Policy, Legal and Institutional Development for Groundwater Management in the SADC Member States (GMI-PLI)

Gap Analysis and Action Plan – Scoping Report (Final)

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FOREWORD

The Southern African Development Community (SADC) Member States, through the support of International Cooperating Partners have gone through a series of Water Sector Reforms which varied in terms of policy, legal and institutional development. The focus of the water sector reforms has been on Integrated Water Resources Management and aimed at achieving sustainable and equitable distribution of water resources in the respective Member States. To a large extent, the water sector reforms did not comprehensively address the sustainable management of groundwater resources, yet 70% of the population in the SADC region depend on it. Climate change continues to negatively affect the availability of surface water, placing significance reliance on the use of groundwater for both urban and rural supply throughout the region. Human wellbeing, livelihoods, food security, ecosystems, natural habitats, industries and urban centres growth throughout the SADC Region are increasingly becoming more reliant on groundwater. The SADC region in general has an abundance of groundwater resources. However, due to several factors which include the lack of an enabling policy, legal and institutional environment, only an estimated 1.5% of the available renewable groundwater resources are currently being utilised.

It is estimated that there are about 30 Transboundary Aquifers (TBAs) and 15 transboundary river systems and that these systems are central to the water security of the region. There is therefore a need for Members States to establish and strengthen existing policy, legal and institutional frameworks to achieve equitable and sustainable access to water resources through joint management of the transboundary resources. It is in view of the above and in response to the need to strengthen the sustainable use of groundwater resources conjunctively with surface water at both the national and regional level, that the Southern African Development Community – Groundwater Management Institute (SADC-GMI) was established by the SADC Secretariat, on behalf of the Member States.

The vision of the SADC-GMI is, “to be a Centre of Excellence in promoting equitable and sustainable groundwater management in the SADC region”. The key focus areas of SADC-GMI are to 1)advocate, raise awareness and provide technical support in SADC around sustainable management through the dissemination of information and knowledge; 2) create an enabling environment for groundwater management through policy, legal and regulatory frameworks; 3) promote action-oriented research; 4) promote impact-oriented capacity building and training for groundwater management in the region; 5) lead and promote regional coordination for groundwater management; and 6) support infrastructure development for groundwater management.

In pursuance of the focus area of creating an enabling environment, SADC-GMI implemented the project entitled "Policy, Legal and Institutional Development for Groundwater Management in the SADC Member States, (GMI-PLI)". The methodology for said project included the development of the Desired Future State, conducting a baseline study of best practices, and description of policy, legal and institutional frameworks which promote sustainable groundwater management. Using an in-Country Experts model, a systematic analysis of the existing policy, legal and Institutional frameworks in comparison with the Desired Future State was conducted to identify gaps that required to be addressed in order to fulfil the SADC-GMI mandate – to achieve sustainable groundwater management in all 16 SADC Member States. The analytical assessment of the gaps identified at national level culminated in the production of 16 National Gap Analysis & Action Plan Reports and the higher-level Regional Gap Analysis Report. The latter summarises the findings across the SADC region.

This National Gap Analysis for Mozambique provides an overview of the existing gaps in policy, legislation, strategy, guidelines and the institutional frameworks and further suggests enablers required to unlock the identified gaps/challenges. The report provides a clear guidance for Mozambique to develop an implementation roadmap through a process of prioritising the Strategic Actions in close liaison and in consultations with all relevant stakeholders. It is hoped that these National/Regional Gap Analysis and Action Plan Reports will aid Mozambique to develop their own Roadmap which will ultimately advance the groundwater narrative and bring it at par with surface water in terms of policy, legal and institutional frameworks which will no doubt enhance sustainable groundwater management at a national and regional level in the SADC Region.

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LIST OF ACRONYMS

ACRONYM	DEFINIATION
AdeM	Waters of the Maputo Region
AFORAM	Association of water supply Entities of Mozambique
AIAS	Administration of Water and Sanitation Infrastructures
ARAs	Regional Water Administrations (South, Center,center-North, North and Zambezi)
CIWA	Cooperation in International Waters in Africa
CNA	National Water Council
CRA	Regulatory Council for Water Supply
DAF	Department of Administration and Finance
DFID	Department for International Development
DGBH	Department of Watershed Management
DNA	National Directorate of Water
DNAAS	National Directorate Water Supply and Sanitation
DNGRH	National Directorate of Water Resources Management
DOH	Department of Hydraulic Works
DP	Planning Department
DRI	Department of International Rivers
EC	Electro-Conductivity
EIA	Environmental Impact Assessment
FIPAG	Investment and Assets Fund for Water Supply
GDP	Gross Domestic Product
GEF	Global Environment Facility
GESI	Gender, equity and social inclusion
GMI	Groundwater Management Institute
GMI-PLI	Groundwater Management Institute – Policy, Legal and Institutional
GW	Groundwater

ACRONYM	DEFINIATION
INAM	National Meteorology Institute
INE	National Institute of Statistics
LIMCOM	Limpopo Watercourse Commission
MDG	Millenium Development Goal
MICOA	Ministry of Coordination of Environmental Affairs
MINAG	Ministry of Agriculture
MOPH	Ministry of Public Works and Housing
MOPHRH	Ministry of Public Works Housing and Water Resources
NGO	Non-Governmental Organisation
PLI	Policy, Legal and Institutional
PRONASAR	National Water and Sanitation Program
SADC	Southern African Development Community
SADC-GMI	Southern African Development Community – Groundwater Management Institute
ZAMCOM	Zambezi Watercourse Commission

1. INTRODUCTION

1.1. Background to the GMI-PLI Project

The critical role of groundwater in building the region's resilience to climate change and improving water security is reflected by the World Bank in their June 2017 online article: *People in Southern Africa are largely dependent on groundwater shared between countries and communities for health and well-being, food production, and economic growth*. As climate variability alters the amount of surface water that is available, people in the region are increasingly turning to groundwater, a resource that is already challenged by threats of depletion and pollution.

The sustainable management of groundwater is a key part of the broader water security for the region, especially in understanding transboundary aquifers. The Southern African Development Community (SADC) has established the Groundwater Management Institute (GMI) to better understand the region's needs and improve their groundwater management capabilities.

The SADC Groundwater Management Institute (SADC-GMI) is the implementing agency of the World Bank funded Sustainable Groundwater Management in SADC Member States Project. This funding is secured through the Global Environment Facility (GEF) and the Cooperation in International Waters in Africa (CIWA) trust. Part of this funding has been dedicated by the SADC-GMI to respond to gaps in the existing policy, legal and institutional (PLI) frameworks for groundwater management in the region towards fulfilling one of four main components of the project –"Enhancing institutional capacity of governments in SADC Member states and transboundary organisations". The objective is to be met through a series of organised steps which broadly included the development of a benchmark document called the Desired Future State Document, a Gap Analysis and high-level Action plan for all SADC Member States and for the region, development of a suite of guidelines to strengthen groundwater management regionally. To inform the guideline on the development of a groundwater PLI Roadmap, Tanzania was selected as a pilot from which to draw lessons and develop the process.

This report presents the outcomes of the gap analysis for Mozambique.

1.2. Socio-economic drivers for Mozambique

Mozambique is situated in Southern Africa and occupies an area of 799,380 square kilometres. The country is administratively divided in 11 provinces including Maputo City. It is crossed by ten main rivers that flow towards the Indian Ocean. Mozambique is a downstream country where most of the rivers flow in from neighbouring countries. As a result, Mozambique normally faces two types of challenging situations: floods during the rainy season and drought during the dry season caused not only by action of nature but also by human intervention. This scenario has its negative impact on the socioeconomic status of development in the country. Water is necessary for the different uses, however human consumption and agriculture are the most critical water use sectors in Mozambique.

According to the 2017 census, Mozambique has an estimated population of 28.9 million, which is significantly higher than the 2007 census figure of 20.5 million. Mozambique remains sparsely populated with 29 people per square kilometre, ranking at the 178th position in the world, (INE, 2017). The population growth in the country has influenced the increase in water demand and supply characteristics in recent years.

Under conditions of limited resources and increasing demand for water, energy and food, the need for sustainable use and management of basic resources is more and more needed. Agenda 2025 recognized that Mozambique imported more than it exported, with minimal use of irrigation systems, citing inoperative irrigation systems and a lack of national programmes to store surface water for irrigation, flood control and other purposes.

Agenda 2025 foresaw the development of more dams and weirs for storing water, more secure national interests among shared watercourses, economic and social justice in pricing and expansion of small water systems to most of the population that were managed by communities and not the State. Boosting water provision in the context of climate change and variability has to be accompanied by intentions to make "better use" of water by all sectors especially in agriculture which accounts for about 73% of the total water consumption; to expand water infrastructure into areas with productive potential; to build and rehabilitate systems and to expand access to electricity for better production of and productivity of water resources.

Agricultural productivity has been very low in Mozambique due to under-practiced irrigation, limited market access, poor post-harvest infrastructure, poor availability of credit and insurance mechanisms and vulnerability to climate change. The complementarity of the sectors shows how they are dependent on each other. The Irrigation Strategy and Irrigation Programme have guided use of water in agriculture, both prepared in close collaboration between the Ministry of Public Works and Housing (MOPH) and the Ministry of Agriculture (MINAG). Intended to reverse low infrastructure development and access to irrigation, the National Irrigation Strategy, was approved by the Mozambique Government for the period 2011–2019, (Stephan 2015).

Mozambique has a US$4.3 billion economy. Agriculture produces approximately 22% of the GDP, industry (including manufacturing) produces about 33%, and services produce about 45%. All these sectors are dependent on an adequate supply of water. Agriculture (including irrigation, livestock and forestry) uses about 73% of the total water consumption, with industries using about 2%. This indicates that about 75% of the water use in the country has a direct impact on economic production. Urban and rural domestic water supply account for most of the remaining 25% of the total water consumption and has a direct impact on the service industries and public health, (World Bank, 2005).

It is important to note though, that the potential for irrigation varies across the country and cannot be seen as the optimal solution in all areas. Much of the potential irrigable land is located in the Zambezi basin (more than 1.3 million ha). South of Save River, possibilities for irrigated agriculture are severely constrained by the low storage infrastructure and high evapotranspiration rates in most cases above average rainfall, (World Bank, 2005).

1.3. Water Resources

General description - The water resources situation in Mozambique compares well with the rest of the world in absolute terms. The availability per capita of surface water resources is about 5,550 m3/year (for runoff generated within the country) or 12,000 m3/year (including cross-border flows).

Most of the rivers have a torrential regime, with high flows for 3-4 months and low flows for the remainder of the year, which means that without storage these resources cannot be used. The country has 104 main river basins, out which 50 have a catchment area less than 1,000 km2, 40 are with an area between 1,000 and 10,000km2, 12 between 10,000 and 100,000 km2, and 2 basins (Zambezi and Rovuma) have catchment areas more than 100,000 km2.

The most important river basins, from South to North, are: Maputo, Umbeluzi, Incomati, Limpopo, Save, Buzi, Pungoe, Zambezi, Licungo, Lurio, Messalo and Rovuma. With the exception of the Licungo, Lurio and Messalo, all major basins are shared with other countries.

Water Resources Variability - Mozambique has a highly variable, climate, which has a significant influence on the amount, timing, and frequency of precipitation events. Rainfall varies considerably within annual cycles with 60-80% of the annual precipitation falling in the period from December to March. The annual average rainfall ranges from over 2000 mm in Northern Mozambique to about 500 mm in the South. The variability of rainfall from year to year is also much higher in the South than in the Northern and Centre regions of Mozambique with almost no flow observed in some rivers in dry years in the South, (World Bank 2007).

On average Mozambique have ample water resources - if an overall water balance of each basin is evaluated, nearly all basins would show a significant surplus of annual total runoff compared to any foreseeable water demand. However, within these aggregates, serious water shortages occur during dry seasons in several basins, especially in the South, (World Bank 2007).

Tropical cyclones and the El Nino/La Nina phenomenon compound the variability resulting in extreme floods and droughts such as the floods of 2000, 2015 in the South and 2001 in the Centre of the country. However, floods and droughts are frequent in Mozambique, occurring cyclically with varying intensity. More localized droughts are observed every 3-4 years and are often not well recorded. According to the National Meteorology Institute, INAM, the intervals between extreme rainfall events are shortening, while the intensity of rainfall in these events is increasing. The years of major floods in Mozambique over the last 25 years are 1977-1978, 1985, 1988, 2000, 2001, and of major droughts – 1981-1984, 1991-1992, 1994-1995, 2002-2003. It is predicted ed that these conditions will be exacerbated by climate change, (World Bank 2007).

International Rivers - Mozambique is a downstream riparian state on all nine of its major rivers, with about 54% of the total annual runoff generated outside of the country. The high dependence of Mozambique on shared water resources is an important factor in the national water vulnerability. In the South, all major rivers (Maputo, Umbeluzi, Incomati, Limpopo and Save) originate in neighbouring countries. Significant water abstraction from these rivers in the upstream countries, along with high flow variability, reduces water

availability in these basins and increases water vulnerability of the Southern region. The combined average natural flow in the four basins1 is about 11 km3/year – this is predicted to reduce to about 5 to 6 km3/year over the next 20 years, and be more variable in future, due to growing demand on the resources from riparian neighbours.

The management of river basins and reservoirs upstream of its territory has direct impact on its own risks, particularly related to floods. Mozambique is very active in a number of joint processes with riparian countries to ensure that its interests and concerns are addressed, through the ratified the SADC protocol for water sharing, and ratify agreements with most of neighbouring countries, the cases of Tanzania (Rovuma River), Swaziland (Mpongola Umbeluzi and Mpongola Rivers), South Africa (Incomati and Maputo River), South Africa, Botswana and Zimbabwe (Limpopo River), Angola, Botswana, Malawi, Namibia, Tanzania, Zambia and Zimbabwe (Zambezi River), Zimbabwe (Save and Pungue). The details on the established trans boundary water management protocols and agreements established as of today are included in the section 6.1.1.4

1.3.1. Status of water resources (Surface, groundwater and transboundary)

The water resources situation in Mozambique, in absolute terms, compares reasonably well with other countries occupying similar climatic zones. Total mean annual runoff is estimated at 216 km3/year. The total inflow at the border is about 116 km3/year while the runoff generated within the country averages about 100 km3/year. Therefore, more than 50% of the total mean annual runoff is generated outside of the country. The Zambezi basin represents about 18% of the country's total mean annual runoff and 75% of the total cross border inflow: the basin receives 88 km3/year of inflow at the border and 18 km3/year of the basin's runoff is generated within the country, giving a total mean annual runoff of 106 km3/year. The availability per capita of surface water resources is about 5550 m3/year (only for the runoff generated within the country) or 12000 m3/year (including the cross-border flows), (World Bank, 2007).

Mozambique has substantial water resources; however, these resources vary across the country (wet north – dry south), vary significantly from season to season and vary from year to year with occasional extreme events of floods and droughts. Water shortages in Mozambique are localized and highly seasonal. The minimum monthly flow is 1-2% of the annual runoff for many rivers. Because of this variability and very limited infrastructure, only a fraction of total runoff can be utilized. High variability means that the amount of usable and available water resources depends heavily on the development of storage and diversion infrastructure.

1.3.2. Groundwater environmental and ecology

The environment uses water to sustain river health and ecological functions. In order to preserve an acceptable balance within a specific watercourse, it is necessary to ensure that an adequate ecological reserve is maintained in the river basin – the reserve refers to both the quantity and quality of water in the

[1] Excluding the Save river where water demand in Mozambique is very low.

river. The ecological reserve of water ensures the ecological integrity of rivers, estuaries, wetlands and groundwater resources. Water allocated to the environment (and to some extent to hydropower) is also used for recreational activities. Recreational use of water in Mozambique is expected to increase due to the Government's on development of tourism industries. In Mozambique, there are currently 34 nature conservation and protection areas, covering more than 10% of the country's total area. Many of these biodiversity rich areas are under threat from unsustainable use of natural resources, including water resources.

The environmental requirements for water, in quantitative and qualitative terms, need to be developed for each river basin in Mozambique. Water allocation for the environment is also an important tool in the negotiation of joint basin agreements in the international context of Mozambique's major river basins. This requires that sufficient water is maintained within the system to meet environmental requirements in downstream riparian states, thus providing another important dimension to the negotiation of basin agreements and inter-national allocation of water rights, (World Bank, 2007).

1.3.3. Status of groundwater infrastructure

Groundwater infrastructure in Mozambique is mostly limited to boreholes equipped with hand pumps along the country, where surface water cannot address the human needs, neither due to availability in quantity nor in quality.

Single exceptions for the Great Maputo area, where there are a limited number of piezometers covering limited area to monitor the groundwater aquifers.

The collection of hydrogeological information of a complete aquifer system (~5000 km2) is made in the metropolitan area of Maputo. The operational network consists of 25-groundwater level monitoring points and 48 water quality-monitoring points. Data collection includes groundwater levels, electro-conductivity (EC) and chemical parameters. Groundwater levels are monitored monthly whereas groundwater samples are taken quarterly, (Igrac, 2013).

A monitoring and data base preparation linked to the Rural water and sanitation program, linked to the project called SINAS is collecting and creating a data base for the water sources in a great actual improvement in the sector. Results of it can be showed in the following link. http://213.136.89.20/akvo/DNAAS/

1.3.4. Groundwater supply and demand

There is an impression that the main source of water in Mozambique is surface water. However, groundwater is utilized on a large scale in a number of cities for drinking water supply, including in the major cities as a complement to the main water supply system in the peri-urban areas. Groundwater potential is substantial and lies in the alluvial formations of the various rivers. The Maputo city is supplied by surface water and the metropolitan region of Maputo (Per-Urban) are supplied by both surface and groundwater. A similar situation is found in the following cities, Maxixe, Nacala, Inhambane, Moatize Vilanculos and Angoche which are supplied by groundwater.

Groundwater is currently used for some water supplies for human consumption, including such towns as Pemba, Tete, Xai Xai, Quelimane, Maputo, Nacala, and Chokwe, as well for irrigation at “machongos”, wetlands often found at the foot of the eastern escarpments used for dry season farming through careful control of groundwater levels. It is also known that there are some groundwater resources in the sandy coastal plain, although soils there are generally poor. Given the fact that the geology of sizable parts of Mozambique is very similar to that of neighbouring countries where groundwater has been found in substantial quantities and plays an important role in the national water supplies, thorough investigation of the groundwater potential in Mozambique is an important strategic priority in water resources development. This has already commenced in the Maputo Metropolitan Area in the form of the 2007-2010 ARA-SUL Groundwater Resources Pilot Program.

The hostilities that ended in 1993 prevented groundwater exploration in Mozambique in the past. However now, with national priorities changing to positively promote water resources development for small rural communities, it is clearly of strategic importance to initiate a national groundwater exploration program. Such a program should identify and map groundwater occurrence, yields and quality throughout Mozambique, beginning with the provinces and corridors that are (1) likely to be prospective for such groundwater resources, and (2) of high national priority for water resources and community development for domestic water supply and small-scale irrigation. In addition, the Government’s relevant strategies and policies should require that identification of opportunities for small and medium scale water resources development should always include evaluation of groundwater as well as surface water options.

2. METHODOLOGY

2.1. Overview

The methodology for the gap analysis included conducting a desktop review of available literature. This was coupled with the development of a desired future state to provide a baseline for groundwater management and is discussed in more detail below. Key stakeholders were also identified during the early stages of the gap analysis and multiple engagements were held whereby a questionnaire was administered to evaluate the current state of groundwater management in the country. Based on the desktop review, stakeholder engagements and results from the questionnaire, a draft gap analysis report and action plan was developed which was then validated at Validation Workshops. These workshops involved key groundwater actors from the Member State and provided an opportunity to obtain buy-in and support for the gap analysis reports as well as obtaining further inputs. The draft report was also circulated to broader stakeholders i.e. Water User Associations, Water Service Providers etc. whereby written comment was received. The draft gap analysis report was then finalised based on the comments received from the Validation Workshops and broader stakeholders. The methodology outline is illustrated in the figure below.

Figure 1: Methodology Outline

The literature collected is detailed on the inventory list available in **Appendix A**. The list of stakeholders who responded to the questionnaire as well as the full list of groundwater stakeholders is provided in **Appendix B**. Several individuals/institutions were engaged for data collection using the structured questionnaire, based on the Desired Future State, elaborated on below.

The desired future state has been contextualised for the SADC region, taking into account:

- The high levels of groundwater dependency in many SADC countries, in rural areas in particular;
- The variety of geohydrological contexts;
- High levels of poverty, gender disparities, social exclusion and pollution; and

- Relatively low levels of state capacity – skills, infrastructure and finance.

It sets out the ***minimum*** requirements that support the delivery of national, regional and international developmental goals, including the Sustainable Development Goals, meeting basic human needs to water, energy and food (the WEF nexus), and the protection of ecosystems that are dependent on groundwater.

The sections below describe, at a high level, what is considered to be the minimum best practice for policy, legislation and subsidiary legislation, regulations and standards for effective groundwater management. For a more detailed description of the desired future state, see **Appendix C**.

The **minimum policy requirements** that should be in place are:

- A long-term policy to protect groundwater by preventing pollution and overuse.
- The social, economic and environmental values of groundwater are all recognised.
- The human right to water is recognized and a rights-based approach to groundwater management is taken.
- Groundwater is recognised as a highly important source of domestic and agricultural water supply and a key resource for poverty alleviation, food security, and the sustainable economic development of rural areas.
- The biophysical and ecological linkages between ground and surface water for their use, protection and management are recognised, including land use zoning for groundwater protection and recharge (conjunctive use).
- The importance of the maintenance of the ecological integrity of wetlands in groundwater management is recognised (recharge zones).
- Intersectoral collaboration is promoted and facilitated.
- The need for adaptive management is recognised.
- The roles of various stakeholders and water users in groundwater management is recognised and participation of stakeholders is promoted and facilitated.
- An apex body that is responsible explicitly for GW management and playing the role of custodian/trustee on the part of the state is clearly defined.
- Effective institutional arrangements are coordinated at transboundary, national and local levels.
- Public access to geohydrological data held by the state is promoted and facilitated.
- Additional environmental principles necessary to protect and sustain groundwater are mandated, including: the precautionary principle, the principle of gender equity and social inclusion (GESI), the principle of subsidiarity, and the principle of intergenerational equity.

The **minimum legislative requirements** that should be in place are those that explicitly address the use, management, and protection of groundwater and provides the necessary tools for the state to regulate, manage, control, protect and develop groundwater resources in conjunction with surface water resources. At a minimum, legislation and/or subsidiary regulations should:

- Provide the status of groundwater noting that all water has a consistent status in law, irrespective of where it occurs, and there is explicit reference to groundwater and conjunctive use management;

and recognise the human right to water recognized in groundwater legislation, facilitating prioritization of drinking water and basic human needs, as well as small-scale users.

- Regulate groundwater quantity by providing conditions for accessing groundwater through water use authorisations system that does not discriminate (especially against the rural poor), is not tied exclusively to land tenure and enables effective compliance monitoring and enforcement.
- Provide groundwater protection mechanisms that includes regulating pollution (point source and non-point source), regulates depletion, regulates abstraction and recharge (usually via permitting) and provides for the sustaining wetlands;
- Enables integrated planning through specifying the need for long term plans (at catchment or basin level) to ensure the sustainable use of groundwater, including drought management plans and cross-sectoral coordination.
- Make provision for institutional arrangements including the mandate, competence and power of the relevant authorities, enabling the integrated management of groundwater and surface water resources, engaging in the arbitration of competing demands and diverging interests regarding groundwater abstraction and use, and support the collaborative engagement with other sector authorities, competent for public health, land-use planning, soils management, and waste management.
- Support effective stakeholder engagement through specifying when and how stakeholders, the public and/or other water users are to be engaged in the development of laws and regulations, planning, decision making and self-management regarding groundwater and should specifically address the issue of the involvement of women and youth in decision-making and the implementation of groundwater supply schemes.
- Provide for Monitoring and data collection to support regulation including protocols for data collection, management, exchange and dissemination, including standardization and harmonization of data, as well as national monitoring and information systems for the management of data and information.
- Regulate to ensure water conservation and efficiency of use.
- Support compliance and enforcement through clear mechanisms for promoting compliance with groundwater regulations through enforcement provisions that enable inspections, the imposition of fines and/or additional administrative penalties and other instruments to address failure to comply with the law.
- Conflict resolution mechanisms and/or the right to appeal.
- Enable the development of regulations on any relevant matter in the legislation to regularise aspects of groundwater management and incentivise appropriate use of groundwater resources.

The actual **requirements for subsidiary regulation** will differ from country to country, according to their own National Legislation. However, it is important to understand the extent to which critical issues around groundwater management have been translated into regulations. Below are some examples of how this could look.

- Subsidiary legislation or regulations pertaining to use, protection including on-site sanitation, borehole drilling, and appropriate financial and economic regulatory tools e.g. water pricing.
- Clear protocols and standards on data collection and storage.
- Templates for municipal by-laws.
- Community management of groundwater and community participation in groundwater management.

From an **institutional perspective**, it is critical that countries have as a minimum, a dedicated Ministry for water resource management, which is also the custodian for ground water management. Noting that the groundwater is a localised resource, decentralised institutions at trans-boundary, catchment and local government level are crucial, where groundwater management fits into overall mandate for water resource management.

3. POLICY

3.1. Evolution

3.1.1. Evolution of the Water Policy

The water policy is the one significant policy to groundwater management that has undergone significant changes since its establishment. In 1991, the first Mozambican water policy was established, and was revised in 2007 to incorporate general improvements to the management of water resources. In terms of the evolution of this policy, the following needs to be emphasized in relation to ground water management:

- The 1991 water policy stresses two principal policies: the value of water i.e. 'water value', and integrated water resources management (IWRM). The policy indicates clearly the need to recover the costs of water resource management services at various basin levels and stresses that the monitoring and management tolls at the basin levels will be gradually established, with a special attention to the cross-border rivers and to the places were considerable water needs is registered.
- The policy also indicates that protection zones for ground water will be established where the risk for the excessive exploration or pollution is identified.
- In addition, the policy prioritizes the establishment off international shared water agreements on the international river basins (Incomati, Limpopo, Pungue, Save and Zambezi), to ensure that the minimum ecological flows are granted out of the other uses including human consumption, irrigation and industrial.

In the revised water policy of 2016, some of the previous principal policies have been improved and some new ones were added. The most relevant policy improvements related to groundwater are:

- the increase of the responsibilities of the interested parts,
- participation of the beneficiaries in the water management process,
- decentralization of the management process to the local authorities,
- water education to the population and knowledge of water resources.

The improvements made in water policy highlights the need to consider the intrinsic relationships between surface and ground water, as well as consideration of dedicated groundwater studies in dry areas to ensure that boreholes will provide sufficient yield to supply the populations sustainably during the dry seasons. Furthermore, there will be need for monitoring water quality, close to the water reservoirs, at the borders and close to the identified potential pollution focus areas, as well as considering the water needs for environmental protection.

In general, the 2007 water policy provides more clarity to the objectives defined in the 1991 version of the same policy and introduces new relevant concepts such as decentralization. This includes the elaboration of responsibilities of the various parties, as well as the indication of targets to be achieved in short term (2015) and long term (2025) for the different fields of action. There were no specific targets provided particularly in relation to the objectives related to the necessity of use, water for environmental conservation (preservation and maintenance of ecosystems, water quality in the water bodies, protection of principal aquifers, etc.), reduction of vulnerability to floods and droughts, regional integration and warranty of water resources for

Mozambican development through the joint management of shared basins (quantity and quality) by riparian states. This made it difficult to monitor the outputs of the registered evolution.

3.2. Policies to support groundwater management

3.2.1. General

In Mozambique water is considered to belong to an existing group of natural resources. According to the Mozambique National Constitution, water is referred to as a public good. In terms of management and preservation of water, groundwater management is referred to in various crosscutting sector policies, especially where the sector activities could negatively interfere with the groundwater resources. Reference to documents with policies reflecting on such groundwater related policies are listed below:

- National Constitution (1975/1990/2004/2017)
- Water Policy (1991/2007)
- Water Tariff Policy
- Environmental Policy (1995)
- Land Policy
- Mineral Resources Policy

3.2.2. Water Policy

As reflected in the evolution section above. Moreover, in 2012, Mozambique approved a specific Regulation called the Regulamento de Pesquisa e Exploração de Água Subterrâne – RPEAS (Regulation of Research and Exploration of Groundwater) so that there is a groundwater specific regulation.

3.2.3. Environmental Policy

The environmental policy dated 1995 was approved by the resolution 5/95 August 3rd, and responds to article 72 of the constitution which defines the right of citizens to an equilibrated environment and the responsibility to protect it. The policy establishes the foundations for sustainable development in Mozambique which needs to be met through an acceptable and realistic compromise between socio-economic development and environmental protection. One of the policy's objectives, is the protection of ecosystems and the essential ecological process. The relevant principles of this legislation include:

i) the need for optimized use of natural resources;
ii) persons/entities responsible for pollution activities should reset the environment quality to the level registered prior to the pollution event and should pay the costs for prevention and elimination of the pollution caused by their activities.

The policy stresses the need to develop sectoral policies to deal with issues related to the high rate of exploration of sub surface natural resources that may interfere with groundwater quality; the need to establish adequate mechanisms to supervise and monitor changes in the environment, and the quality of natural resources resulting from the impact of the exploration activities as well as the need for the international cooperation with regards to environmental protection.

The policy makes particular reference to coastal ecosystems; and rehabilitation or construction of sanitation and water supply systems (indicating the need for sewerage treatment plants; mapping environmental risks). And provides for remedial legal actions should water quality offenses be made. Regulations for standards of water quality are in place to enable the implementation of existing environmental policy.

The status and need for monitoring are evaluated as part of the environmental studies (environmental impact assessment studies _EIAs) required for the licensing process of projects including those related to the water abstraction and rejection of effluents.

3.2.4. Land Policy

The land policy was approved by the resolution 10/95 on October 10th, 1995. The policy highlights important principles linked to groundwater including the sustainable use of the natural resources and securing of protection zones. This policy makes reference to the need to harmonize the proposed review of land law with the other sectorial policies that are undergoing preparation for review including water, mining, tourism, etc. The policy indicates that the right to use the land does not entitle the beneficiary for unlimited exploration of ground water but allows for the abstraction of sufficient quantities for human consumption and irrigation up to the established limit.

3.2.5. Water Tariff

This policy was approved by the resolution 60/98 on 23rd December 1998. It was built under the following principles bases: user-payer and polluter-payer; protection of the water resource and its efficient use; environmental sustainability of its exploration; decentralization and participative management of water resource. The policy indicates that the rejection of the effluents of water uses in the water courses, aquifers based on the pollution parameters fixed in the respective legislation should be paid.

3.2.6. Mineral Resources

The policy dated December 2013, was approved by resolution 89/2013 of December 31st. The main policy was built based on the following principles to be followed by mining/ground exploration entities:

i) Preserving environment by creating the necessary technical conditions for preservation;
ii) Promoting the use of efficient technology with benefits to the environment;
iii) Promoting capacity building for operators and communities in matters relating to the sustainability of the activities that are related to environmental protection;
iv) Ensuring that the mine operators take into consideration the safety and environmental preservation measures;

3.3. Gaps and challenges identified

From the analyses of the above analysed Policies the main gaps identified are the following:

- The policy does not propose clear actions with identified targets to promote the improvement of the groundwater management;

- Lack of clear policy for capacity building and promoting trainings on the field of ground water.
- Lack of clear policy actions that my conduct to an update of the geo-hydrological data base and the knowledge of aquifer systems.

3.4. Enablers required to unlock these gaps and challenges

The table below reflects on the enablers required to unlock the identified gaps and challenges being experienced.

Table 1: Enablers required to unlock the policy gaps and challenges

Groundwater gap/challenges	Enablers
Lack off supporting specific policy for groundwater management. The groundwater context in most of the existing policies is generally included under the group of natural resources.	▪ Raise awareness of groundwater related policy among water resources managers and decision makers ▪ Where necessary apply groundwater interpretation of existing general water resources policies ▪ Update water policies to include more specific sections specific to groundwater management
The policy does not propose clear actions with identified targets to promote the improvement of the groundwater management;	▪ Policy review to include clearer actionable and enforceable policies on groundwater management for the short, medium and long term to protect, secure and monitor groundwater use.
Lack of clear policy for capacity building and promoting trainings on the field of ground water.	▪ Create a section under the National Directorate of water resources equipped with qualified personnel to deal with issues of groundwater management
Lack of clear policy actions to enable an update of the geo-hydrological data base and the knowledge of aquifer systems.	▪ The revised policy should provide for a process of updating existing geo-hydrologic maps

4. LEGISLATION

4.1. Evolution

The evolution of the Mozambican constitution starts from the first constitution dated 1975, with subsequent major amendments on 1990, 2004 and punctual revision in 2017.

The first national constitution, of 1975, prepared after the National Independence, indicates on its article 8 that "Land and natural resources located in the soil and subsoil, in territorial waters and on the continental shelf of Mozambique are State property. The State determines the conditions for its use and its exploration". In this period there were not a clear reference to the ground water.

This constitution was changed in 1994, because of the peace agreement, with the finish of the 16 years civil war. On the constitution a reference to the water was made on:

The #2 of its article 6 – Territory, of the chapter #1- the Republic, stating that "The extent, boundary and regime of territorial waters, the exclusive economic zone, the contiguous zone and the rights to the seabed of Mozambique are established by law". This is a clear mention that a specific legislation should dealt with the water issues.

The #1 and #2 of its article 98 – State propriety, of Title # 4 – Economic, Social, Financial and Fiscal organization, under the chapter #3 – Individual Rights, Freedom and Guaranties, indicates that all the natural resources are state property including those at inland, in the territorial sea, on the continental shelf and in the exclusive economic zone.

The #1 of its article 117 – Environment and life quality, of Title # 4 – Economic, Social, Financial and Fiscal organization, under the chapter # 3 – Social Organization, which promotes the initiatives for the equilibrium, conservation and preservation of the environment, and on its #2 indicates that the State adopt politics to prevent pollution.

The Constitution of Mozambique is the supreme overarching law of the land and any act or conduct inconsistent with it is invalid and will have no force of law. In this topic the constitution of 2004 does not bring changes. The major improvement seen in the constitution was introduced in the 1990.

In General, the constitution defines the right of all citizens to live in a balanced natural environment and their obligation to protect it and addresses matters relating to the environmental protection and quality of life for all in Articles 45, 81, 90, 98, 102 and 117. Article 90, which are part of Chapter V (Economic, social and cultural rights and duties) of Title III (Fundamental rights, duties and liberties), give the people of Mozambique the right to live in a balanced environment free of contamination. Furthermore, the State is required to promote initiatives that ensure ecological balance and preservation of the environment; and implement policies to prevent and control pollution and integrate environmental objectives in all public sector policies to guarantee citizens the right to live in a balanced environment under a sustainable development framework (Article 117 of the Constitution).

The constitution consider that water is included in the group of as a natural resource, and that the Natural resource are property of the state, and the use and its exploration is ruled by specific legislation.

4.1.1. Water Use and Legislation

Water use in Mozambique may be classified as common use and private use. Common use is free and exempt from licensing and aims to meet domestic and personal water needs, including small-scale farming (DFID 1999). Private use is given by concession or through the law. Licensing is required for various activities including (i) prospecting, capture and use of groundwater in a protected area; (ii) installation of reservoirs, planting of crops or felling of trees on the beds or shores of a water source; and (iii) removal of sand or clay on the banks or shores of a water source.

Water use licences are valid for five years and are renewable. However, the licence is revoked if a water concession is requested in the same area. Licences, being temporary and revocable cannot form the basis for opposition to a concession request. In any situation not covered above, a concession is required. Concessions are also given by the ARA, are valid for 50 years, are renewable, and their application must be based on economic and technical reasons.

Article 18 of the Water Law gives jurisdiction over water management to Regional Water Authorities (Administração Regional de Águas – ARA), which were established on the basis of river basins (DFID 1999). The ARAs maintain financial and organizational autonomy, but report to the National Water Directorate. Five regional ARAs exist (DFID 1999) as follows:

- ARA Sul (South), covering the south border of the country to the basin of the Save river;
- ARA Centro (Central), which includes the basin of the Save river to the basin of the Zambezi River;
- ARA Zambezi that consists of the basin of the Zambezi River
- ARA Centro Norte (Central North) covering the region from the basin of the Zambezi River to Lúrio River;
- ARA Norte (North), which consists of the basin of the Lúrio River to the northern border.

The ARAs are responsible for collecting hydrological information, controlling the water abstraction for the irrigation systems, and collecting water fees.

Regulation on the Quality of Water for Human Consumption (Ministerial Diploma of18/2004)

This regulation establishes the parameters of quality of the water destined for human consumption and the terms of realization of its control, aiming for protecting human health from harmful effects resulting from any contamination that may occur in the different stages of the water supply system from its capture to the consumer. The Regulation establishes the competent authority, at central level, the Department of Environmental Health and the National Laboratory of Water and Foodstuffs Hygiene, at provincial level, the Centres for Environmental Hygiene and Medical Examinations and the Provincial Laboratories for Water, while at the local level, the Health Centres.

The Regulation applies to, inter alia, fresh underground water destined for direct consumption or for production of water for human consumption and establishes compulsory parameters that must be measured

in the water destined for human consumption. It also establishes the regimen, modalities, frequency, parameters and characteristics of control in its. In addition, the supply of drinking water may be subject to the observance of the rules set out in articles 56 and 57 of the Water Law 16/19, for ensuring the quality of water.

Regulation for Quality Standards of the Environment and Emissions of Effluents

This regulation prohibits "the deposit in the soil, outside the boundaries legally established, of harmful substances that may determine or contribute for its degradation" and establishes the quality standards of the environment (air, water, soil, noise).

All the rejection effluents to be discharged in the water course or in the recharge area of the aquifers are governed by this regulation.

National Surface and Groundwater Standards

The Mozambican Government, via the Ministry of Coordination of Environmental Affairs (MICOA), has not published water quality guidelines for surface and groundwater. In the absence of locally derived criteria from MICOA it is therefore necessary to consult authoritative sources from other jurisdictions.

Other National Water-related Legislation

In addition to the above, other relevant National Water Legislation includes:

- Decree 25/91, of November 14, 1991, that determines the entry into force of the National;
- Water Council (CNA – Conselho Nacional de Águas);
- Decree 8/96, of April 2, that alters the composition of the CNA;
- Decree 72/98, of December 23, 1998, that establishes the Framework for Delegated Management;
- Decree 73/98, of December 23,1998, that establishes the Investment and Assets Fund for Water Supply (FIPAG - Fundo de Investimento e Património do Abastecimento de Água);
- Decree 74/98, of December 23, 1998, that establishes the Regulatory Council for Water Supply (CRA - Conselho de Regulação de Abastecimento de Água);
- Ministerial Diploma 134/93, of November 17, 1993, that approved the Statutes of South Regional Water Management Authority (ARA Sul - Administração Regional de Águas Sul); and;
- Ministerial Diploma 163/96, of December 25, 1996, that approved the bylaw of ARA – Sul.

4.2. Legislation to support groundwater management

In Mozambique the main legislation that support the ground water management are the Water Law (Law 16/91 of 1991) and environmental Law and its regulations.

In Article 6 the Water Low refers to the protection of groundwater in use, including the solid and liquid parts of the aquifers and the protection zones as required.

The environmental low provides the means of water quality to consider for the licencing and to monitor the situation of the water bodies during the exploration.

4.3. Gaps and challenges identified

The Gaps and challenges under the legislation can be summarized as follow

- Limited legislation to support groundwater management, and brings a superficial reference to groundwater management
- Poor interpretation of existing water law to ensure it addresses the gaps in groundwater management

Some enablers to address these gaps are provided in section 4.4 below.

4.4. Enablers required to unlock these gaps and challenges

The table below reflects on the enabling actions required to unlock the identified gaps and challenges being experienced.

Table 2: Enablers required to unlock the legal gaps and challenges

Groundwater gap/challenges	Enablers
Limited reference to groundwater in existing legislation, limiting the regulation of groundwater specific uses	▪ Establish groundwater specific regulations and guidelines aligned to general water legislation to make them enforceable ▪ Review the actual legislation to consider the inclusion of clearer groundwater specific legislation (where absolutely necessary) noting that changing of legislation is no easy task and can take years to accomplish.
Poor interpretation of existing water law to ensure it addresses the gaps in groundwater management	▪ Interpretation of the water law by water practitioners to proactively examine how and where groundwater regulation can be enforced with the already existing water law

5. STRATEGY AND GUIDELINES

5.1. Evolution

Amongst others, one of the main objectives of the 2012 Water Sector Strategy defined as target for urban water to service 70% of the urban population, by serving 4.0 million people. For the rural areas, the strategy set a provision of potable water to 69% of the rural population, serving around 13.5 million people. While the urban water supply is secured by different sources (surface and groundwater), the rural water supply almost only in groundwater, through spread water points equipped with hand pumps. In the other hand, the sustainable Development Goals, set a target of 100% coverage for both, urban and rural water supply.

Groundwater, in many parts Mozambique, provides the sole and or partial water supply for meeting basic human needs.

Even in the large cities where significant portion of the demand is addressed by surface water, the groundwater still provides a great contribution to the water supply service. As an example, Maputo city is supplied by surface water, however, the peri-urban areas where most of the population is located are supplied by small private service providers based on small water supply systems fed by groundwater. Furthermore, the North of Mozambique relies in the groundwater to address almost 80% of the water demand, except the Northern part of Cabo Delgado where the geohydrological condition is not favourable.

The water supply service has been a challenge for the country since the independence in 1975, it is reported that in 1990 the service coverage was as low as 35% and 30% for urban and rural water supply and raise to 64% and 56.6% in 2010, respectively. It is worth to note that the rural water coverage has shown significant change on the figures due to the adjustment on the ratio from 500 inhabitants to 300 inhabitants per water point from January 2013.

In the past, the investments in the groundwater subsector were characterized with separate initiatives funded by different donors throughout the country, which in some cases led to overlap of intervention in some areas and lack of intervention in others. The 2010 Ministerial Diploma 258 created the National Water and Sanitation Program (PRONASAR) with the main objective of accelerating the interventions toward the MDGs, which were set for 2015. Apart from the quantification of the infrastructures required to achieve the MDGs, PRONASAR set the most adequate technological options recommended to be implemented. The financial arrangement of PRONASAR is common fund, which receives Government as well as Donor's funds which are to be managed in holistic basis to address the goals established under the Government midterm and long-term plans. PRONASAR objectives have been updated and extended to 2030, with the main target of universal (100%) access to water supply.

The time has proven a continuous increase on the country dependency on groundwater resources to address the human needs in terms of water supply. However, the definition of sector strategy has not matched this tendency, hence, the subsector has not showed effective response to the increase on the demand

5.2. Strategies and guidelines to support groundwater management

Unlike wise for the Water Resources Management which focuses in surface water, there has not been any specific groundwater strategy to guide the subsector actions. Consequently, any actions in the groundwater subsector are supported by non-robust planning tools, and mostly adapted by those planed based on the surface water.

5.3. Gaps and challenges identified

Although there is the 2012, Water Sector introduction wells for urban supply. Furthermore, the information generated from the drilling programs has been badly managed to feed existing and future data bases that will be required to inform future studies.

The gaps and challenges in the groundwater subsector include lack of specific groundwater studies to define the potential of the existing aquifers, risk of saline intrusion, limitations of the groundwater availability and setting operation rules to protect the source.

The lack of strategy to guide the subsector has led to notable misuse of the scarce financial resources with prejudice to the outcome and limitation of the increase in the water supply service coverage. As example of the impact of lack of strategy and adequate planning, there have been cases of repetition of negative boreholes in same location due to drilling programs targeted to same areas with recent history of negative boreholes.

Groundwater resources are lacking proper management within the country due to lack of knowledge and skills especially with regard to the development, sustainable use, protection, and principles of groundwater resource management.

In summary the main identified gaps are:

- Inexistence of a ground water resource development and exploration strategy.
- Inexistence of a robust ground water planning process.

5.4. Enablers required to unlock these gaps/challenges

With an increase in the dependency on groundwater usage, the need to properly and effectively protect, use, develop, conserve, manage, and control groundwater resources has continuously become critical, to revert the current lack of country strategy for the groundwater subsector. The current groundwater allocation decision making tools have proven to be far inadequate to make informed decisions regarding the investment planning and prioritization. A full evaluation and analysis of groundwater planning use process and decision-making tools should be considered to overcome the current situation. The investments in the subsector should go beyond a simple drilling plans, they should address the lack of adequate tools for a better protection, use, development, conservation, management, and control of the groundwater resources.

The strategies to overcome the current situation should give priority to capacity building, including human resources, with focus to education, in order to ensure proper skills in planning the protection, use and management of the groundwater resources.

From the analyses of the identified Gaps and the above we summarize the actions to unlock the situation:

- Prepare a national ground water resource development strategy
- Establish a robust ground water planning process, evolving the local authorities, the beneficiaries, private sector,
- Establishment of an effective monitoring process that includes the performance indicators framework to measure the key results of the interventions, toward the Sustainable Development Goals. The program should include a legalization of the existing ground water infrastructure's
- program fines for those that, after advertisement remains in non-compliance with the regulations for the ground water regulation.

Table 3: Enablers required to unlock the Strategy and Guidelines gaps and challenges

Groundwater gap/challenges	Enablers
Inexistence of a ground water resource development and exploration strategy	▪ Prepare a national ground water resource development strategy
Inexistence of a robust ground water planning process.	▪ Establish a robust ground water planning process, evolving the local authorities, the beneficiaries, private sector,
The gaps and challenges in the groundwater subsector include lack of setting operation rules to protect the source	▪ Establishment of an effective monitoring process that includes the performance indicators framework to measure the key results of the interventions, toward the Sustainable Development Goals. The program should include a legalization of the existing ground water infrastructure's
Groundwater resources are lacking proper management within the country due to lack of knowledge and skills especially with regard to the development, sustainable use, protection, and principles of groundwater resource management.	▪ program fines for those that, after advertisement remains in non-compliance with the regulations for the ground water regulation.

6. INSTITUTIONAL FRAMEWORK

6.1. Evolution

Up to 2015, the Mozambican Water Sector had fallen under the responsibility of the National Directorate of Water (DNA) and from 2015 to date, the responsibilities have been split into two separate entities, namely, the National Directorate of Water Resources Management (DNGRH) and the National Directorate Water Supply and Sanitation (DNAAS). The water sector in Mozambique is developed under a structure subordinated to the Ministry of Public Works Housing and Water Resources (MOPHRH), on which we are highlighting later the following entities, as main players, and on bold those that take the main actions on the ground water management:

1. National Directorate of Water Resources Management - DNGRH
2. National Directorate of Water Supply and Sanitation - DNAAS
3. Water Supply Regulatory Council - CRA
4. Investment Fund and Heritage of Water Supply - FIPAG
5. Waters of the Maputo Region - AdeM
6. Administration of Water and Sanitation Infrastructures - AIAS
7. Regional Water Administrations (South, Centre, centre-North, North and Zambezi) – ARAs
8. River basin Committees (international and National)
9. Water management committees (at community level)

The study focused on actors with direct intervention in the management of water services, namely in the entities responsible for water resources management, water supply and water supply regulation.

The organizational structure linking institutions and responsibilities in water resources management is as below.

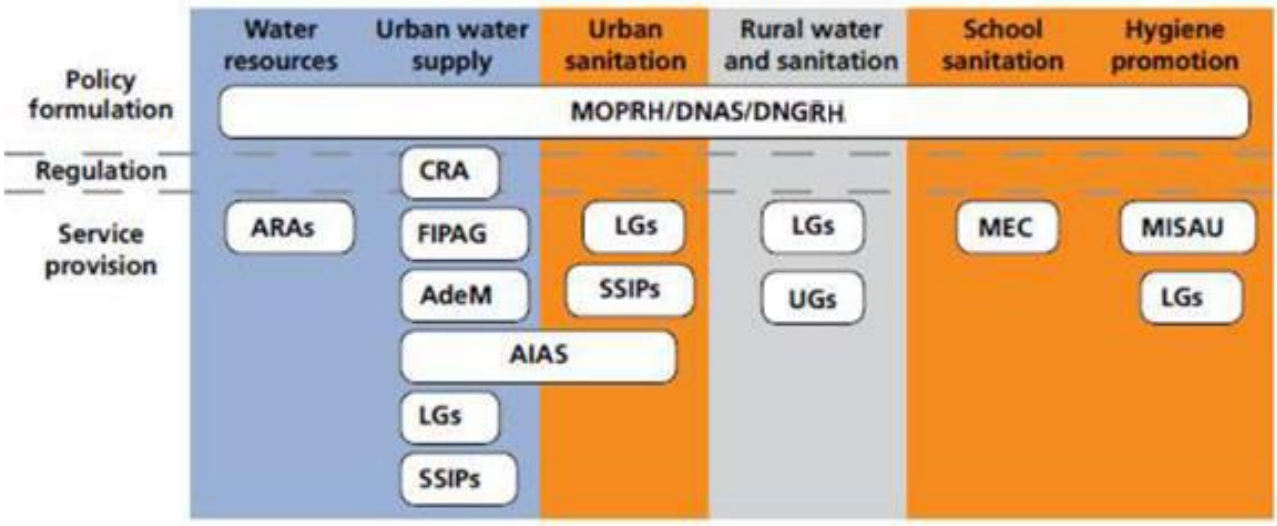

Figure 2: Institutional Organogram illustrating linkages in function and coordination in Mozambique's water sector

From these institutions the DNGRH and ARA Sul are the main ground water management responsible, while the DNAAS, FIPAG, AIAS and AdeM are the main users as water supply service providers, on which we can add the agriculture sector as a user as well but not in intensive as the others. There is a crosscutting sector that should play they role under education and sanitation promotion which helps on the ground water pollution events, however, the link is not working properly, the cases of Ministries of Mineral Resources and Energy, Health and Education. Only the Ministry of Environmental is active as they take a role under the licensing process and establishment of the environmental management plans. The flow chart showing below illustrate the framework of this institutions.

From 1981 to 1987 there was a project to create the National Water Institute, an organization with the main objective is to increase the capacity of the Mozambican government to assess and Manage its water resource in a rational basis. Due to absence of national professional staff and very low output of civil engineers by the university it has not possible to create the National Water Resource Institute.

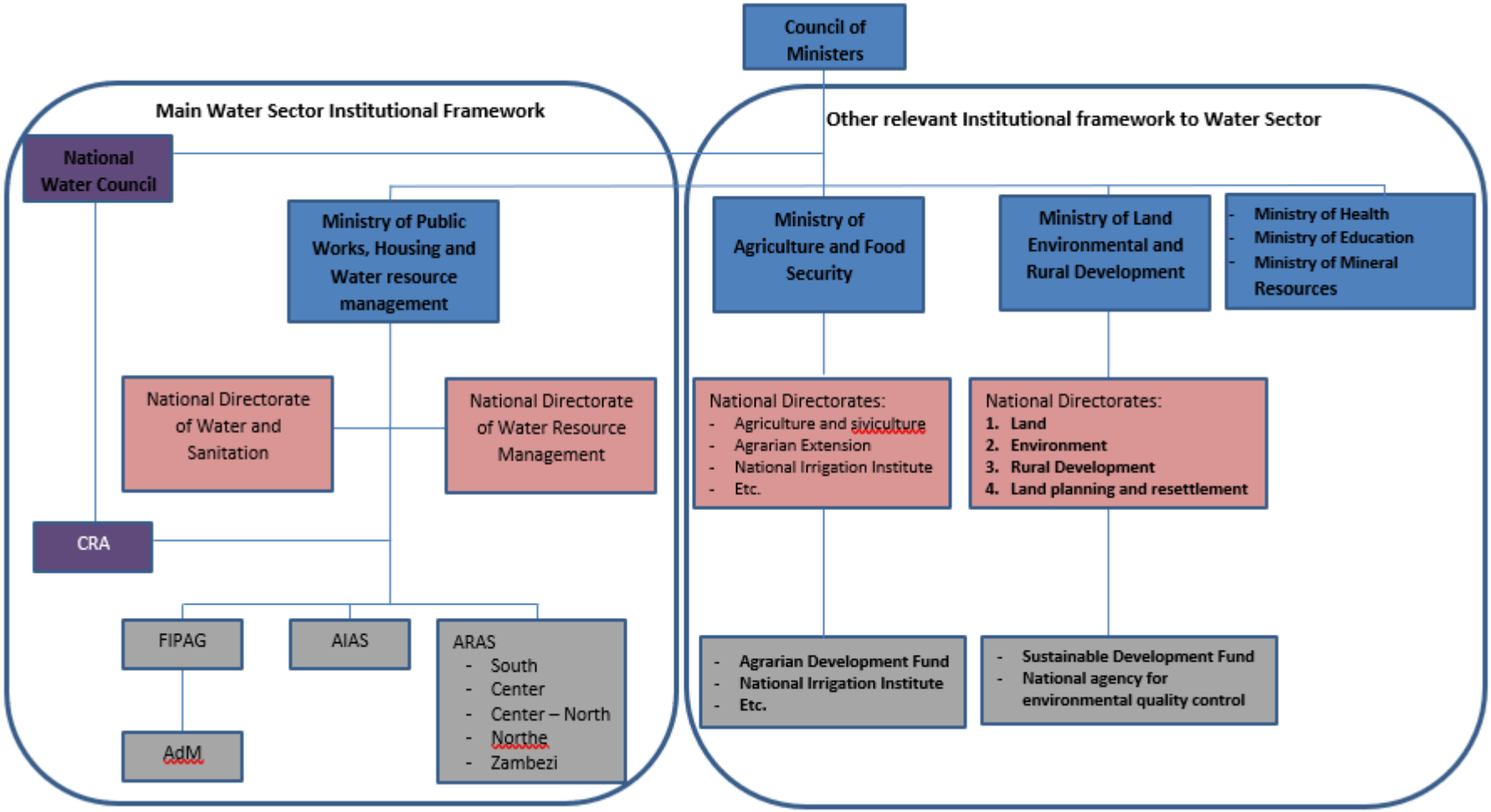

Figure 3: Structure showing linkages between institutions related to groundwater management in Mozambique

6.1.1. Roles and Responsibilities of the main players

National Directorate of Water Resources Management

Amongst others, the two National Directorate of Water Resources Management is responsible for the following with impact on the groundwater resources:

a) To propose policies and strategies for the development, conservation, use and utilization of water resources of the hydrographic basins;
b) Ensure availability of water in quantity and quality for different uses;
c) coordinate cooperation actions in the field of shared water resources, ensuring participation in cooperation bodies in the field of water;
d) Assess compliance with international agreements on the joint use of water resources;
e) periodically assess the balance of water resources in river basins and water needs at national and regional level;
f) To establish the cadastre of the uses and use and to operate national systems of information on water resources;
g) To elaborate and monitor the implementation of the Basin Plans to support short, medium- and long-term planning on the use and use, conservation and development of water resources, in accordance with the principle of unity and coherence of watershed management;
h) Promote investments for the construction and maintenance of strategic uses for water management, storage, protection, diversion and transportation, as well as the regularization of river beds, ensuring their sustainable exploitation;
i) Carry out strategic studies for the conservation, protection and development of water resources;
j) Prepare proposals for legislation and the regulatory framework on water resources and ensure monitoring and compliance;
k) To keep updated the cadastre in order to guarantee the conservation of the patrimony of the public water domain;
l) Ensure the integrated and rational management of water resources and the system of water resources management based on river basins;
m) Ensure and coordinate integrated strategic planning of water resources management;
n) Ensure the establishment of forecasting and flood warning systems;
o) Prepare, update and monitor the implementation of the national plan for the construction of hydraulic infrastructures;
p) Propose investments for the construction, maintenance and expansion of infrastructures for water management, protection and storage;
q) Propose the definition of protection zones and areas prone to floods and droughts.

The DNGRH is headed by a National Director and has the following structure:

1. Department of Watershed Management (DGBH);
2. Department of Hydraulic Works (DOH);
3. Department of International Rivers (DRI);

4. Planning Department (DP); and
5. Department of Administration and Finance (DAF).

It is important to stress that up to 2010, there was a Department of Rural Water within the National Directorate of Water, which was responsible for planning and implementation of the groundwater exploration programs, however the same was mostly oriented to drilling and operation of boreholes. The same Department was also responsible for small systems fed by different water sources other than the groundwater. Since such 2010, with the establishment of PRONASAR, running under the DNAAS management, the Department of Rural Water has been disaggregated and its role distributed among the new structure including, integrated to the Department of Water Supply and sanitation, which may have contributed to reduce the focus on the groundwater issues.

National Directorate of Water Supply and Sanitation (DNAAS)

The National Directorate for Water Supply and Sanitation, shortly known as DNAAS, is the Ministry of Public Works, Housing and Water Resources (MOPHRH) responsible for supplying drinking water and sanitation to the population and ensures the implementation of water supply programs and sanitation, aiming at achieving sustainable services and universal coverage.

According to the organic statute of the MOPHRH, DNAAS has, among others, the following functions:

a) propose and ensure the implementation of policies, strategies, standards, regulations and technical specifications for water supply and sanitation, as well as programs in the water supply and sanitation sector;
b) Promote investments for the construction, maintenance and expansion of water supply and sanitation infrastructures;
c) harmonize plans and actions to ensure universal access to water supply and sanitation services;
d) Ensure a balance in access to water supply and sanitation services;
e) Updating and disseminating strategies for water supply and sanitation;
f) Encourage private sector participation in the provision of water supply and sanitation services, including private public partnership;
g) Monitor compliance with standards for the prevention of domestic and industrial pollution;
h) To elaborate norms for drainage of rainwater in rural and urban settlements, and to monitor its compliance;
i) Establish and operate national water and sanitation information systems;
j) Provide technical and methodological support to local State and local authorities in the field of water supply and sanitation.

Regional Water Administrations (ARAs)

The Regional Water Administrations are public legal entities with legal personality and administrative, patrimonial and financial autonomy, under the supervision of the Ministry of Public Works, Housing and Water Resources (MOPHRH).

These entities have as their objective the management of water resources, planning and monitoring their exploitation, as well as the infrastructures for this purpose, focusing on dams that aim to store water for consumption and to control floods and droughts.

In Mozambique five ARAs, namely ARA South, ARA Centro, ARA Centro-Norte, ARA Norte and ARA Zambeze are established. The process of its establishment began with the creation of ARA Sul, followed by ARA-Centro, ARA-Zambeze, ARA-Norte, then and finally ARA-Centro Norte.

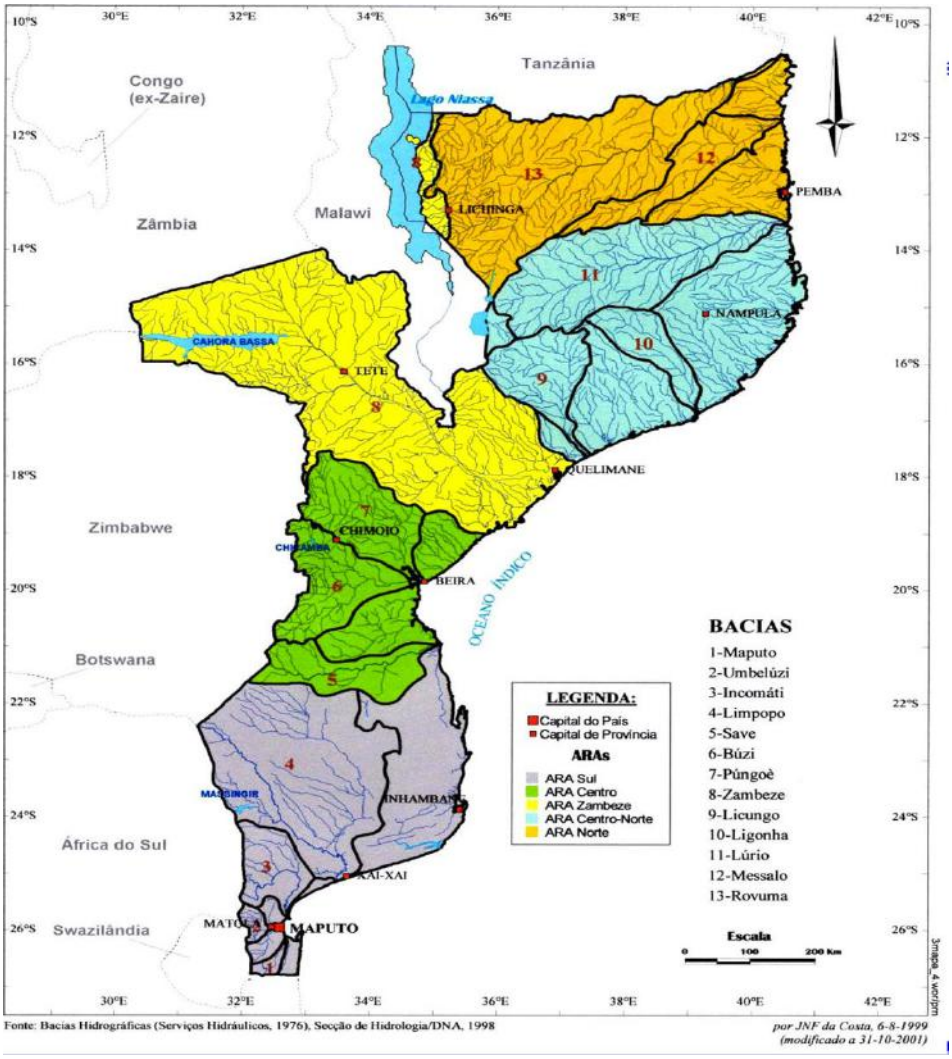

Figure 4: Map showing the water management areas in Mozambique

The assignments of the ARA's are similar, by way of example, details of the ARA-South's sta- tuses are detailed.

According to the new Decree that created the ARAs, approved in June 2018, the ARAs have only administrative autonomy, their financial and patrimonial autonomy has been removed. The ARA-Sul, created by 134/93 of November 17, has its headquarters in the city of Maputo and operates from the southern border to the exclusive Save River basin.

Within its area of competence, ARA-Sul is organized by Hydrographic Basin Management Units and may establish and close technical or administrative delegations or facilities necessary for the pursuit of the statutory purposes.

ARA-Sul has as its corporate objective the management of water resources, and it is responsible for:

a) Participate in the preparation, implementation and review of the river basin occupation plan;
b) The administration and control of the public water domain, the creation and maintenance of the water registry and the registration of private use, as well as the launch and collection of water use and use rates.
c) The licensing and concession of the use and exploitation of waters in the public domain, the authorization of evictions, the imposition of administrative easements, as well as the inspection and inspection of compliance with the requirements to which they are subject;
d) The approval of the hydraulic works to be carried out and its inspection;
e) Declare the expiration of authorizations, licenses and concessions and their extinction or revocation.
f) The projection, construction and exploitation of the works carried out with its own means, as well as those assigned to it;
g) The provision of technical services related to its attributions and the assessment of the local State organs, public and private entities and individuals;
h) collect and keep up-to-date the hydrological data required for river basin management;
i) Reconcile conflicts arising from the use and use of water;
j) Proceed to water policing, apply sanctions, order the demolition of works, and elimination of unauthorized uses and uses, and closure of sources of contamination;
k) Propose the definition of protection zones provided for in the Water Law;
l) To recognize common uses of traditionally established waters and to promote their registration;
m) Any other attributions that are conferred by law or regulation.

The river basin committees and agreements stabilised and studies

These comities have the mandate to discuss all the basin issues, participate on the planning and management under the basin, mainly in the water users. However, this are mainly focus on the disaster management and water user management for the agriculture propose.

The following agreements or comities have been crated:

- Joint water Commission South Africa and Mozambique, on all shared rivers, created in 1999
- SADC Protocol on shared water course, signed in 1995
- Revised SADC Protocol on shared water course, signed in 2000
- Inco-Maputo: among South Africa, Swaziland and Mozambique, on the Incomate river, signed 2002
- Joint water Commission Zimbabwe and Mozambique, on all shared rivers, created in 2002
- ZAMCOM, Zambezi river water commission, created in 2004
- LIMCOM, Limpopo river water commission, created in 2004
- Joint water Commission Tanzania and Mozambique, on all shared rivers, created in 2007

As a result of the above-mentioned agreements studies have been conducted along the shared river. Although the majority of them was focus in the surface water they have a well-developed component of ground water. The identified studies cover the following international basins: Rovuma, Buzi, Púnguè and Save.

Other identified studies that has in its scope an analyses of ground water, not much developed as the indicated above, covers the basins of Incomate Umbeluzi and Maputo.

Only two studies were identified with a single objective to analyse the transboundary ground water aquifer. The Studies is conducted in the Chire and Limpopo Basin River, both of them are under its inception phase, and is founded by SADC.

One of the outcomes of these studies is the mapping of the transboundary aquifers in the SADAC. The referred MAP was prepared in 2010 and updated in 2017, and its available on the GMI site. (Refer to map in Figure below).

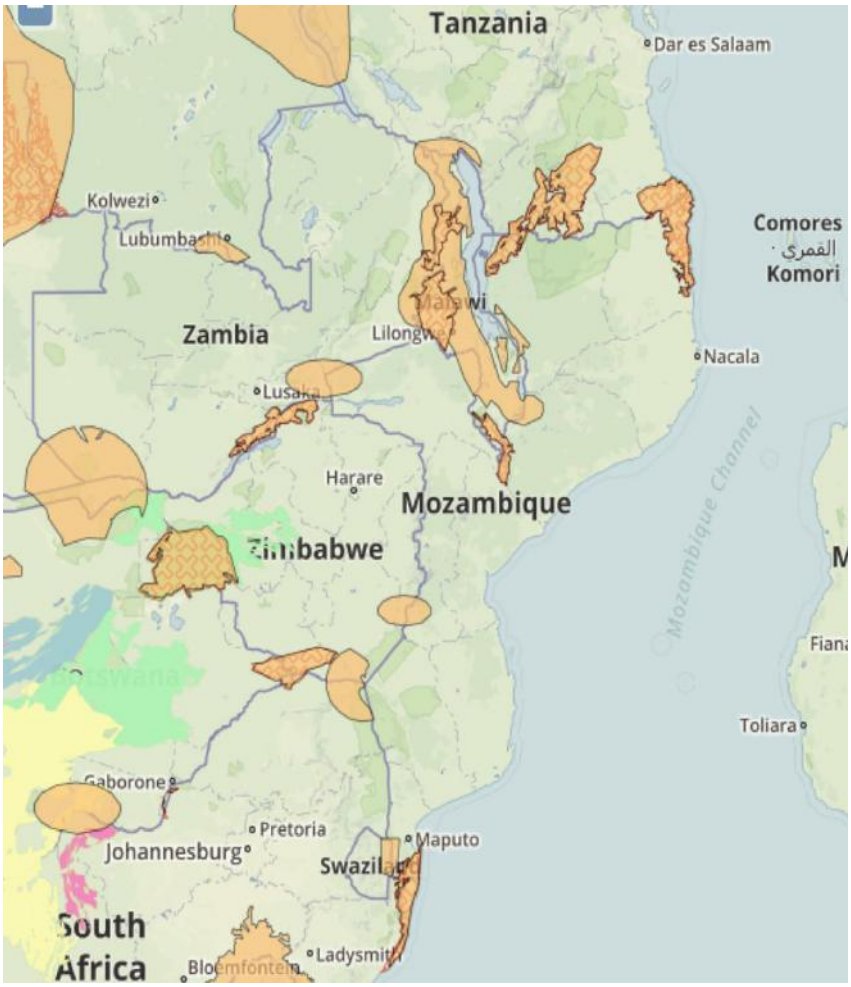

Figure 5: Illustration of the mapping of transboundary exercise

A part of the committees on the shared rivers the basin is organized at National level with catchment committees, water user's associations. Although this institution has a role on the ground water management

as well as to secure the gender equity strengthening as part of the decision makers on the planning process, management and monitoring of ground water uses in the catchment, this matters are not part of the agenda of the regular meetings of this organizations, mainly as a result of lack of knowledge of the ground water management needs, importance, as well as they own responsibility, rights and roles as part of this forums.

Some of the catchments are huge in area and the committee's action does not reach some regions of the catchment. The engagement of the main institution is basically weak and most of them are following the surface water objectives with almost no objectives on the groundwater even knowing that it is the main source of water for the urban and rural area.

6.2. Institutional arrangements to support groundwater management

The current arrangement to support groundwater management at national level falls under the two National Directorates (Water Resources Management - DNGRH) and Water Supply and Sanitation - DNAAS). The Section of Groundwater, integrated to the Department of Water Supply, is responsible for the day-to-day management of the groundwater related activities, and the department of river basin management have the responsibility of planning and monitoring.

At the Provincial level the Provincial Directorate of Public Works and Water Resources Management is responsible for the water sector related activities through Department of Water and at the district level the District Service of Infrastructure takes the responsibility of the water Sector. Neither at provincial level nor the district level is a specific sector responsible for the groundwater, therefore, the groundwater at these levels is limited to management of drilling activities and operation and maintenance of the existing boreholes.

Under DNAAS there is a program named SINAs that is undertake some data collection on the groundwater information through the registration of the existing and new springs and boreholes, the main data collected are (coordinates, deep, yield, water quality, picture, registration number, equipment (electric, hand or solar pump)) with the aim to feed a data base on the water resources. As of today, the collected information does not include the lithology of the borehole which is the most information needed for the upgrade of the existing ground water maps.

There is no structured plan for research under the ground water field, some universities under they own initiative are conducting some research with a small impact to the sectors. Some of the Regional Water administration includes in they plan the need to conduct some studies on the ground water but the lack of budget does not allow them to implement the plan.

Most of the research done are linked to the water supply needs, conducted by FIPAG and AIAS with the aim to secure a source for water for some of the systems that is being rehabilitated.

6.3. Gaps and challenges identified

Need to develop a section or department that deals with all related issues of the ground water development program, not being part of its activity but to have a full responsibility on its development and monitoring.

- Lack of legislation knowledge, even among the management unity staff and including the users,
- Poor groundwater knowledge and limited information dissemination actions about the ground water resource cycle and management
- Nonexistence of a specific section or institution, with staff allocated for the ground water management, under the framework of the National Directorate of water – department of Watershed Management.
- Lack of staff with adequate capacity to develop the ground water management activities
- lack of strategy on the ground water training and capacity building
- Budget constrains to undertake the monitoring and research activities at central or regional level.
- Groundwater database management in Mozambique is poorly developed. Inter-institutional relationships regarding database management do not yet exist.
- Mozambique needs professional capacity building on groundwater management and hydrogeological knowledge of aquifer systems.

6.4. Enablers required to unlock these gaps/challenges

The following should be considered in order to unlock some of the challenges discussed in 6.3 above:

- There should be more initiative to promote the enforcement of the existing legislation related to groundwater management.
- The roles and responsibilities of the different entities should be more segregated to give more focus to the groundwater management, currently the groundwater is just deemed to be addressed under water resources in general.
- The roles and responsibilities related to groundwater management should be extended at least to the provincial level.
- Ensure budget for the development of the ground water management activities
- Capacity building on the stabilising a monitoring network for the ground water, either for the DNGRH and for the Regional Water Administration.
- Develop pilot projects under the regional water administration for the Identification of the main aquifers, establish a ground water management network and a monitoring process.

In addition, the table below reflects on some enablers that could help to address the gaps and challenges highlighted above.

Table 4: Enablers required to unlock the gaps and challenges

Gaps and Challenges	Enablers
Lack of legislation knowledge/awareness of groundwater /water legislation among the technical water management staff and users **Poor groundwater knowledge and limited information dissemination actions about the ground water resource cycle and management**	▪ Awareness raising campaigns/programmes on water legislation and importance of groundwater in the context of competing demands and climate change impacts. ▪ Programmes to cover technical water staff as well as users of the water possibly through the existing water user groups ▪ Develop pilot projects (under the regional water administration) for the identification of the main aquifers, establish a ground water management network and a monitoring process.

Gaps and Challenges	Enablers
Nonexistence of a specific section or institution, with staff allocated for the ground water management, under the framework of the. National Directorate of water – department of Watershed Management	▪ Outline and allocate specific roles and responsibilities to existing institutions aligned to groundwater management_ this to enable accountability as an incentive for better groundwater resources practices ▪ An oversight committee within the National Directorate of water – department of Watershed Management should be given the oversight role to ensure the performance and accountability of all institutions in line with their assigned roles and responsibilities for groundwater management
Lack of staff with adequate capacity to develop the ground water management activities	▪ Conduct capacity building as part of the technical skills upscaling process towards improved groundwater management. This should consider existing water practitioners and technicians, students, community water officers and groundwater committees if established within the various regions
Lack of professional capacity building on groundwater management and hydrogeological knowledge of aquifer systems	▪ Conduct technical and professional training on groundwater management and hydrogeological knowledge of aquifer systems to boost capacity of water practitioners, water managers and water technicians. ▪ Prepare a capacity building program on groundwater management and hydrogeological knowledge of aquifer systems and their importance to addressing Mozambique's water scarcity challenges. This program should involve water practitioners from all water related sectors including government staff; construction works supervisors as well as contractors.
Budget constraints to undertake the monitoring and research activities at central or regional level.	▪ Conduct groundwater cost benefit analyses to reflect on the potential improvement/impact on Mozambique's economy that groundwater investment can generate_ to incentivise more investments not only by government but other sectors_ including private sector. ▪ Encourage private sector investments in groundwater within the constraints of the legislation
Groundwater database management in Mozambique is poorly developed. Inter-institutional relationships regarding database management do not yet exist.	▪ Prepare a program to reactivate the groundwater database, improving the model for data collection and monitoring data, defining clear mechanisms for the Inter-institutional relationships regarding database management.

7. CHALLENGES TO IMPLEMENTATION

From the analyses made above the key challenges that are hindering the ability to deliver on good groundwater management in Mozambique, are listed below.

At the Legislation level

- Absence of specific supporting legislation for groundwater management;
- Poor knowledge of the existing legislation by the users and some stakeholders.

At Strategic Level

- Inexistence of an action plan or program for groundwater management and exploration development;

At Institutional Level

- Inexistence of a specific Institution or section under the National Directorate of water – department of Watershed Management, responsible for the development and monitoring of ground water development activities;
- Lack of skilled staff with adequate capacity to develop ground water management at national and regional levels;
- Budget constrains to undertake the ground water activities;
- Poor coordination between institutions on groundwater management

8. ACTION PLAN

The MoSCoW method of prioritisation has been used to develop the action plan. This method identifies the *Must have*, *Should have*, *Could have*, and *Won't have* elements for the Groundwater Management Regulatory Framework.

Table 5: Action Plan: "Must Haves"

Prioritisation	Element	Description
Must have: ***those elements of the regulatory framework that are critical***	**Policy**	▪ Develop groundwater management (to include groundwater quality, quantity and its relationship with dependent ecosystems) ○ Establish clear groundwater management objectives ○ Include protection zoning e.g. subterranean control areas ○ Include multiple uses of the subsurface space ○ Incorporate principles of adaptive management ○ Include customary rights ▪ Multi (social) media (Facebook, Twitter, Podcasts, YouTube) Dissemination campaign for politicians and decision-makers on the socio-economic consequences of not implementing groundwater management. Such a campaign would be assisted by briefs that clearly show the advantages and cost savings inherent in groundwater use, drawing on the regional examples
	Legislative	▪ Develop groundwater monitoring regulation: capturing (including privately held groundwater data), processing, reporting and sharing of data
	Institutional	▪ Operationalise basin management units as a local groundwater management institution ▪ Establish the National Ground Water Institute, following the process initiated in 1982-1987, with adequate staff and budget for the activity's implementation. ▪ Establish a groundwater Section under the National Directorate of Water management, with adequate staff and equipment. ▪ Establish at Basin level groundwater governance organizations in all areas of over-abstraction, and all areas where multiple users coincide (e.g. urban use and irrigation) ▪ Ensure in each river basin unit that the ground water unit is headed by a senior hydrogeologist ▪ Transboundary groundwater management ▪ Capacitate river basin units, Regional water administrations, and the National Water Resource Management directorate in the groundwater management ▪ Review the existing agreements to make explicit the ground water aspects and operationalise its implementation
	Strategy/ Guidelines	▪ Ensure functional strategies that also address the economic and equity aspirations as communicated in the National Water ▪ Establish explicit framework for basin groundwater management including multi-stakeholder dialogues ▪ Develop awareness campaign on the costs and benefits of groundwater management targeted at the general public

Prioritisation	Element	Description
		▪ Establish Private-Public-Civil Society partnerships on groundwater management ▪ Capacitate government institutions in groundwater management (skills and resources) through training, mentoring and funding ▪ Develop a Data Acquisition and Management Strategy for Water and Sanitation ▪ Develop National groundwater Resources Monitoring strategy, indicating the main requirements and the minimum network needs in each ARA. ▪ Awareness on the value of groundwater infrastructure including instrumentation ▪ Promote community ownership and acceptance ▪ Promote protection measures

Table 6: Action Plan "Should Haves"

Prioritisation	Element	Description
Should have	**Policy**	▪ Establish specific coordination mechanisms for groundwater management
	Legislative	▪ Establish mediation mechanisms for conflict resolution ▪ Provide greater clarity of rights, duties and institutions for consistent jurisprudence
	Institutional	▪ Every entity that is using a ground water resource should employ a hydrogeologist technetium, and that person should report quarterly to the ARAs
	Strategy/ Guidelines	▪ Implement a program to meet a short-term targets ▪ Performance monitoring and reporting process

Table 7 : Action Plan " Could Haves"

Prioritisation	Element	Description
Could have	**Policy**	▪ Promote the groundwater leadership
	Legislative	▪ Amend National Water Law to promote conjunctive management of ground water and surface water, in order to strengthen: o Multi-sectorial participations in basin level management o Definition of the classes of groundwater management and set areas to command the issuing of groundwater abstraction licenses o Develop National Groundwater program
	Institutional	▪ Establish a scheme for young ARAs hydrogeologists to work in the private sector for a year to gain experience and perspective ▪ Establish the secondment of experienced private sector staff to ARAs
	Strategy/ Guidelines	▪ Update guidelines and standards with reference to groundwater management regulations

Table 8: Action Plan " Won't Haves"

Prioritisation	Element	Description
Won't have	**Policy**	▪ Continued institutional dominance of surface water in a country where the majority relies on groundwater,
	Legislative	▪ Continued legal and uncertainty regarding groundwater institutions and local governance
	Institutional	▪ Consolidation and dominance of interim and relatively weak local groundwater governance organisations
	Strategy/ Guidelines	▪ Lack of traction for revised National Groundwater Strategies

9. REFERENCES

USAID; 2010; Mozambique Water and Sanitation Profile

Mozambique Government., November (2011)., Estratégia Nacional de Água e Saneamento 2011 - 2025

Mozambique Government., (2018)., Environmental and Social Management Framework

Pietersen, K., Beekman, H., (2016) Groundwater Management in the Southern Africa Development Community

International Groundwater Resources Assessment Central; 2013; Groundwater Monitoring in SADC Region.

AFTWR Africa Region The World Bank; (2017); Mozambique Country Water Resources Assistances Strategy.

FAO., (2014)., Impact of Climate Changes on Household Food Security in the Philippines.

World Bank Report., (2005); The Role of Water in the Mozambique Economy.

Mozambique Government; (2011); Plano Estratégico para o Desenvolvimento do Sector Agrário PEDSA 2011 – 2020.

INE; (2018); CENSO 2017 IV Recesseamento Geral da População.

Sanitation and Water for all; Economic Impact of Water and Sanitation

Mozambique Government; 1991; Mozambique Water Low; Serie I

Mozambique Government; (2007); Decreto no 43/2007 - Regulamento de Licenças e Concensões de Águas;(Series I)

Netherland Government; (2011); Impact Evaluation of Drinking water supply and sanitation interventions in rural Mozambique.

Bullock., A., Hulsmann., S., (2015); Strategic Opportunities for Hydropower within the water-energy-food Nexus in Mozambique; United Nation University.

Anadarko., (2014); Environmental Impact Assessment Report for the Liquefied Natural Gas Project in Cabo Delgado; (Volume I)

Mechlem., K.,(2016); Groundwater Governance: The Role of Legal Framework at the Local and national Level; Academic Editor

Kotze, Y.L.; Tonder G.J.; Van der Merwe; Groundwater Use Authorisation as part of Groundwater Resource management in Water Scares Areas Within South Africa

Latifa R. Ibraimo; (1999); Water Low, Water Rights and Water Supply (Africa) - Mozambique Study Country Report

Hassane., C.; Mauro Pinto et al; (2017); Crafting the right partnerships for better access to basic services

K. Arvidsson et all; (2011); A Hydrological Study of Nhandugue River, Mozambique a major Groundwater recharge zone; Geology Dep. Eduardo Mondlane University

Costal Environmental Services; (2014); Environmental and Social Impact Assessment for Irrigation and Organic Sugarcane Project Chemba District; (Volume 3)

Correia., A.; (2014); Moçambique e Sector de Água - Desenvolvimento do Quadro Institucional do Sector de Água em Moçambique; Pontes e Parcerias nos Países de Lingua Portuguesa

APPENDIX A: LITERATURE INVENTORY LIST

No	Year	Title of Document	Author	Publisher	Report Number	Link (if it is a website document)
1	1995	Water Policy				
2	2010	Mozambique Water and Sanitation Profile	USAID			Report SADC/Ref/mozambique2010.pdf
3	2011	Estratégia Nacional de Água e Saneamento 2011 - 2025	Mozambique Government	Ministry of Public Works and Housing		Report SADC/Ref/Estratégia Água e Saneamento Urbano 2011 - 2025.pdf
4	2018	Environmental and Social Management Framework	Mozambique Government	Ministry of Public Works, Housing and Water Resource		Report SADC/Ref/P158231 - MZ IFRDP - ESMF - Final - 23FEB18.pdf
5	2016	Groundwater Management in the Southen Africa Development Community	Dr. Kevin Pietersen and Dr. Hans Beekman	Groundwater Management Institute		Report SADC/Ref/SADC-GMI-Draft-Final-Position-Paper2.pdf
6	2013	Groundwater Monitoring in SADC Region	International Groundwater Resources Assessment Central	International Groundwater Resources Assessment Central		Report SADC/Ref/Report_Groundwater Monitoring in SADC region.pdf
7	2017	Mozambique Country Water		AFTWR Africa Region		Report SADC/Ref/Mozambique_-

No	Year	Title of Document	Author	Publisher	Report Number	Link (if it is a website document)
		Resources Assistances Strategy		The World Bank		_Mozambique_Country_Water_Resources_Assistance_Strategy.pdf
8	2014	Impact of Climate Changes on Household Food Security in the Philippines	Célia Reyes, Joel Barcolita, et all	FAO		Report SADC/Ref/Impact of climate changes.pdf
9	2005	The Role of Water in the Mozambique Economy	World Bank	World Bank		Report SADC/Ref/The Role of Water in Mozambique Economy.doc
10	2011	Plano Estratégico para o Desenvolvimento do Sector Agrário PEDSA 2011 - 2020	Mozambique Government	Ministry of Agriculture		Report SADC/Ref/EStartégia do Sector agrário Moz.pdf
11	2018	CENSO 2017 IV Recesseamento Geral da População	INE	INE		Report SADC/Ref/Doc_FINALApuramento_Preliminar.pdf
12	S/D	Economic Impact of Water and Sanitation	Sanitation and Water for all			Report SADC/Ref/Mozambique - WASH Economic Briefing_EN (1).docx
13	1991	Mozambique Water Low	Mozambique Government	Serie I	Publish 31	Report SADC/Ref/lei-aguas.pdf
14	2007	Decreto no 43/2007 -	Mozambique	Serie I	Publish 43	Report SADC/Ref/Regulamento e

No	Year	Title of Document	Author	Publisher	Report Number	Link (if it is a website document)
		Regulamento de Licenças e Concensões de Águas	Government			licenças de vconcensão de águas.pdf
15	2011	Impact Evaluation of Drinking water supply and sanitation interventions in rural Mozambique	Netherland Government	Minister of Foreign Affair		Report SADC/Ref/49295401.pdf
16	2015	Strategic Opportunities for Hydropower within the water-energy-food Nexus in Mozambique	Andrew Bullock and Stephan Hulsmann	United Nation University	Working peper n 4	Report SADC/Ref/WorkingPapers_No4.pdf
17	2014	Environmemtal Impact Assessment Report for the Liquefied Natural Gas Project in Cabo Delgado	Anadarko	Anadarko	Volumme 1	Report SADC/Ref/Vol I-_front_pages_NTS_LNG_Final_EIA_Sept_2014_Eng.pdf
18	2016	Groundwater Governance: The Role of Legal Framework at the Local and national Level	Kerstin Mechlem	Academic Editor		Report SADC/Ref/water-08-00347.pdf
19	S/D	Groundwater Use Authorisation as part of	Y.L. Kotze and G.J.Van	Institute of Grandwater Studies.		Report SADC/Ref/04 YL Kotze_GROUNDWATER USE

No	Year	Title of Document	Author	Publisher	Report Number	Link (if it is a website document)
		Groundwater Resource management in Water Scares Areas Within South Afgrica	Tonder and Van der Merwe	University of the Frees State Province. SA		AUTHORISATIONS AS PART OF GROUNDWATER RESOURCE MANAGEMENT IN WATER SCARES AREAS WITHIN SOUTH AFRICA.pdf
20	1999	Water Low, Water Rigths and Water Supply (Africa) - Mozambique Study Country report	Latifa R. Ibraimo			Report SADC/Ref/R73273.pdf
21	2017	Crafting the rigth partnerships for better access to basic services	Claire Hassane, Mauro Pinto et all			Report SADC/Ref/Waza-Getting-formal-in-Mozambique-May-2017-2.pdf
22	2011	A Hydrological Study of Nhandugue River, Mozambique A major Groundwater recharge zone	K. Arvidsson et all	Geology Dep. Eduardo Mondlane University		Report SADC/Ref/Ref SADC.pdf
23	2014	Environmental and Social Impact Assessment for Irrigation and Organic Sugarcane Project Chemba	Costal Environemental Services		Volumme 3	Report SADC/Ref/Ch 3 - Surface and Groundwater.pdf

No	Year	Title of Document	Author	Publisher	Report Number	Link (if it is a website document)
		District				
24	2017	Moçambique e Sector de Água - Desenvolvimento do Quadro Institucional do Sector de Água em Moçambique	Arlindo Correia	Pontes e Parcerias nos Países de Lingua Portuguesa		Report SADC/Ref/3.-DNAAS-Arlindo-Correia.pdf

APPENDIX B: STAKEHOLDER LIST

Full Stakeholder List

No.	Title	Name	Surname	Affiliation	Role	Sector Group	Telephone	Email:	Priority (yes/no)
1	Mrs.	Ana	Fotine	DNGRH		National Government	+258 82 380 5870	anafotine@yahoo.com.br	Yes
2	Mrs.	Lucas	Chairuca	DNGRH		National Government	+258 82 392 4630	chairuca@yahoo.com	Yes
3	Dr	Delario José	Sengo	ARA Sul	Head of Technical Department	Government - Southern Water Management Authority	+258 84 787 1947	dsengo@yahoo.com	Yes
4	Mr.	Joao	Neto	ARA Sul		Government - Southern Water Management Authority		-	No
5	Dr	Elidio	Cossa	FIPAG	Head of Operation Department	Urban (large cities) Water Provider Authority	258 846 242 032	khossa@fipag.co.mz	Yes
6	Mr.	Valdemiro	Matavel	AIAS	Head of Technical Department	Urban (small cities) and Rural Water Provider Authority	+258 84 407 5114	matavald@gmail.com	Yes

No.	Title	Name	Surname	Affiliation	Role	Sector Group	Telephone	Email:	Priority (yes/no)
7	Dr.	Dinis	Juizo	UEM	Letture	Reserch/Academia	+258 82 536 3702	dinisjuizo@gmail.com	Yes
8	Mrs.	Maria Isabel	Vaz	Consultant	Water Supply Project Division	Business	258 845 877 236	ivaz@consultec.co.mz	No

Stakeholders consulted to respond to the questionnaire

Name	Institution, Designation	Stakeholder Group
Ms. Ana Isabel Fotine **Mr. Antonio Chairuca** **Mrs. Manuela Ribeiro**	National Directorate of Water Resource Management	Government
Mr. Sergio Sitoe	LIMCOM	Government/NGO
Mr. Dinis Juizo	Eduardo Mondlane University	Academia
Mr. Valdomiro Matavele	AIAS	Government
Mr. Delário Sengo	ARA Sul	Government
Eduardo Josefa	National Directorate of Water Resource Management – Head of the Hydraulic Infrastructures Department	Government
Mr. Adriano Chiute	AFORAM – Association of water supply Entities of Mozambique	NGOs
Ms. Isabel Vaz	CONSULTEC	Private Sector
Mario Chilunde	Eduardo Mondlane University	Academia and Civil Society

Validation Workshop

Name	Position	Stakeholder Group
Ms Ermelinda Canda	Water Resource Management at ARA-Sul	Government (Validation Workshop)
Mr Elídio Khossa	North Regional Director of FIPAG,	Government (Validation Workshop)
Ms Ana Isabel Fotine	Ministério de Obras Públicas Habitação e Recursos Hídricos Departamento dos Rios Internacionais	Government (Validation Workshop)
Mr Luísa do Céu Ricardo da Conceição	A Direcção Nacional de Águas	Government (Validation Workshop)

APPENDIX C: DESIRED FUTURE STATE

Reflection of Policy Framework as per the minimum requirement for the DFS

Minimum requirement for desired future	Status	Comment
A long-term to protect groundwater by preventing pollution and overuse. This is comprehensive, implemented at all appropriate levels, consistent with other water management policies and be duly taken into account in other sectorial policies;	Partially achieved	The policy does not make a clear reference to the ground water and the implementation at the appropriate level is not satisfactory
The social, economic and environmental values of groundwater are all recognised;	Achieved	Although it is included in general terms for the water resource as a natural resource
The human right to water is recognized and a rights-based approach to groundwater management is taken, *inter alia*, through:	Partially	No specific reference to ground water but water resource
Prioritization of drinking water/basic human needs in water legislation;	Achieved	The prioritization was set
Ensuring that land-based rights cannot entitle unlimited access/use of freshwater, including groundwater;	Achieved	This is included in the water policy and in line with the land and tariff policies
Ensuring groundwater is legally recognized as a public good;	Achieved	In Mozambique all the natural Resources are public good. This is included in the constitution and stressed in the water
Recognising the role of groundwater in meeting basic human needs for food security;	Achieved	Although not explicit regarding groundwater it refers to all water resources which includes groundwater
Legal recognition of customary rights to freshwater, including groundwater;	Achieved	The policy indicates that the access to water for human consumption is free. No clear mentioned to the ground water is made.
Legal mechanisms to ensure gender equity in access, use and management of freshwater, including groundwater;	Partially Achieved	The policy includes the provision for the inclusion of the woman's in the water management process. There is a need to clearly include a provision to ensure a gender equity in the management process
Provision of pricing mechanisms that incentivize equitable distribution of rights to access and use of groundwater, as well as prioritization of small-scale users' livelihoods and food security needs, especially youth and women.	Partially	Women have been specifically included in the policy as one of the most important groups for consideration to ensure adequate distribution of the right of access water. Policy also has a provision which allows for a definition of the varied tariffs to ensure equitable access to the water.
Groundwater is recognised as a highly important source of domestic and agricultural water supply and a key resource for poverty	Partially achieved	Policy considers only the water source without a discrimination among the surface and ground water, for any kind of uses. It needs to be improved to bring a deep analysis for each source

Minimum requirement for desired future	Status	Comment
alleviation, food security, and the sustainable economic development of rural areas;		
The biophysical and ecological linkages between ground and surface water for their use, protection and management are recognised, including land use zoning for groundwater protection and recharge (conjunctive use);	Partially achieved	Policy refers to the intrinsic relation among the surface and ground water, and the fact that it should be taken in account during the planning process
The importance of the maintenance of the ecological integrity of wetlands in groundwater management is recognised (recharge zones);	Partially achieved	The policy notes that the aquifers serving to the water for different uses need to be identified and protected. However there has been little progress in this particular field which may be attributed to weak capacity to enforce/monitor the process
Intersectorial collaboration is promoted and facilitated so that the needs and impacts of different sectors (e.g., land, agriculture, mining, municipal, and environment) are taken into account in groundwater management and the impacts of developments in those sectors on groundwater are accounted for;	Partially achieved	The provision is included in the legislation. However, there is inadequate sharing/exchange of information between stakeholders/users/institutions that could allow for better water resource management
The need for adaptive management is recognised due to the inherent limitations in the nature of scientific information in conjunction with the widely occurring dynamic processes of climate, social and institutional change;	Partially	The need of deep studies of the aquifers have been identified for a better understand of the situation
The roles of various stakeholders and water users in groundwater management is recognised and participation of stakeholders in decision-making and groundwater management is promoted and facilitated;	Partially	There is no particular legislation for ground water management. However, this may well be an open window for all water resources(including groundwater) to be managed as a whole_ conjunctive uses.
An apex body that is responsible explicitly for GW management and playing the role of custodian/trustee on the part of the state is clearly defined;	Achieved	ARAS are the apex body responsible for Ground Water. Out of the registration of the boreholes very few are being done in this field with the exception of particular aquifers e.g. Maputo, Quelimane, Pemba Metugy and Nhartanda.
Effective institutional arrangements are coordinated at trans boundary, national and local levels;	Not Achieved	There are some agreements signed but the monitoring and implementation process are not that active either effective. Existing water resources management institutions need to be reinforced on groundwater matters
Public access to geo-hydrological data held by the state is promoted and facilitated	Partially	This information is free, however need to be requested to the management body

Minimum requirement for desired future	Status	Comment
▪ Additional environmental principles necessary to protect and sustain groundwater are mandated, including: the precautionary principle, the principle of gender equity and social inclusion (GESI), the principle of subsidiarity, and the principle of intergenerational equity.	Partially	Some of these principles are included in the existing legislation. There is a need to specify it to separate the actions for surface and ground water under the management bodies

Reflection of Legal Framework as per the minimum requirements for the DFS

Minimum requirement for desired future	Status	Comment
Provide Status of Groundwater		
All water has a consistent status in law, irrespective of where it occurs	Achieved	
Explicit reference to groundwater and conjunctive use management in catchment/water management and development plans and drought/emergency management plans	Partially Achieved	The Legislation refers to the need of develop studies for the dry area to evaluate at which extent the ground water can be explored for the satisfaction of the population needs.
Human right to water recognized in groundwater legislation, facilitating prioritization of drinking water and basic human needs, as well as small-scale users	Not achieved	To be incorporated under the proposed revision of the water policy and law
ii. Regulate Groundwater Quantity *a. Provide conditions for accessing groundwater* i. Water use authorizations:	Partially Achieved	Mozambique has a regulation for the exploration of the ground water; regulation for licences and concessions, address this issue. A review to refine could be made
Legislation must enable the authorisation of groundwater use (with a system that does not discriminate, especially against the rural poor);	Partially Achieved	
The permitting of groundwater use should not be tied exclusively to land tenure;	Not achieved	To be incorporated through the review of the legislation
Legislation should allow for the categorisation of water users;	Achieved	The general categorization of water uses was already included in the legislation and the same are useful for ground water
Groundwater should be declared a public asset and/or authority vested in government to restrict, in the public interest, the rights accruing from its private ownership to prevent	achieved	Thru the actual legislation the water is a public good, and all the exploration of it is regulated by law. The land owners have the wright to use it for the consumption propose up to such extent above

Minimum requirement for desired future	Status	Comment
over-abstraction or inequitable access/use by landowners;		which a special licence is required. The proposed legislation review should account for specificities of ground water,
New legislation should strive towards changing ownership rights to use (usufruct) rights, subject to a government-controlled, permit system for large scale users with appropriate non-permit systems for addressing the needs of small-scale users		
The legislation recognises and legalises affordable, small-scale and indigenous solutions;		Mozambique has a basic manual that includes provisions for ground water exploration. It includes some local solutions for the borehole construction.
The legislation should enable the regulation of borehole drillers, regulation for drilling, control of drillers, information from drillers and standards for borehole drilling;	Partially Achieved	Mozambique has a basic manual that includes provisions for ground water exploration. It can be updated to fulfil the new knowledge of the art.
Legislation should give water inspectors the right to enter land with the offenses and associated penalties noted in the legislation (this includes appropriate fines and jail time that needs to be adjusted annually);	Partially Achieved	The actual legislation enables for the inspections. The is an established monitoring process
The legislation should enable the regulation of exploration;	Achieved	The regulation already exists
The legislation should allow for zoning for overused/fragile aquifers;	Achieved	The existing legislation already account for it
Groundwater use organizations should be integrated into existing institutional frameworks (e.g., catchment management, customary institutions)	Partially achieved	The legislation recommend that the water used be part of the management structures of the basins. However, in these forums they normally are discussing the surface water only.
Stakeholder engagement		
The legislation should specify when and how stakeholders, the public and/or other water users are to be engaged in planning, decision making and self-management regarding groundwater;	Partially Achieved	It is specified in the legislation that this could be discussed in the basin committee, which includes the community, civil society, users, etc. However, the forums should be prepared to include these subjects as part of the normal discussions/agenda.

Minimum requirement for desired future	Status	Comment
There should be specific mechanisms for directly involving stakeholders in the development of laws and regulations related to groundwater and decisions that may impact the use or quality of groundwater on which they depend for drinking, livelihoods, food security, economic or cultural well-being; and	Partially Achieved	The water policy promotes a wide and open discussion of the instruments as part of the approval process.
The legislation should specifically address the issue of the involvement of women and youth in decision-making and the implementation of groundwater supply schemes.	Partially Achieved	The legislation mentions women.
Monitoring and data collection to support regulation		
The legislation should specify the need and parameters for a sustainable system for data collection, management and dissemination, including standardization and harmonization of data. This entails a national monitoring and information system which captures quantity and quality data from key aquifers;	Not Achieved	The legislation did specify the parameters. However, it does not incorporate the ground water parameters on it
The legislation should specify the need for drought monitoring systems which extend beyond rainfall, surface water and food security indicators to groundwater and groundwater supply status, including the appropriate prediction of future hydrogeological conditions;	Not Achieved	The parameters that are being monitored does not include the ground water
In transboundary basins, legislation should address the need for standardization and exchange of data as well as the establishment of joint inventories; and	Partially Achieved	The agreements on the transboundary water courses already include this need. However, the process of standardize the parameter and the way it should be disseminated is a process that the implementing entities of the agreement should follow.
The legislation should enable access by the public to geohydrological data held by the state.	Achieved	It is included in the legislation
Water conservation and efficiency of use Legislation should enable regulation to ensure the efficient use of groundwater, such as the use of economic incentives and imposition of technologies.	Partially Achieved	
Compliance and Enforcement		

Minimum requirement for desired future	Status	Comment
Clear mechanisms for promoting compliance with groundwater regulations should be included in the legislation	Not Achieved	
Enforcement provisions should include, *inter alia*, inspections authority for groundwater management institutions, the ability to impose fines and/or additional administrative penalties and adjust those as necessary, and enumerate criminal offenses associated with failure to comply with the law.	Achieved	ARA Sul is the entity who should manage this. However, the monitoring process need to be improved to reach that level of management
Conflict resolution mechanisms and/or the right to appeal		
Regulatory measures		
The legislation must enable the relevant authority (Minister) to make regulations on any relevant matter in the legislation	Achieved	The means of the conflict resolutions are also included in the shareholder agreements with the neighbourhood countries.
Legislation should provide a clear ability for the government to pass regulatory measures, such as abstraction fees and waste disposal charges, to provide revenue to water management institutions and to incentivise appropriate use of groundwater	Achieved	

Reflection of Strategy and Guidelines Framework as per the minimum requirement for the DFS

Minimum requirement for desired future	Status	Comment
Provide Status of Groundwater		
Groundwater Protection Mechanisms ***Regulating Pollution (Point source and non-point source)***		
Water quality targets; Regulation of emissions/wastewater discharge/waste storage including the impact of mines on groundwater quality: Permits can be used to regulate the discharge, disposal and possibly the storage of waste should specifically take into account the vulnerability of the aquifer concerned and the provisions necessary for its protection;	Partially achieved	The existing regulation does not make a clear reference to the impact of mining activities to the ground water. The evaluation of the Impacts falls under the ESIA Studies. The monitor of the EMP proposed are not part of the process or plans of the water management entities. This needs to be revised to make the process stronger

Minimum requirement for desired future	Status	Comment
Classification of water bodies; and	Partially achieved	The water bodies were already classified under the existing legislation.
Reducing and regulating abstraction.	Achieved	Water abstraction is regulated through the tariff policy, Licence and concession policy.
Powers of compliance monitoring and enforcement	Partially achieved	Although included in the legislation there is a need to ensure the monitoring process of the explorations.
Regulating Depletion		
Regulation of abstraction and recharge (usually via permitting);	Partially Achieved	The existing regulation only cover the abstraction. It must be updated to include the recharge
Sustaining wetlands;	Not Achieved	This topic needs to be clearly included in the legislation
Land use zoning – prohibition of abstraction in certain zones; cropping or irrigation practices; protection zones for recharge areas; no surfacing/drainage requirements; and	Partially achieved	The legislation refers to the need for these actions. However, over the years less has been done in this matter, even on the identified aquifers with high risk of contamination.
Legislation must make it mandatory for installation of monitoring equipment of boreholes especially for large-scale users (the information must then be supplied to the state).	Partially achieved	It is included however an enforcement for the monitoring is needed
Powers of compliance monitoring and enforcement		
Planning		
The legislation should specify the need for long term plans to ensure the sustainable use of groundwater, including drought management plans and cross-sectorial coordination;	Not Achieved	
Where water legislation provides for catchment level or basin level planning, groundwater should be integrated into those plans (for example through impact assessment requirements);	Not Achieved	In Mozambique legislation, water resource management is operationalised in a catchment based model. As the abstraction requirements are not being made as part of the basin plan, the result of the impact assessment studies does not reach the management entities.
The legislation should specify that groundwater management planning should	Partially Achieved	By law the planning process should take this in consideration. A better coordination among the

Minimum requirement for desired future	Status	Comment
take into account and be integrated into land use and environmental planning; and		institutions to include the results of the ESIA in the monitoring platform is needed
Planning should be cyclical and based on continuous learning from data and stakeholder feedback to ensure adaptive management and effective responses to changing climatic, social, political and institutional contexts/drivers.	Partially Achieved	The legislation specify that the basin plans should be updated every 5 years. However, it is critical to arrange the budget to ensure the said activity happen for all the principal basins at least. A more realistic timeline should be set.

Reflection of Institutional Framework as per the minimum requirement for the DFS

Minimum requirement for desired future	Status	Comment
Legislation should contain provision for its effective implementation, including the mandate, competence and power of the relevant authorities in accordance with uniform governance principles;	Partially achieved	The Mozambican Legislation includes this provisions. However the enforcement to make the role followed is a challenge
Water authorities or coordinating bodies should have the competence to integrate all aspects of water management and should be rendered competent to arbitrate among various competing demands, and diverging interests regarding groundwater abstraction and use, both in the short-term and in the long-term;	Partially achieved	under the legislation and regulation, it is ok. However as the exploration plan and monitoring process of the ground water needs and demands are not part of a recurrent process it is difficult to evaluate the competing demands, mainly for the long term. Some pilot aquifers monitoring process are on going in Maputo.
The authority or body should collaborate with other authorities, competent for public health, land-use planning, soils management, waste management;	Achieved	This is clear indicated in the legislation. However, there is a need of a clear protocols for the management of the licences, data, and monitory. This could only be reached with a strong authority on this subject.
Water user associations and other appropriate forums (such as municipalities) should be utilized to strengthen the user advocacy role and achieve new partnerships and a joint management of the common resource.	Partially achieved	Under the sanitation programs there are some actions that with indirect intentions contribute to reduce the risk of contamination of the ground water. There is a lot that needs to be done consciously. A clear identification of the targets could be one of the forms to achieve this

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TOWARDS A COMMON FUTURE

GROUNDWATER MANAGEMENT INSTITUTE