

					Telefax: +258 21 496301	
40		Academia	Higher Institute of Technologies and Management (ISTEG)			
41	Joao Ribeiro	Academia	National Institute for Disaster Management/INGC			
42		Government	National Water Research Institute/Ministry of Science and Technology			

Human Resource Development

The capacity development in the water sector is considered the premise for effective water resource management in Mozambique. The sector has been increasing its investment in education and training technicians in water related fields since 1978. However, the current situation indicates a shortage of human resources of different specialisation as presented in Table 10 below.

Table 10. Human Resources Needs for Meeting Millennium Development Goals in the Water Sector

Source: Juizo *et al.* (2012)

Human Resource Category[3]	Existing		Demand		Shortage	
	Water	Sanitation	Water	Sanitation	Water	Sanitation
Watsan	1,013	269	1,506	601	493	332
Engineers	25	6	329	163	303	158
Management and Finance	526	49	2,426	408	1,900	359
Social Development	1,033	357	4,285	1,125	3,252	768
Total	2,597	681	8,546	2,298	5,948	1,617
Source: Juizo *et al.* (2012)						

[3] The definition of each category is presented by Juizo *et al.* (2012) as follows:

"**Water and sanitation**: a person who is qualified or professionally engaged in the branch of engineering specifically related to the provision of water and sanitation facilities or infrastructure (i.e. civil/environmental engineers)."

"Engineer (other): a person who is qualified or professionally engaged in another branch of engineering that is required in the planning, design or operation of water and sanitation facilities or infrastructure (e.g. hydro-geologists, mechanical/electrical engineers)."

"Management and Finance: a person who is qualified or professionally engaged in management and finance (e.g. Managers (finance, HR, strategic) and office manager (administrative functions)) as well as a person who procures goods and services or a cost planner."

"Social development: a person who is qualified or professionally engaged in hygiene promotion or other relevant water, sanitation and health professions in the social sciences (e.g. health promotion specialist, sociologist, community development worker)."

Table 10 above indicates that human resource shortage is pronounced in the water sector (5,948) and the category that is still in need of the majority of human resources is social and development followed by management and finance and Watsan. The same pattern applies for the sanitation sector. Although the engineer category presents the lowest need, the increase in human resource in this category should be taken into consideration. This is because, the category is a key for the development of infrastructures, and it takes several years to produce human resources under this category.

Although there is a shortage of human resource in water sector, the Higher Education subsector has seen unprecedented increase in number of students, number of institutions, and diversity of programs offered. Between 2000 and 2011, tertiary education institutions have increased rapidly from around 12,000 students in 2000 to more than 101,000 in 2010. There is a combination of public and private institutions with the latter having increasingly more institutions and students (Juizo *et al.*, 2012). At the moment only four of the existing tertiary institutions offer civil engineering courses with an option or specialisation in water and sanitation, namely the Eduardo Mondlane University (UEM), the Higher Institute for Transport and Communication (ISUC), the High Polytechnic Institutes and the Polytechnic University. The Mozambique Technical University (UDM) as well as the Institute of Technologies and Management (ISTEG) has also been offering environmental engineering courses.

Additionally, NEPAD SANWATCE conducted a skills gab analysis in SADC in 2011. The results ties in with the skills gabs in Mozambique, as illustrated in Table 10. The difference is, NEPAD SANWATCE's skills gabs analysis included all the countries in the SADC region, the results are therefore broader, and it recommends further research. The results of the study were as follow: Limited skills in the areas of Conflict Mediation; Environmental Law; Marketing; Occupational; Climatology; Forestry; Waste Management; Chemical Engineering; Construction; Coastal

Engineering; Plant maintenance/operations; Artisans; Agronomy (irrigation, soil sciences) and Ecology.

A further skills assessment was done using an electronic database, SCOPUS, of research outputs in all of the SADC countries (AU/NEPAD SANWATCE, 2012). Major gaps in crucial areas such as water law, groundwater, eutrophication, energy, floods, erosion, infrastructure, sanitation, and governance were identified. The lack of research in these areas reflects in practice, for example, the major challenges in terms of water management. This results in the lack of infrastructure development, a concomitant lack of water supply and sanitation among other limitations. Research driven capacity building should become a major focus of future investment in SADC in order to address the major backlog in terms of research output in the relevant priority areas for specific countries.

Various online portals were assessed to determine the level of vacancies in different water-related job categories in the all SADC countries. This concluded that the top water-sector vacancies in the SADC-region are Water and Sanitation Scientist/Engineer/Area Managers; Civil Engineers; Hydraulics/Water Resources Engineers; Water Treatment Specialists; Senior Management (with technical background); Project Managers; Sales Technologist/Rep/Account Manager (Water Treatment); Process Control Engineers; Human Resources; Electricians; Water and Wastewater Engineers; Social Scientists; Water Systems/Pipeline Engineers; Environmental Project Manager; Managers (Water Treatment); Process Design Engineers; Hydro-graphic Surveyors; Fitter and Turners and Irrigation/Drainage Engineers. It is therefore important that Accredited Service Providers and Further Education and Training institutions should align their educational offering to meet this need. Funding should also be made available for supporting scholars to attend the appropriate courses that are already available in the SADC region. This could be done through establishing a scholarship programme.

Conclusion

This study describes the Mozambican water profile in terms of current water resources supply and demand, socio-economic settings, water management issues, water policies, institutional settings, human capacity development and priorities in water sector. It can be concluded that compared to other countries located in the same climate zone, Mozambique is better off in terms of water supply. However, the demand for water has been increasing and it will pose management challenges in near future. The socio-economic settings of the country suggest that Mozambique is heavily dependent on agriculture for food and income for the majority of its population. Additionally, agriculture sector is a major (23%) contributor in the country GDP and it presents 73% of water consumption. This fact implies that water has direct contribution to the economy of the country. Mozambican GDP growth is reported to be decreasing by 5.6% points, on average, when a major water shock occurs. Consequently, access to water is key factor for economic development.

The management of water resource in the country has been following the IWRM principles. Examples include the development of legal frameworks such as the 1991 Water Law and the 1995 Water Policy. These legal frameworks have created institutions at all levels and decentralised the management of water resources at the most appropriate level. Although the country has been implementing IWRM, essential parts of IWRM are yet missing. Examples includes limited water allocation criteria that take into account efficiency and economic benefits, limited emphasis on groundwater, revenues from water users are still the minor part for financing the operational work of IWRM, lack of cross-sectoral coordination in the field of pollution control. These limitations are in part due to limited water resource infrastructures as well as human resources. In terms of water infrastructures, there is a need for constructing and rehabilitating dykes for flood control, development and rehabilitation of irrigation infrastructures and construction of dams such as the Moamba Major and Mapai Dams. Regarding human resources, recent assessment

indicates that there is a deficit of human resources in all fields. This implies human resources development should be a continuous activity in Mozambique.

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