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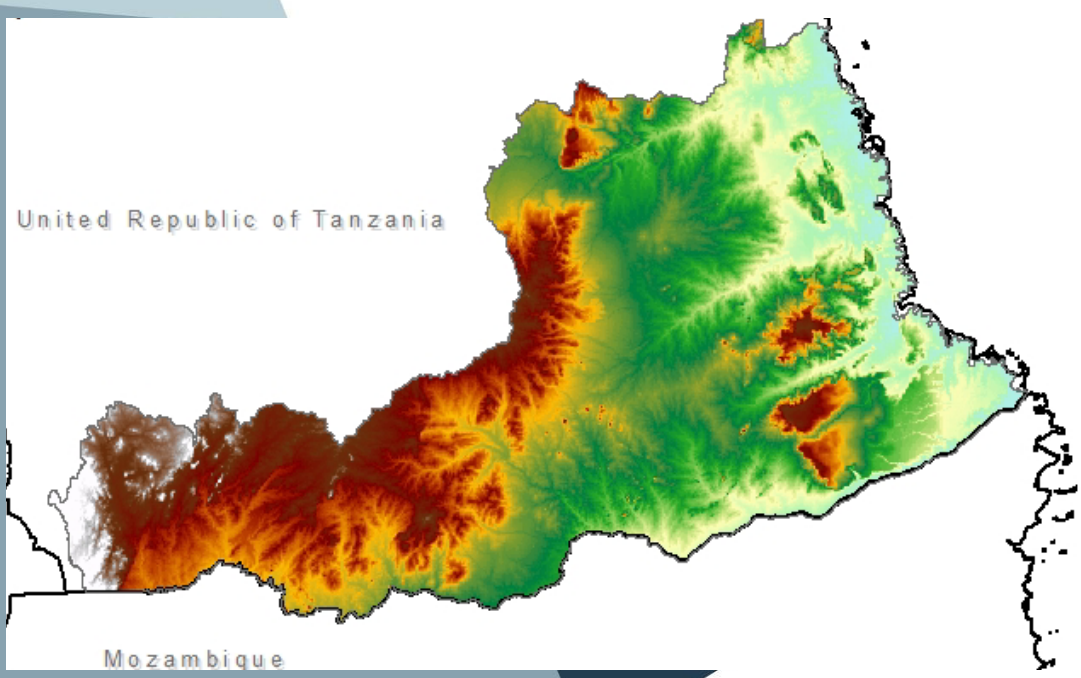
Provision of Consultancy Services for Preparation of an Integrated Water Resources Management and Development Plan for the Ruvuma River and Southern Coast Basin



FINAL REPORT

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In association with

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Consulting Engineers

Plan Design Enable

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AfDB	African Development Bank
ASDS	Agricultural Sector Development Strategy
AusAID	Australian Aid for International Development
BBM	Building Block Method
BMU	Beach Management Unit
BWB	Basin Water Board
CBFM	Community Based Forest Management
CCIAM	Climate Change Impact, Adaptation and Mitigation
CDM	Clean Development Mechanism
COMESA	Common Market for Eastern and Southern Africa
COWSO	Community Owned Water Supply Organisation
CROPWAT	FAO's Cropwater Requirement Model
CSO	Civil Society Organisation
CWC	Catchment Water Committee
DC	District Council
DFID	Department for International Development
DMD	Disaster Management Department
DoE	Department of Environment
DSS	Decision Support System
EA	Environmental Assessment
EAC	East African Community
ECOSAN	Ecological Sanitation Initiative
EFR	Environmental Flow Requirement
EMA	Environmental Management Act
EMC	Ecological Management Class
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
ESIA	Environmental and Social Impact Assessment
ESMP	Environmental and Social Management Plan
EU	European Union
FAO	Food and Agriculture Organisation
JF	January-February Season
JFM	Joint Forest Management
JJAS	June-July-August-September Season
GDP	Gross Domestic Product
GEF	Global Environment Facility
GHG	Green House Gases
GIS	Geographic Information System
GTZ	German Technical Cooperation
GW	Groundwater
GWh	Giga watt hour
GWP	Global Water Partnership
HIV/AIDS	Human Immune-Deficiency Syndrome
HP	Hydropower
IDP	International Development Partner
IO	Irrigators Organisation
IPCC	International Panel on Climate Change
IWRM(D)	Integrated Water Resources Management (and Development)
JICA	Japanese International Cooperation Agency
LGA	Local Government Authority

LGRP	Local Government Reform Programme
LUWASA	Lindi Urban Water and Sewage Authority
MCUM	Million cubic meters
MAFSC	Ministry of Agriculture, Food Security and Cooperatives
Makonde WSA	Makonde Water Supply Authority
MAM	March-April-May season
MANAWASA	Masasi Nachingwea Water Supply and Sanitation Authority
MAR	Mean Annual Runoff
MAUWASA	Masasi Urban Water and Sewage Authority
MBREMP	Mnazi Bay Ruvuma Estuary Management Park
MC	Municipal Council
MDG	Millennium Development Goal
MEM	Ministry of Energy and Minerals
MIS	Management Information System
MKUTATA	National Strategy for Growth and Reduction of Poverty II
Mld	Million litre per day
MLFD	Ministry of Livestock and Fisheries Development
MNRT	Ministry of Natural Resources and Tourism
MoW	Ministry of Water
MtDC	Mtwara Development Corporation
MTUWASA	Mtwara Urban Water and Sewage Authority
MW	Megawatt
M&E	Monitoring and Evaluation
NADMAC	National Disaster Management Committee
NAPA	National Adaptation Programme for Action
NAWAPO	National Water Policy
NAWSDS	National Water Sector Development Strategy
NBCBN	Nile Basin Capacity Building Network
NCCFP	national Climate Change Focal Point
NCCSC	National Climate Change Steering Committee
NCCTC	National Climate Change Technical Committee
NDC	National Development Corporation
NEMC	National Environmental Management Council
NGO	Non-governmental Organization
NIMP	National Irrigation Management Programme
NORAD	Norwegian Agency for Development Cooperation
NWB	National Water Board
OND	October-November-December season
PAP	Project Affected Person
PET	Potential Evapo-Transpiration
PES	Present Ecological Status
PIDG	Private Infrastructure Development Group
PIM	Participatory Irrigation Management
PMO	Prime Minister Office
PMO-RALG	Prime Minister Officer Regional Administration and Local Government
PPP	Public-Private Partnership
PRSP	Poverty Reduction Strategy Paper
REDD	UN Programme on Reducing Emissions from Deforestation and Forest Degradation
RJWC	Ruvuma Joint Water Committee
RSCB	Ruvuma and Southern Coast Basin

RSCBWB	Ruvuma and Southern Coast Basin Water Board
RUMAKI	Rufiji-Mafia-Kilwa Seascape
SADC	Southern African Development Community
SCB	Southern Coast Basin
SESA	Strategic Environmental and Social Assessment
SHILDA	Southern Highlands Livestock Development Association of Tanzania
SOUWASA	Songea Urban and Sewage Authority
SPATSIM	Spatial and Time Series Information Modelling
STP	Sewerage Treatment Plant
SWC	Soil and Water Conservation
TANDREC	Tanzania Disaster Relief Committee
TANESCO	Tanzania Electric Supply Company Limited
TMAA	Tanzania Mineral Auditing Agency
TNA	Technology Needs Assessment
TZS	Tanzanian Shilling
UN	United Nations
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
USAID	United States Agency for International Development
USD	United States Dollar
URT / GoT	United Republic of Tanzania / Government of Tanzania
UWASA	Urban Water and Sanitation Authority
VPO	Vice President's office
WDM	Water Demand Management
WMA	Wildlife Management Area
WRDP	Water Resources Development Programme
WRMA	Water Resources Management Act
WS	Water Supply
WSDP	Water Sector Development Programme
WUA	Water Users Association
WUG	Water User Group
WWF	World Wide Fund for Nature / World Wildlife Fund

1. INTRODUCTION

1.1. Project Background

The Tanzanian Ministry of Water (MoW) is presently implementing the Water Sector Development Programme (WSDP) 2006-2025 and the development of Integrated Water Resources Management and Development Plans for Tanzania's river basins is a key objective of the WSDP. The plans will provide a blueprint for sustainable development and management on the country's water resources. The outputs from this project will assist the Basin Water Board, Mtwara (BWB) with the implementation of these plans for the Ruvuma River and Southern Coast Basin (RSCB).

MoW has set out the approach for the development of the plan for the RSCB through the completion of five components set out in the Request for Proposals. These components are:

Component 1: Review and inventory of water use and demand and water resources assessment comprising:

Volume 1: Surface Water Resource Assessment (this document)
Volume 2: Groundwater Resource Assessment
Volume 3: Water Demand Assessment
Volume 4: Water Quality and River Health
Volume 5: Fisheries, Wildlife and Limnology
Volume 6: Protection and Conservation of the Mtawanya and Mikindani Aquifers

Component 2: Institutional, Policy and legal framework comprising
Volume 1: Institutional, Policy and Legal Framework and Stakeholders
Volume 2: Socio-Economic Assessment

Component 3: Sector/Thematic Water Plans
Volume 1: Sector/Thematic Water Plans
Volume 2: Flood and Drought Management
Volume 3: Water Resources Monitoring and Management Systems
Component 4: Integrated Water Resources Management and Development Plan
Volume 1: IWRMD Plan

Component 5: IWRMD Plan Implementation Strategy and Action Plan
Volume 1: IWRM Implementation Strategy
Volume 2: IWRM Implementation Action Plan

Final Report (this document)

Appendix Reports
Volume 1: Upper Ruvuma Sub-Basin Plan
Volume 2: Likonde Sub-Basin Plan
Volume 3: Upper Middle Ruvuma Sub-Basin Plan
Volume 4: Lower Middle Ruvuma Sub-Basin Plan
Volume 5: Lower Ruvuma Sub-Basin Plan
Volume 6: Mambi Sub-Basin Plan
Volume 7: Lukuledi Sub-Basin Plan
Volume 8: Mbwemkuru Sub-Basin Plan
Volume 9: Mavuji Sub-Basin Plan
Volume 10: Matandu Sub-Basin Plan
Volume 11: Implemented Capacity Building Activities
Volume 12: Map Volume

This final report presents the brief features of the RSCB and summary of the IWRMD Plan to be used by the Basin Water Board (BWB) and Ministry of Water (MoW) to disseminate it to the Government, Parliament and other political leadership.

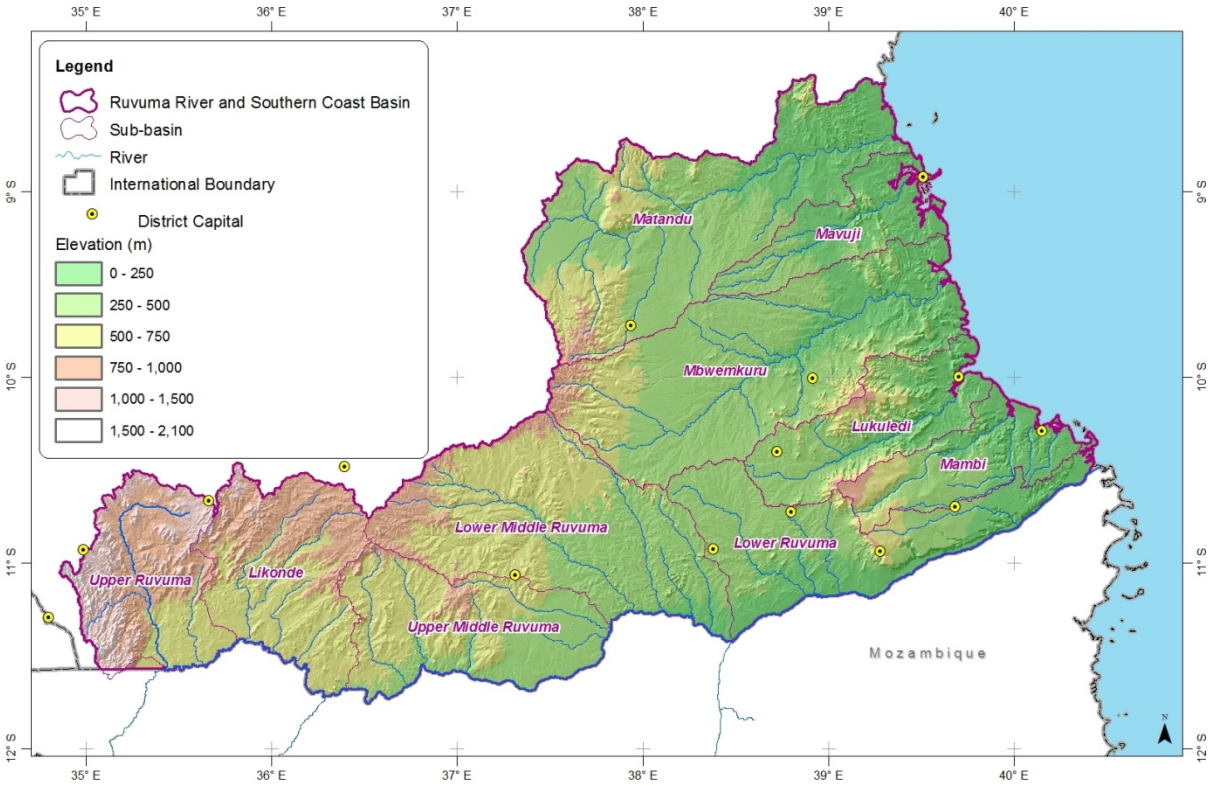
2. THE RUVUMA AND SOUTHERN COAST BASIN (RSCB)

2.1. Basin Introduction

The Ruvuma and Southern Coast Basin (RSCB) is comprised of the Tanzanian side of the Ruvuma River Basin and 22 other rivers between the Ruvuma and the Rufiji rivers, which drain into the Indian Ocean directly. The main Ruvuma River rises within Tanzania in the Songea region on the eastern side of the Mbinga hills and Matogoro hills, at an altitude of about 2,100 m. It flows west and then south for a distance of 110 km before changing direction to the east. From this point onwards the river also becomes an international boundary between Tanzania and Mozambique. The river drains into the Indian Ocean at Mnazi Bay, south of Mtwara, after flowing for 650 km as a border. In terms of catchment area, nearly two thirds of the total (100,000 km^2) is in Mozambique, one third (52,000 km^2) in Tanzania and less than 1.0% in Malawi (2,500 km^2), adjacent to the south-western corner of the Mozambique part of the catchment.

The Figure 2.1 shows the topography and main land forms in the RSCB. The western part of the Ruvuma catchment is hilly whereas the eastern and the South Coast basins are mostly low and slightly undulating. The dominant features in the south-eastern part of the RSCB are the Makonde and Rondo Plateaux which provide spring flows to some of the nearby rivers. The Lukuledi Valley runs between these two plateaux and joins the coast between Mtwara and Lindi. Other important river valleys are the Mbwemkuru and Matandu. The Selous Reserve, one of the major protected game reserves in Tanzania, is located at the head waters of Matandu and Mbwemkuru rivers and the Likuyu river in the Ruvuma Basin.

Figure 2-1: Topography of the RSCB

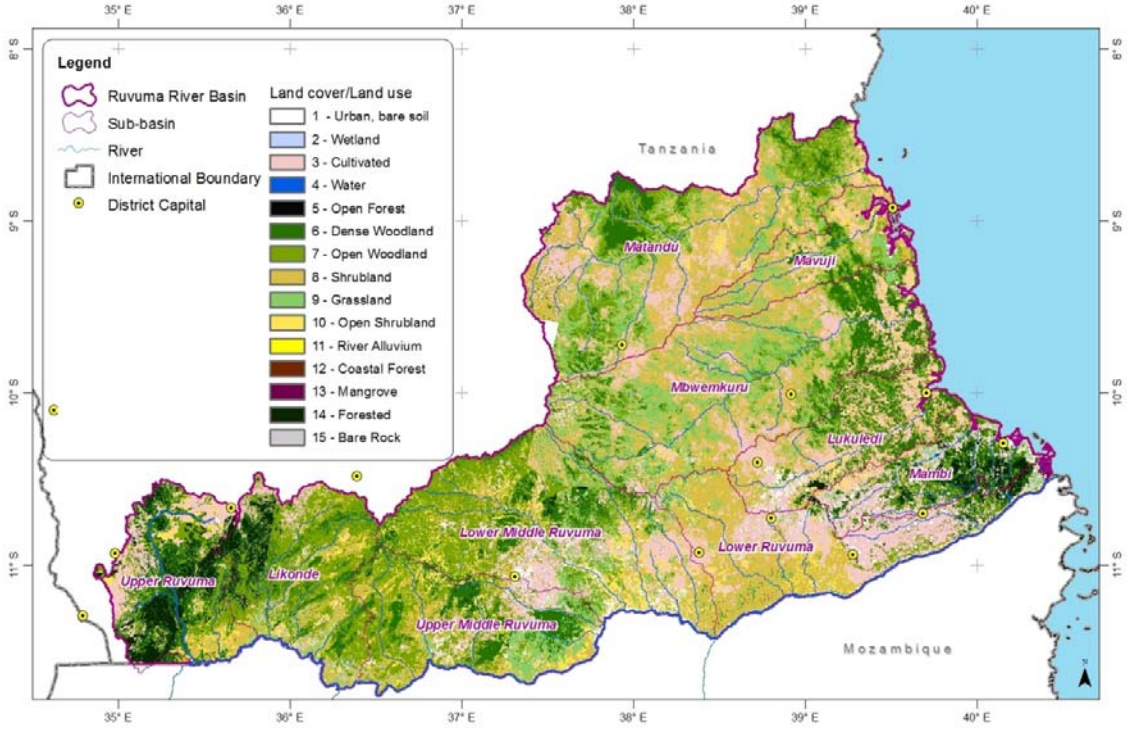


2.1.1. Land Cover

The Ruvuma Basin is dominated by the Eastern Miombo Woodlands eco-region that stretches from the eastern Democratic Republic of the Congo to the coastal regions of Tanzania. This vegetation type is best represented in the western mountain regions of Mbinga where it is appears as dense forests and woodlands. Sub-tropical woodlands and shrub land predominate in the central plateau areas around Tunduru. This vegetation complex is coincident with the occurrence of abundant wildlife resources hence the predominance of protected areas in this part of the basin. The coastal zone is characterised by coastal vegetation types such as mangrove swamps at the estuary of the Ruvuma River and coastal forests along the coast.

The basin is rich in biodiversity but remains largely unexploited. Most of the region is rural with 3% of the land area classified as urban and 10% under agriculture (See Figure 2.2).

Figure 2-2: Land cover and land use in the RSCB



2.1.2. River Network and Basin Administration

The RSCB comprises the Ruvuma River and its tributaries and a number of independent river systems which all drain into the Indian Ocean. There are ten sub-basins out of which five are in the Ruvuma catchment and the rest are in the Southern Coast basin. The estimated combined basin area is approximately 105,500km^2 of which the Southern Coast basins cover approximately 53,000 km^2. For the main Southern Coast sub-basins the estimated areas are as follows: Mambi (5,258 km^2), Lukuledi (6,848 km^2), Mbwemkuru (18,636 km^2), Mavuji (4,928 km^2), Matandu (17,360 km^2).

2.1.3. Climate

The Ruvuma and Southern Coast Basin is characterised by two climatic zones, namely the coastal zone where temperatures and humidity levels are high, and the plateaux and mountain regions further inland where sub-tropical conditions and higher rainfall prevail. Rainfall ranges from 750 mm per year along the coast to 1250 mm per year in the mountainous regions of Mbinga on the border with the Lake Nyasa basin.

The projections of climate change in Tanzania show a trend towards warmer, wetter conditions in most seasons. For the 2030s annual average temperatures are projected to increase by between 0.9

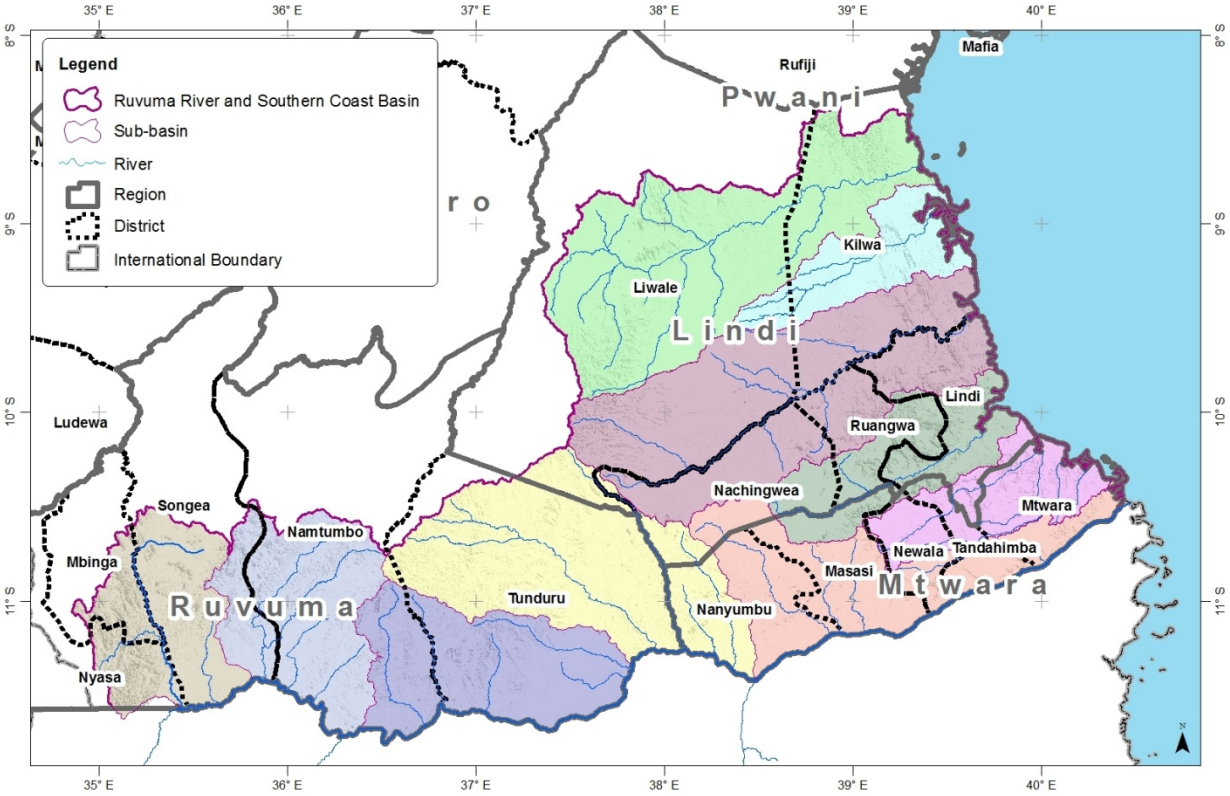
and 1.4°C. Mean increases in rainfall (0 to 10 percent) are projected for all seasons with the exception of the June-September period for which decreases (0 to -10 percent) are projected for the majority of the country.

2.2. Socio-economic Situation

2.2.1. Administrative boundaries

In Tanzania the Ruvuma River covers parts of Mtwara and Ruvuma regions and the Southern Coast Basin covers parts of Mtwara and Lindi regions. There are totally 18 districts. Fig 2.3 also shows the map of regions and districts which fall within the catchment.

Figure 2-3: The Ruvuma (Tanzanian Part) and Southern Coast Basin Regions and Districts

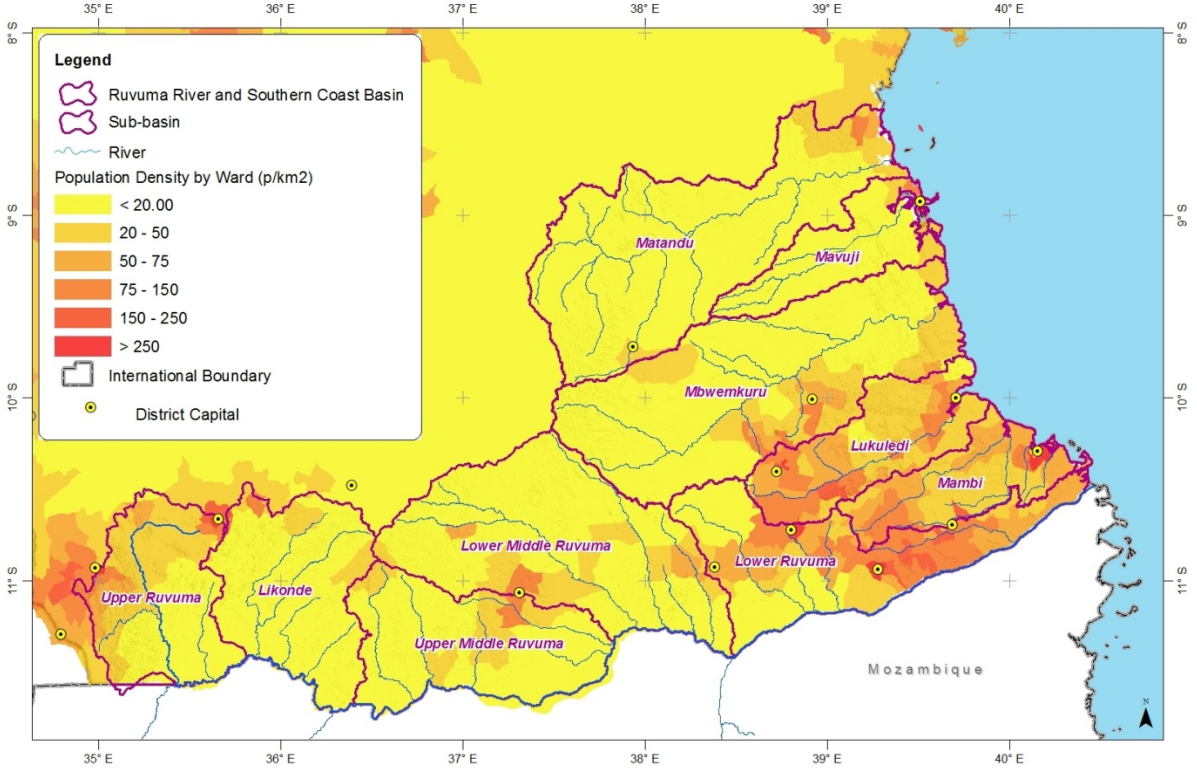


2.2.2. Socio-economic Situation

The population, as per the 2012 Population and Household Census Report is 1,270,854 in Mtwara region, 864,652 in Lindi region, and 1,376,891 in Ruvuma region. The population is unevenly distributed in these regions (Fig 2.4).

Most of the population in the regions live in rural areas with approximately 15% living in urban areas. For the period 2012 to 2030, the population is expected to rise to 5.42 million (i.e. 55% growth). Settlements consist of scattered village communities, market centres, district towns and a few regional centres, i.e. Songea, Mtwara and Lindi. About 15% to 20% of the population live in urban areas. Masasi has also recently become an urban centre. The majority of indigenous people are of Bantu origin with the Makonde accounting for about 60% of the population.

Figure 2-4: Population Density



The Basin is rich in natural resources but sparsely populated. The main economic activities are agriculture, livestock rearing, forestry, artisanal fisheries, small-scale mining, agro-processing and tourism. Although the RSCB's economy has considerable potential for development, the industrial and commercial sectors of the regions are among the least developed in the country. In 2009 per capita GDP in Ruvuma region was estimated at USD 625 compared to USD 390 in Mtwara and USD 435 in Lindi. Annual economic growth ranged between 4.0% and 6.0%. About 80% of the economically active population are employed in the agricultural sector and 20% are employed in mining, agro-processing and the service sectors.

Maize is the main cereal crop. Other cereals grown are paddy and sorghum/millet. Pulses are grown as a source of protein, while oilseeds are widely grown as cash crops. Other food crops include cassava, vegetables and fruit. The most important perennial crop is cashew, while coconut is also widely grown in the coastal districts. Other perennial crops included coffee, pigeon pea, mango, banana, sugar cane and citrus. In general crop productivity is low and the adoption of improved seeds, fertilisers and pesticides is very low. To meet the growing demand for food there is an urgent need to increase crop productivity. Smallholders should be encouraged to move away from shifting cultivation and to adopt more intensive cropping based on rotations and improved cropping practices.

The area under irrigation is estimated at only 14,780 ha (or 2% of annual cropped area). The main sources of irrigation are rivers and canals and about 90% of households either use hand buckets or gravity methods to convey water to the field. Given the extensive areas with high irrigation potential (estimated at 56,800 ha) there is considerable scope for rapid expansion of small-scale irrigation. Very few farmers have adopted soil and water conservation measures and this should also be given high priority in areas where land degradation has become a major problem.

Livestock production is an important economic activity particularly in the Ruvuma region where a large proportion of the population are engaged in livestock rearing. The main types of livestock are cattle, goats, sheep, pigs and poultry. Livestock rearing is typically managed on a small-scale by livestock owning households primarily for subsistence but also as a source of cash income. Livestock productivity is very low due mainly to animal diseases, parasites and poor nutrition, so there is a need to expand veterinary services as well as livestock extension services. In the long-term livestock productivity could also be enhanced through the introduction of improved breeds.

The RSCB has two major fishing resources: (i) marine and (ii) fresh water. Marine fishing is mainly carried out by about 2,500 artisanal fishermen and is concentrated along the inshore waters. Some

fish are sold fresh but most are dried or smoked before being sold. Fishing in the Ruvuma region is primarily located on Lake Nyasa but there are also fishing activities on the rivers, small lakes and ponds. It is estimated that there are 5,000 full and part-time artisanal fishermen in the region.

In Mtwara and Lindi regions 10% of the land area is covered by forest reserves and about 97% of forest reserves are owned and managed by central government. Forests in the Ruvuma region are estimated to cover 55% of the land area and over 80% of the forest area is classified as unreserved woodland. The rate of deforestation is far greater than the rate of replanting and deforestation will continue to increase as population increases and shifting cultivation remains prevalent.

In the Ruvuma region mining is being undertaken by artisanal miners and mineral deposits include various gemstones, gold, coal, uranium, building materials and diamonds. The use of mercury in the extraction of gold has polluted both surface and groundwater resources resulting in severe adverse impacts on aquatic ecosytems. The Mchuchuma-Katewaka coalfield is one of the largest coalfields in Tanzania with a total estimated reserve of 526 million tons. There are plans to construct a 400 MW coal fired power station to utilise the reserves.

There are a few agro-industrial enterprises in Mtwara and Lindi regions including cashew nut factories, sisal factories and a number of grain mills. The agro-industrial base of the Ruvuma region is also small but includes tobacco, cashew and coffee processing factories. Industries in the Basin are faced with various constraints including (i) poor road infrastructure, (ii) unreliable power supply, (iii) inadequate water supply, (iii) poor management and unskilled workforce, and (iv) lack of credit.

At present tourism within the RSCB is very limited as there is a general lack of infrastructure and services. However the RSCB has a variety of attractions including game reserves (e.g. Selous Game Reserve), national parks (e.g. Mnazi Bay-Ruvuma Estuary Marine Park), sandy beaches, waterfalls and historic/cultural sites. The potential for tourism development is considerable but, to attract foreign visitors, there is a need to provide good facilities and services.

These rivers and coastal areas were assessed for river health in the assessment phase of the process leading to the formulation of this plan. They were found to be largely in a good state with the exception of those areas where farmers are using pesticide and chemical fertilizers for crop production and in the areas where unregulated mining for gold is being practiced. These areas, mainly concentrated in the plateau area around Tunduru, showed signs of pollution and eutrophication. Other activities that presented potential impacts on water quality in the Basin are unsustainable forest utilisation which has resulted in the river sedimentation.

A number of indicators clearly demonstrate the levels of poverty in the RSCB. The proportion of the population living below the basic needs poverty line within the Basin is estimated to range from 36% to 42%. Rural areas account for the largest proportion of poor households with over 82% of poor households living in the rural areas. The proportion of the urban population living below the basic need poverty line is estimated at around 26%.

Access to safe water in the region is low due to low levels of development of water infrastructure with most of the population drawing water from unprotected sources or boreholes. Sanitation is also poorly developed with those that have water borne sanitation dependent upon local solutions such as septic tanks. Only Songea town has a sewage system in the whole region.

Health services are generally poor across the whole region which, when combined with poor water supply, contributes to the prevalence of a wide range of diseases and malnutrition among the infants and children.

Energy poverty levels are also high with the majority of the population using biomass based energy for both lighting and cooking. Most service centres are also not connected to the electricity grid, a situation which compromises transition from primary production to industrial development. This situation might change in the near future with the discovery of natural gas off the coast which will be used for the generation of electricity.

3 WATER BALANCE

3.1 Water Resources Assessment

The development of the Ruvuma River and Southern Coast Basin IWRMD Plan and Action Plan required an understanding of the current status of water resources and the current and projected water demand from the key water use sectors in the basin. Surface water and groundwater assessments were conducted to establish total water availability in the basin despite the paucity of data.

3.1.1 Surface Water

The SPATSIM (Spatial and Time Series Information Modelling), water resources modelling package was used for the water resources assessment. In particular the Groundwater Version 3 variant of the PITMAN rainfall-runoff model was used. Table 3-1 summarises the resulting estimates at the sub-basin and basin scale.

Table 3-1: Summary of Model Results for the RSCB Sub-basins and Basins (1981 to 2010)

Sub-basin	Annual total (Mm^3/year)	Mean Annual Runoff (mm/year)	Basin	Annual total (Mm^3/ year)	Area (km^2)	Mean Annual Runoff (mm/year)
Upper Ruvuma	2,672	321	Ruvuma (Tanzania)	9,242	52552	176
Likonde	2,704	308				
Upper Middle Ruvuma	1,584	166				
Lower Middle Ruvuma	1,638	108				
Lower Ruvuma	644	60				
Mambi	401	76	Southern Coast	2,467	53030	47
Lukuledi	481	71				
Mbwemkuru	842	45				
Mavuji	168	33				
Matandu	575	33				

The results suggest that the mean annual runoff decreases from about 300-350 mm/year in the western part of the Ruvuma Basin in Tanzania to values as low as 30-40 mm/year for some of the Southern Coast Basins.

These results also suggest that the mean annual flow from the Tanzanian side of the Ruvuma River was about 9,242 Mm^3/year from 1981 to 2010 and the corresponding value for the Southern Coast Basins was about 2,467 Mm^3/year. The corresponding runoff values were 176mm and 47mm respectively.

The projections of future climate for Tanzania suggest an intensification of seasonal rainfall – i.e. the wet season(s) getting wetter and the dry season(s) getting drier – and warmer temperatures across all seasons, which translate into an increase in Potential Evapotranspiration (PET). PET is expected to increase in the range of 2% to 5% in the 2020s and 2030s.

Applications of climate change parameters in the rainfall-runoff model suggest small reductions in flows (<5 percent), except for the Mambi sub-basin, in terms of annual runoff for both the Dry and Mid scenarios. The differences from the baseline are substantially larger for the Wet scenario, with increases in annual runoff in the range of 9 to 21 percent for the 2020s and 15 to 36 percent for the 2030s.

When the impact on runoff is considered on a monthly scale, it can be seen that the majority of the difference is found in the JF and MAM season. Figure and Figure show the monthly impact on runoff for the Upper Ruvuma and Matandu sub-basins. For the Upper Ruvuma flow is similar in the OND season for all scenarios. For JF and MAM runoff is substantially higher for the Wet scenarios (peaking in May), very slightly higher in the Mid scenarios and slightly lower for the Dry. For the JJAS season

only the Wet scenarios have a runoff larger than the baseline as both the Mid and Dry scenarios show slightly less runoff.

The impact on seasons shows a similar pattern for the Matandu sub-basin, although the largest increase in runoff for the Wet scenarios is seen in May. Additionally the Mid scenario shows a larger increase in MAM runoff than for the Upper Ruvuma, and an (albeit small) increase in runoff in the majority of months. The runoff for both Dry scenarios is around, or just beneath, the baseline.

That the most substantial change in runoff is found in the JF and MAM seasons was to be expected but it is interesting to note that Dry scenarios can result in lower year-round run-off, with no increase in wet season rainfall to compensate for decreases in the rest of the year.

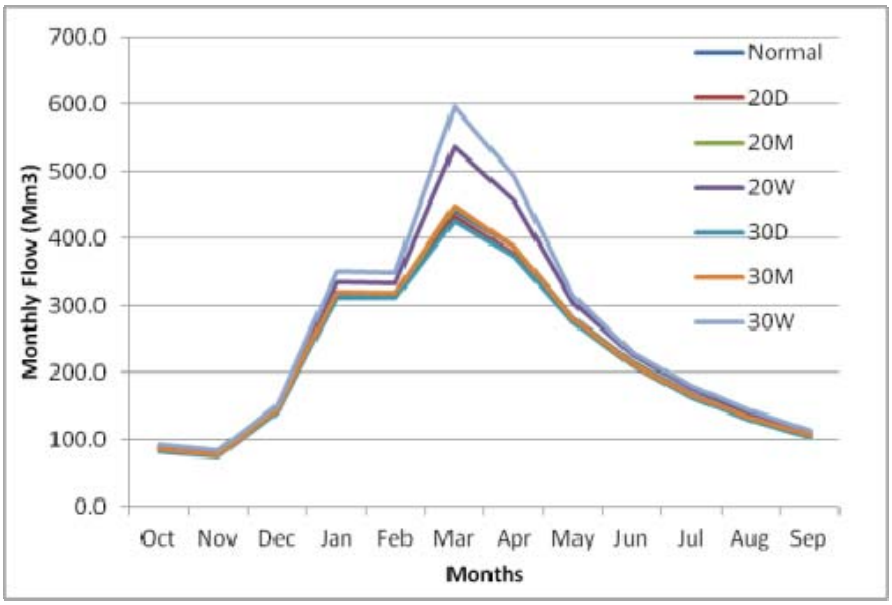


Figure 3-1: Monthly average runoff for the Upper Ruvuma sub-basin (all scenarios and timeslices)

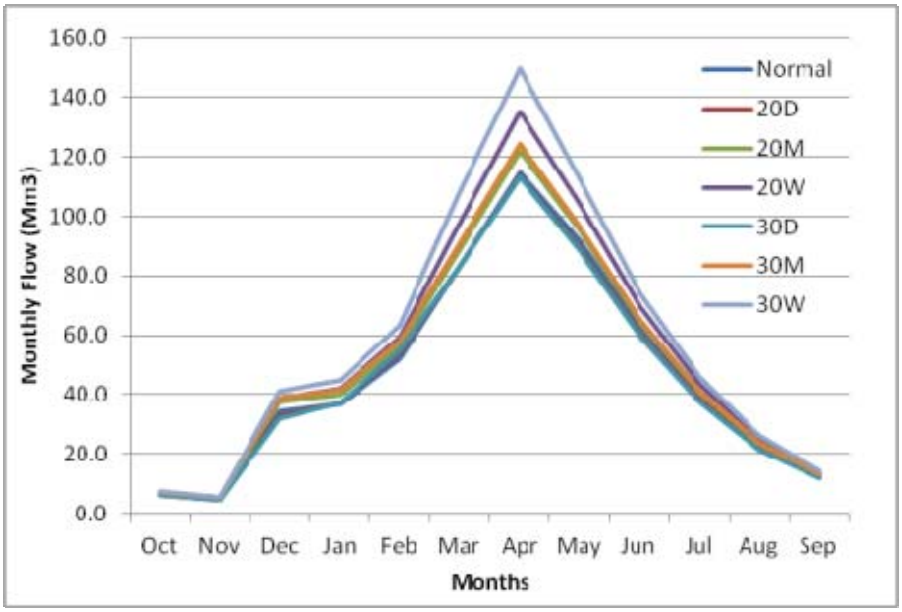


Figure 3-2: Monthly average runoff for the Matandu sub-basin (all scenarios and timeslices)

Table 3-2: Model results for the estimated impact of climate change on run-off

No	Sub-Basin	Current			2020s								
					Dry			Mid			Wet		
		Average Rainfall (mm)	Average Runoff (mm)	Runoff (% of MAR)	Average Rainfall (mm)	Average Runoff (mm)	% difference with current	Average Rainfall (mm)	Average Runoff (mm)	% difference with current	Average Rainfall (mm)	Average Runoff (mm)	% difference with current
Ruvuma Basin													
1	Upper Ruvuma	1168.4	320.8	27.46%	1199.5	315.4	**-1.68%**	1178.5	321.1	**0.09%**	1223.7	352.4	**9.85%**
2	Likonde	1219.0	307.9	25.26%	1235.2	314	**1.98%**	1229.4	308.2	**0.10%**	1276.1	344	**11.72%**
3	Upper Middle Ruvuma	1007.4	165.9	16.47%	1007.9	163.4	**-1.51%**	1015.4	166.5	**0.36%**	1052.1	183.9	**10.85%**
4	Lower Middle Ruvuma	998.3	108.1	10.83%	1013.8	106.1	**-1.85%**	1020.8	108	**-0.09%**	1059.8	126.3	**16.84%**
5	Lower Ruvuma	941.7	60	6.37%	940.3	57.9	**-3.50%**	946.8	59.3	**-1.17%**	987.7	69.5	**15.83%**
	Average						**-1.31%**			**-0.14%**			**13.02%**
South Coast Basin													
6	Mambi	980.4	76.3	7.78%	977.9	72	**-5.64%**	985.5	74.8	**-1.97%**	1029.2	92.5	**21.23%**
7	Lukuledi	949.9	70.8	7.45%	949.2	68	**-3.95%**	958.2	70.6	**-0.28%**	998.2	85.2	**20.34%**
8	Mbwemkuru	934.7	45.2	4.84%	936.3	44.4	**-1.77%**	950.2	46.6	**3.10%**	980	52.1	**15.27%**
9	Mavuji	881.8	33.4	3.79%	883.7	32.7	**-2.10%**	902.9	35.2	**5.39%**	923	38.2	**14.37%**
10	Matandu	891.3	32.5	3.65%	894.1	31.9	**-1.85%**	912.7	34.1	**4.92%**	932.6	36.9	**13.54%**
	Average						**-3.06%**			**2.23%**			**16.95%**

No	Sub-Basin	Current			2030s								
					Dry			Mid			Wet		
		Average Rainfall (mm)	Average Runoff (mm)	Runoff (% of MAR)	Average Rainfall (mm)	Average Runoff (mm)	% difference with current	Average Rainfall (mm)	Average Runoff (mm)	% difference with current	Average Rainfall (mm)	Average Runoff (mm)	% difference with current
Ruvuma Basin													
1	Upper Ruvuma	1168.4	320.8	27.46%	1169.2	312.2	**-2.68%**	1182.5	321.6	**0.25%**	1254.8	371.4	**15.77%**
2	Likonde	1219.0	307.9	25.26%	1220	293.4	**-4.71%**	1233.5	308.6	**0.23%**	1308.3	361.9	**17.54%**
3	Upper Middle Ruvuma	1007.4	165.9	16.47%	1008.1	161.4	**-2.71%**	1018.6	166.9	**0.60%**	1077.9	195.8	**18.02%**
4	Lower Middle Ruvuma	998.3	108.1	10.83%	1013.5	104.5	**-3.33%**	1023.4	108.2	**0.09%**	1086.5	126.8	**17.30%**
5	Lower Ruvuma	941.7	60	6.37%	939.4	57.3	**-4.50%**	948.7	59.1	**-1.50%**	1013.9	76.2	**27.00%**
	Average						**-3.59%**			**-0.07%**			**19.13%**
South Coast Basin													
6	Mambi	980.4	76.3	7.78%	976.4	70.8	**-7.21%**	987.5	74.4	**-2.49%**	1057.5	103.2	**35.26%**
7	Lukuledi	949.9	70.8	7.45%	948.6	67.5	**-4.66%**	961.1	70.6	**-0.28%**	1025.3	95	**34.18%**
8	Mbwemkuru	934.7	45.2	4.84%	936.7	44.1	**-2.43%**	955.9	47.2	**4.42%**	1005.6	56.9	**25.88%**
9	Mavuji	881.8	33.4	3.79%	884.2	32.4	**-2.99%**	910.5	35.9	**7.49%**	946.9	41.5	**24.25%**
10	Matandu	891.3	32.5	3.65%	895	31.6	**-2.77%**	920.4	34.9	**7.38%**	956.3	39.9	**22.77%**
	Average						**-4.01%**			**3.30%**			**28.47%**

3.1.2 Groundwater

Four main hydrogeological zones; coastal, plateau, basement and karoo, were identified across the Ruvuma and Southern Coast Basin. The groundwater availability and quality across the RSCB is highly dependent upon the geology types. The Groundwater Potential Map for the RSCB is shown in Fig 3.3 below.

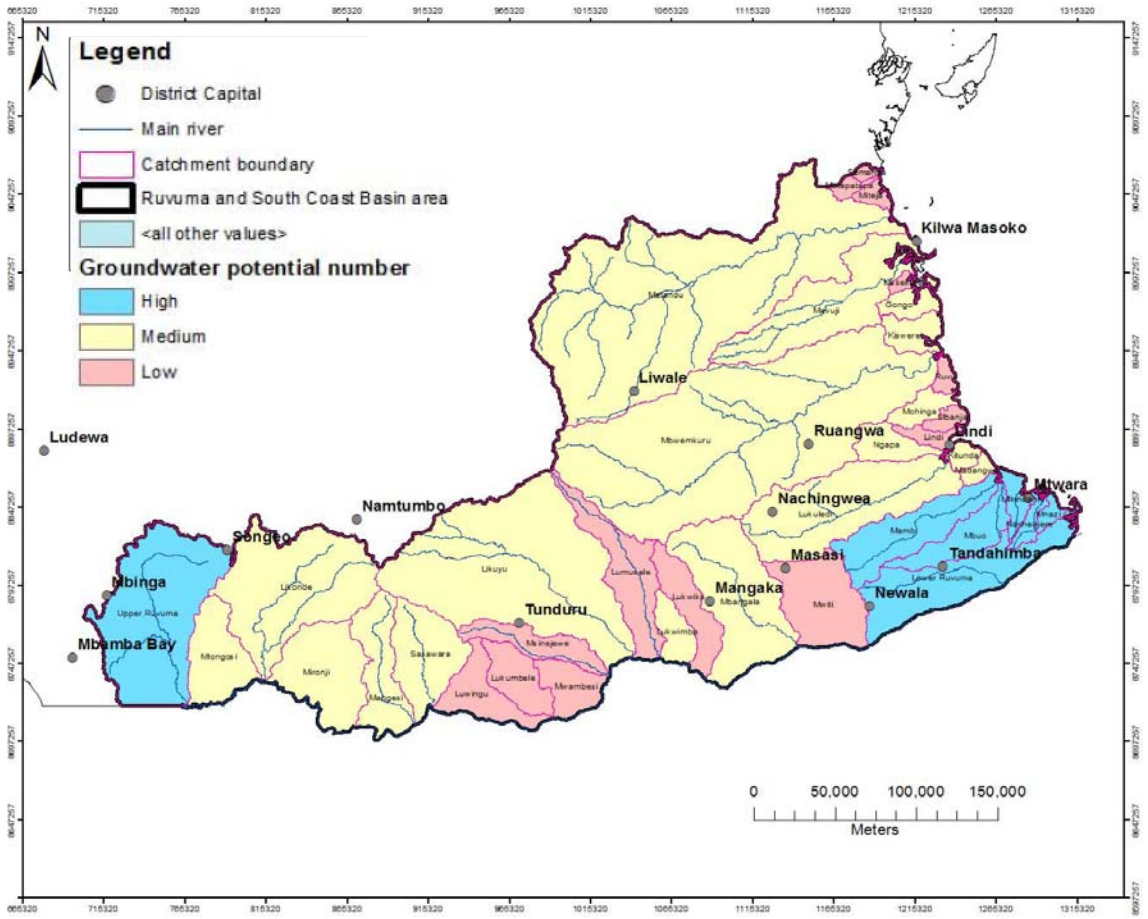


Figure 3-3: Groundwater Potential by catchment

This assessment provided a useful overview of the current groundwater availability within the RSCB and the areas for potential future groundwater development (Table 3.3).

Table 3-3: Estimated Groundwater Availability

Sub-Basin	Mean Annual Groundwater Recharge (Mm^3/a)	Sustainable groundwater use (taken as 40% of recharge) (Mm^3/a)	Current Groundwater Abstraction (Mm^3/a)	Sustainable Groundwater Availability in catchment (Mm^3/a)
Upper Ruvuma	688	276	16	259
Likonde	745	298	5	294
Upper Middle Ruvuma	753	302	4	298
Lower Middle Ruvuma	902	361	5	356
Lower Ruvuma	921	368	18	349
Ruvuma (Tanzania)	**4,009**	**1,605**	**47**	**1,556**
Mambi	712	285	13	273
Lukuledi	578	232	12	219
Mbwemkuru	1,202	480	9	472
Mavuji	617	248	1	246
Matandu	1,189	475	4	472
Southern Coast Basin	**4,298**	**1,720**	**38**	**1,682**
TOTAL	**8,307**	**3,325**	**85**	**3,238**

A major issue of concern with regards to groundwater quality is the potential for saline water intrusion along the coast at Mtwara and Lindi. This is particularly apparent in the Mtawanya aquifer which

supplies the bulk of public water supply to Mtwara. The extent of this problem has been assessed and mitigation measures, including reduced and relocated abstraction from boreholes, have been proposed under in addition to recommendations for future development of the aquifers. There is also the potential for pollution of groundwater due to existing and expanding settlements at these locations which have been addressed. Other vulnerable aquifers have been identified across the RSCB predominantly associated with areas of major settlements.

3.2 Water Demand

Water demand has been determined for various sectors such as rural and urban water supply, irrigation, industrial water supply, livestock, forest, wildlife and other non-consumptive sectors such as hydropower and navigation.

The summary of water demand by sectors and by sub-basin is presented in the Table 3-4 below. Environmental flow demand is by far the largest demand currently standing at 4,800 Mm^3 per annum in the RSCB (96% of total demand). The EFR will vary depending on the management decision on the level of ecological management category needed. River health assessment and EMC categorisation of the sub-basins have been carried out to determine the EMC category. In this environmental flow demand calculation EFR is calculated to maintain the ecological management category 'B', and 'B/C' in some cases. The water allocation model results (Section 5.4) reveal the water availability against these EFR needs. Irrigation demand at 141.6 Mm^3 per annum is very low in the RSCB (3% of total demand) but is expected to increase to 254.3 Mm^3, 568.2 Mm^3 and 1,056.1 Mm^3 in the years 2015, 2025 and 2035 respectively. By 2035 it will account for 17.6% of total demand. These figures underlie the need for sound management to avoid conflict with environment flow requirements during drought periods. The areas needing to be considered are (a) increasing the efficiency of water use in irrigation and water supply, (b) introducing water saving technology, (c) improving water harvesting systems, (d) increasing the awareness of these issues among the users and (e) introducing regulatory systems.

Table 3-4: Summary water demand by sectors and by sub-basin (Mm^3)

Sectors	Ruvuma Sub-basins						Southern Coast Basins					
	Upper Ruvuma	Likonde	UM Ruvuma	LM Ruvuma	Lower Ruvuma	Total	Mambi	Luku-ledi	Mbwem-kuru	Mavuji	Ma-tandu	Total
2012												
Rural WS	5.6	2.5	0.6	1.2	8.7	**18.7**	6.2	5.0	5.1	0.9	1.5	**18.7**
Urban WS	3.8	0.2	-	-	0.8	**4.9**	2.9	1.6	-	-	-	**4.4**
Livestock	1.3	0.4	0.2	0.3	0.6	**2.7**	0.5	0.7	0.8	0.1	0.4	**2.5**
Irrigation	40.6	10.6	9.8	3.5	27.6	**92.1**	4.6	30.2	11.8	1.4	1.5	**49.5**
Forest & Wildlife	1.2	1.8	4.5	2.6	0.9	**11.0**	0.1	0.1	2.8	0.8	4.8	**8.7**
Environmental Flow	1,108.7	1,284.4	681.3	622.5	225.5	**3,922.4**	139.7	171.6	303.2	59.8	204.5	**878.9**
Total	**1,161.3**	**1,299.9**	**696.4**	**630.1**	**264.1**	**4,051.7**	**154.0**	**209.3**	**323.8**	**62.9**	**212.7**	**962.7**
2015												
Rural WS	6.1	2.7	0.6	1.2	9.3	**20.0**	6.6	5.3	5.4	0.9	1.6	**19.7**
Urban WS	4.3	0.3	-	-	0.9	**5.4**	3.0	1.7	-	-	-	**4.7**
Livestock	1.6	0.5	0.3	0.3	0.7	**3.3**	0.7	0.9	1.0	0.1	0.5	**3.1**
Irrigation	53.9	18.3	16.5	6.7	48.6	**144.0**	18.9	65.1	18.5	4.1	3.7	**110.3**
Forest & Wildlife	1.4	2.1	5.7	3.1	1.1	**13.3**	0.1	0.2	3.6	1.0	6.2	**11.1**
Environmental Flow	1,108.7	1,284.4	681.3	622.5	225.5	**3,922.4**	139.7	171.6	303.2	59.8	204.5	**878.9**
Total	**1,175.9**	**1,308.3**	**704.3**	**633.9**	**286.1**	**4,108.5**	**169.0**	**244.8**	**331.8**	**65.9**	**216.5**	**1,027.9**
2025												
Rural WS	7.9	3.5	0.8	1.4	11.0	**24.7**	7.7	6.2	6.3	1.1	1.8	**23.2**
Urban WS	6.0	0.3	-	-	1.1	**7.4**	3.7	2.1	-	-	-	**5.9**
Livestock	2.0	0.6	0.3	0.4	0.9	**4.2**	0.9	1.1	1.3	0.1	0.6	**3.9**
Irrigation	113.7	34.2	27.8	12.5	154.7	**342.9**	46.9	131.2	31.6	8.1	7.5	**225.3**
Forest & Wildlife	1.9	3.1	8.3	4.3	1.6	**19.3**	0.2	0.3	5.4	1.5	9.3	**16.5**
Environmental Flow	1,108.7	1,284.4	681.3	622.5	225.5	**3,922.4**	139.7	171.6	303.2	59.8	204.5	**878.9**
Total	**1,240.2**	**1,326.1**	**718.5**	**641.2**	**394.8**	**4,320.8**	**199.1**	**312.5**	**347.8**	**70.6**	**223.7**	**1,153.8**
2035												
Rural WS	10.1	4.5	1.0	1.7	13.1	**30.4**	9.1	7.3	7.4	1.3	2.1	**27.2**
Urban WS	9.1	0.4	-	-	1.3	**10.9**	4.6	2.8	-	-	-	**7.4**
Livestock	3.0	0.9	0.5	0.6	1.3	**6.2**	1.3	1.7	1.9	0.2	0.9	**5.9**
Irrigation	159.9	62.5	44.2	18.5	409.4	**694.5**	73.7	216.0	48.0	12.2	11.7	**361.6**
Forest & Wildlife	2.5	4.0	11.0	5.7	2.1	**25.4**	0.2	0.3	7.1	2.0	12.3	**22.0**
Environmental Flow	1,108.7	1,284.4	681.3	622.5	225.5	**3,922.4**	139.7	171.6	303.2	59.8	204.5	**878.9**
Total	**1,293.3**	**1,356.7**	**738.0**	**649.0**	**652.7**	**4,689.8**	**228.7**	**399.7**	**367.7**	**75.4**	**231.6**	**1,303.1**

3.3 Water Availability Vs Water Demand

Water demand against water availability is presented in Table 3-5 below. Due to low levels of economic development in the basin, total water demand is low and is projected to remain below total supply levels up to 2035 and beyond.

Table 3-5: Summary Water Availability vs Demand by Sub-basin (Mm^3)

	2030s									
	Environmental Management Class : B					Environmental Management Class : C				
	Total Water Availability (Mcum)	Total Demand (Mcum)	Surface Water Demand (% of WA)	GW Use (% of GWA)	Hydro-power Generation (GWh)	Total Water Availability (Mcum)	Total Demand (Mcum)	Water Demand (% of WA)	GW Use (% of GWA)	Hydro-power Generation (GWh)
Average rainfall and runoff										
Upper Ruvuma	2955.0	1293.3	54%	9%	142.3	2955.0	1034.7	35%	9%	142.3
Likonde	3008.4	1356.7	48%	2%		3008.4	1085.4	29%	2%	
Upper Middle	1894.4	738.0	38%	3%	36.9	1894.4	479.7	25%	3%	36.9
Lower Middle	2151.7	649.0	37%	1%		2151.7	486.8	22%	1%	
Lower Ruvuma	922.0	652.7	53%	12%		922.0	456.9	44%	12%	
RUVUMA	**10931.5**	**4689.8**	**46%**	**6%**		**10931.5**	**3543.4**	**31%**	**6%**	
Mambi	677.4	228.7	39%	6%		677.4	183.0	31%	6%	
Lukuledi	769.7	399.7	46%	7%		769.7	319.8	36%	7%	
Mbwemkuru	1173.7	367.7	41%	5%		1173.7	294.1	28%	5%	
Mavuji	458.7	75.4	21%	1%		458.7	60.3	14%	1%	
Matandu	892.8	231.6	33%	2%		892.8	185.3	21%	2%	
SOUTHERN	**3972.4**	**1303.1**	**36%**	**4%**		**3972.4**	**1042.5**	**26%**	**4%**	
TOTAL	**14903.9**	**5992.8**	**41%**	**5%**		**14903.9**	**4585.9**	**28%**	**5%**	
80% dependable rainfall and runoff										
Upper Ruvuma	2311.6	1215.7	58%	11%	128.7	2311.6	972.6	38%	11%	128.7
Likonde	1871.1	1275.3	48%	3%		1871.1	1020.3	29%	3%	
Upper Middle	1078.7	693.7	38%	3%	32.2	1078.7	520.3	26%	3%	32.2
Lower Middle	906.1	610.1	32%	1%		906.1	396.5	19%	1%	
Lower Ruvuma	626.8	613.6	75%	15%		626.8	429.5	67%	15%	
RUVUMA	**6794.3**	**4408.4**	**50%**	**7%**		**6794.3**	**3339.2**	**36%**	**7%**	
Mambi	451.9	205.9	45%	6%		451.9	164.7	39%	6%	
Lukuledi	528.9	359.7	58%	9%		528.9	287.8	49%	9%	
Mbwemkuru	776.6	330.9	43%	6%		776.6	264.7	31%	6%	
Mavuji	364.7	67.9	17%	1%		364.7	54.3	13%	1%	
Matandu	651.8	208.4	30%	2%		651.8	166.7	19%	2%	
SOUTHERN	**2774.0**	**1172.8**	**38%**	**5%**		**2774.0**	**938.2**	**30%**	**5%**	
TOTAL	**9568.3**	**5581.2**	**44%**	**6%**		**9568.3**	**4277.4**	**33%**	**6%**	

The important outcomes of the Decision Support System are as follows

a) Annually there are no water deficits during average year, even during the 2030s, but the lower Ruvuma, Mambi and Lukuledi sub-basins experience deficits during the 80% percentile rainfall year. The lower Ruvuma needs could be managed by abstracting water from the River Ruvuma, whereas the Mambi and Lukuledi needs require inter-basin transfer to meet future demand. It is vital to transfer water for municipal water supplies as planned by MTUWASA. Similar arrangements could also be made for Lindi and Masasi water supply systems.

b) Though there are no water deficits annually there are water deficits during September, October and November in the lower Ruvuma, Mambi and Mbwemkuru sub-basins. The monthly water deficits further widened during 80% percentile rainfall years for all the Southern Coast Basins.

c) There is potential for the use of groundwater to meet the deficits but there are restricted as to potential aquifer areas.

d) There is a need to create storage in all the Southern Coast Basins. The storage requirements for Mambi, Lukuledi, Mbwemkuru and Mavuji sub-basins are 87.6, 140.8, 44.7 and 11.7 MCUM respectively. Surface irrigation schemes in all the sub-basins require storage points to meet the irrigation demand during non-rainy months.

e) There is sufficient water available to run the proposed Lumeme, Lupilo, Nakatuta and Kwitanda small hydropower units.

4 MAJOR PROBLEMS AND CHALLENGES

4.1 Problems and Challenges

Many water problems, large or small, add up to a basin level problem of major proportions and pressing significance. IWRM is an interdisciplinary concept aiming to consider quality and quantity problems of both surface and groundwater and how to address these from a technical and managerial perspective.

Unlike in other basins in the country the RSCB faces few, if any, challenges with respect to the availability of water for development. The future of water resources management and development will instead be driven by projected demands from developments in the Basin on account of recent discoveries of coal reserves and off-shore natural gas. Further, increasing global prices for minerals is also expected to increase interest in these resources resulting in the growth of the mining sector. Should this happen, and depending on the scale at which it happens, some negative impact on the local environment and water resources will be experienced as has already occurred, albeit on a localised and small scale, in parts of the Ruvuma region.

On the positive side increased environmental awareness among decision makers has already seen the establishment of terrestrial and marine conservation areas to protect the sometimes endemic environmental goods and services in these two basins. This development will facilitate the practice of mitigation measures to counter the possible adverse environmental effects of development that are discussed above.

The problems and challenges of the RSCB are listed below.

4.1.1 Problems

The general problems and the root causes that are applicable to the RSCB are as follows:

- Catchment degradation due to shifting cultivation, inappropriate cultivation practices especially on the slopes and deforestation
- Pollution of rivers due to poor mining practices and livestock grazing activities
- Insufficient technical manpower and skills
- Insufficient water supply and sanitation at rural and urban areas.
- Insufficient water resources quantity and quality monitoring
- Overfishing due to inappropriate fishing gear such as mosquito nets which damage the aquatic ecosystem by completely unselective catching.

Specific problems are

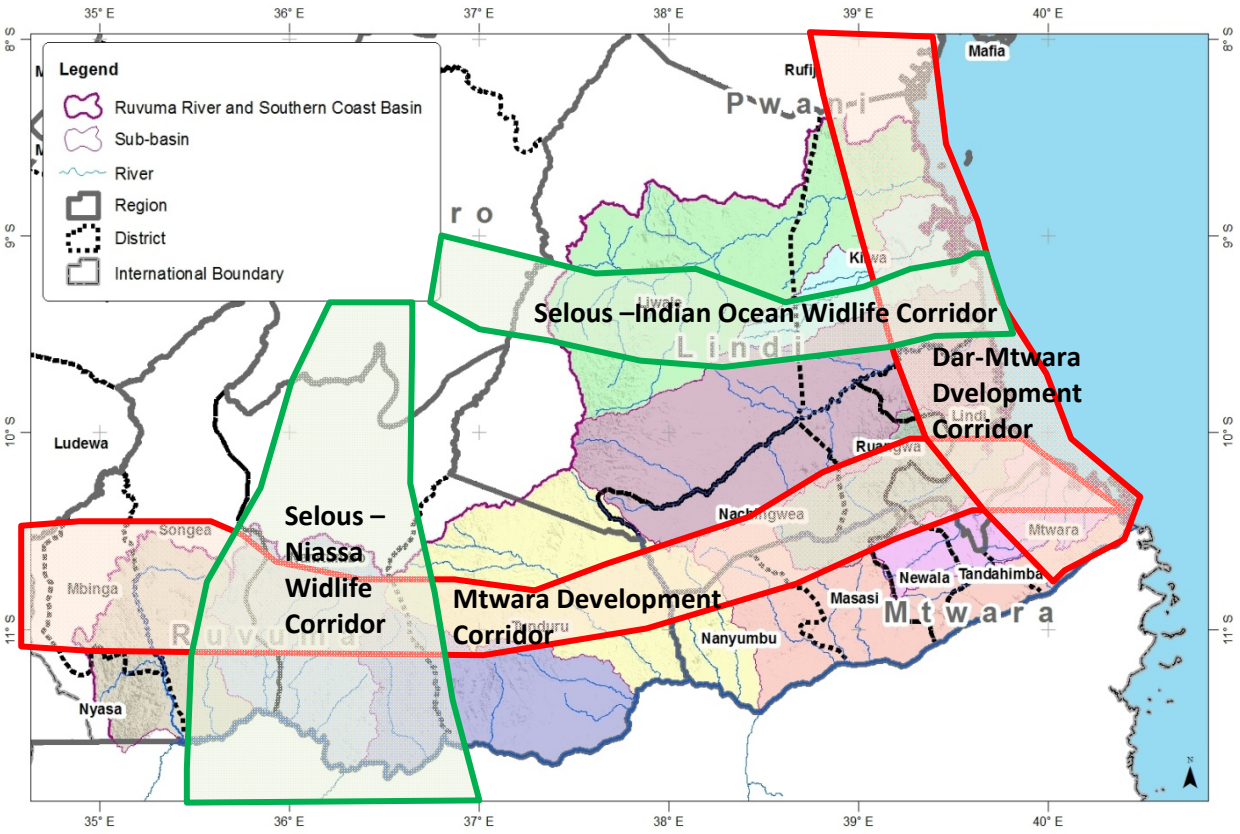
- Livestock migration from the Ihefu wetland to the Lindi region and associated water resources management
- Erosion and landslides on the Makonde and Ronde escarpments due to poor characteristics of the soil, shifting cultivation on the slopes and insufficient protection to slopes while constructing roads and the nature of rainfall erosivity.
- Salinity level increase in the Chidya lake due to dysfunction of its supply channel
- Pollution of the Kitere and the Rutamba lakes due to eutrohpication
- Pollution from mining activities on the rivers Likwika, Lumeme and Lunyere
- Salt water intrusion in the Mtwanya well field
- Lack of floodplain maps
- Insufficient facilities at the water quality laboratories in Mtwara and Songea

4.1.2 Challenges

The general challenges and the root causes, those are applicable to all the sub-basins are

- Development corridor vs wildlife corridor (Figure 4-1)

Figure 4-1: Development Corridor vs Wildlife Corridor



- The conflict between wildlife and humans on the fringes of the forest and game reserves, caused by the encroachment and/or drought.
- The conflict between the pastoralists and agriculturists for sharing of water
- How to meet the shortage of technical manpower and skills
- Lack of funds for water resources development, research, training, workshops, supervision, monitoring and engaging human resources
- Low enforcement of laws and policies.
- Lack of integration and poor communication between sectors and stakeholders.

Specific challenges are

- The coverage of rural water supply by regions are 59%, 49% and 41% in the Songea, Mtwara and Lindi regions respectively. The challenge is to reach 100% coverage in the next 25 years.
- The gap between irrigation potential (66,144 ha) and the developed irrigation (7,500 ha) is too high and requires substantial investment.
- Preparation of Simple EIA and EMP for small-scale mining licenses and their implementation and monitoring is the basic challenge for the primary mining licenses within the RSCB.
- Implementation of hydropower schemes across the Ruvuma River which is a transboundary river.
- Management of environmental flow requirements is a challenge as there are reservoirs to regulate the flows.

- Implementation of IWRMD Plan is a challenge as there is insufficient capacity and institutions (CWCs and WUGs) at catchment level.

4.2 SWOT Analysis

The SWOT Analysis of the RSCB water resources development and management is as follows

Strength	**Weakness**
• Availability of surplus surface and groundwater resources • Untapped potential for irrigation and hydropower development (especially on the Ruvuma river) • Existence of strong legislation on water resources, irrigation development and environmental safeguards. • Existence of institutional arrangement nationally and at river basin level to deal with the water resources management. • Increased environmental awareness among decision makers. • Availability of water resources information and IWRMD Plan (This Project Reports and SADC funded Ruvuma IWRM Reports)	• Low population density and moderate literacy in these three regions, which makes the work of public relations difficult. • Limited skilled labour or institutions to develop skilled labours within these three regions • Low enforcement of laws and policies (illegal logging, status of Jatropha plantation near Kilwa) • Lack of integration and poor communication between sectors and stakeholders. • Limited institutional capacity to deliver the water resources management framework / IWRMD Plan • Low economic growth rate of the three regions • Poor water supply and sanitation leading to health problems and reduced manpower availability • Insufficient funds to implement the IWRMD Plan
Opportunity	**Threat** (including internal threats)
• The SADC initiative on the establishment and strengthening of Joint Water Commission between Tanzania and Mozambique • The 5% GDP growth rate of Tanzania in the last five years • Another SADC initiative of Mtwara Development Corridor, which is aimed at developing these three regions • The discovery of offshore oil and gas between the Kilwa and the Ruvuma estuaries. • The availability of minerals such as gold, copper, gems, coal and uranium • Underdevelopment provides an opportunity for maintaining the environmental / ecological integrity. • The presence of Selous game reserve and the Selous-Niasa Corridor for attracting tourists as the Serengati does for the north.	• The conflict between the pastoralists and agriculturists for sharing of water (migration of livestock from Ihefu wetlands) • The conflict between the developments and environment (MtDC vs SNWC, Developments on Mtwara-Dar road vs S-IO pachyderm corridor) • The unbalanced growth of regions within Tanzania • Slow pace of investment in basic infrastructure, notably water supply and sanitation, irrigation, energy and roads • The conflict between the wild animals and human on the fringes of the forest and game reserves, caused by the encroachment and/or drought (example Liparamba game reserve). • Unchecked human interventions (eg. Choked up supply channels of Chidya lake and building up of salinity) • Erosion and landslides from unsustainable land use practices (Eg. Makonde escarpments and shifting cultivations) • Unchecked pollution from the artisanal miners in the basin (within and across the boundary).

5 INTEGRATED WATER RESOURCES DEVELOPMENT AND MANAGEMENT PLAN

5.1 Plan Objectives

The primary national goals are the Millennium Development Goals (MDGs), MKUKUTA and Vision 25. The United Nations Millennium Summit, held in September 2000, developed a timeframe for measurable goals and targets to combat poverty, hunger, disease, illiteracy, environmental degradation and gender inequality. These MDGs, along with the Millennium Declaration, are now at the centre of the global development agenda. It is also the basis for Tanzania's national strategies for growth and poverty reduction. The Millennium Declaration includes a set of eight goals, which encompass 18 targets for development and poverty eradication to be achieved by 2015.

The national water sector goals or objectives, set out in the MKUKUTA and Vision 2025 are as follows

- Ensure that future demands are met and that present and future water scarcities due to climate variability, climate change or other factors are mitigated
- Ensure the realisation of Agricultural Sector Development Plan, Agricultural Sector Development Strategy and National Irrigation Master Plan objectives through water resources planning process that avoids concentration of water permits;
- Enhance water productivity in agricultural activity and ensure food security; proper management tool with minimal risks in respect of water markets which may lead to inequitable access to water resources and disadvantage poor farmers and other users;
- Protect water resources from potential negative effect to ecosystem integrity, human health, food security and investment in various other social and economic sectors;
- Provide for water requirements and water management for irrigation sector;
- Provide for water requirements for livestock development and animal health, range management, agro-processing;
- Provide for water requirements for industry;
- Enhance industrial development in line with Tanzania Vision 2025 which envisages transforming the economy from a low productivity agricultural economy to semi-industrialised country;
- Increase industrial sector's contribution to GDP;
- Manage both pollution and degradation of water resources due to industrial solid wastes and effluents not properly disposed of;
- Having a strong, vibrant, well organised large and small scale mining industry, conducted in a safe and environmental sound manner;
- Secure water to support these mining activities for it to perform as envisaged;
- Ensure timely control of water pollution arising from mining activities, mine tailing and chemical by-products, to avoid the risk of negative impacts on water quality, fisheries and ecosystems.

Vision and Mission

Vision Statement

"have a basin where the water resources are sustainably developed and managed, and efficiently used to meet the socio-economic and environmental needs of all the lives of the Basin"

Mission Statement

"The shared Ruvuma River waters and other water resources in the basin are effectively managed in an environmentally sustainable manner for the well-being of its people and ecosystem in the basin by equitably allocating water, pollution control, protection of water sources and other integrated approaches."

5.2 Key Areas of IWRMD Plan

The IWRM&D Plan for the RSCB includes all the relevant sectors and is consistent with the national and RSCB goals. The analysis of challenges in the basin led to identification of key areas to include in the plan as guided by the content of the Vision for the basin. The key areas are as follows

1. Water for Domestic Purposes
2. Water for Development
3. Water for Environment
4. Community Participation
5. Institutional Capacity Building

5.2.1 Key Area 1: Water for Domestic Purposes

The water supply and sanitation needs should be met as a first priority among all water uses in order to improve the standard of living. The water needs to be provided to the community continuously either from groundwater or surface water. At the same time the water supply should be part of a multi-purpose project or as a standalone project. Key Area 1 promotes the idea of giving all sections of society access to water supply and sanitation. The objectives and strategies are presented below.

Table 5-1: Objectives and Strategies of Key Area 1

Objectives	Strategies
Objective 1: Achieving water supply and sanitation to all the urban people of the sub-basin	Strategy 1-1: Undertake feasibility studies and implement Songea water supply proposals Strategy 1-2: Develop comprehensive water supply schemes to meet urban rural water demands (in addition to the present plan of Ruvuma-Mtwara Water Supply Scheme) Strategy 1-3: Rehabilitation and extension of Mtawanya and Mikindani Aquifers Strategy 1-4: Identify new sources for water supply Strategy 1-5: Develop comprehensive water supply schemes to meet both urban and rural water demands Strategy 1-6: Develop and implement sewerage master plans for all cities and towns Strategy 1-7: develop programmes under ECOSAN and improve existing sanitation
Objective 2: Achieving water supply and sanitation to all the rural people of the sub-basin	Strategy 1-4: Identify new sources for water supply Strategy 1-5: Develop comprehensive water supply schemes to meet both urban and rural water demands Strategy 1-6: Develop and implement sewerage master plans for all cities and towns Strategy 1-8: Undertake feasibility studies and implement rural water supply proposals Strategy 1-9: Rehabilitation and extension of Makonde Water Supply Scheme
Objective 3: Surface and groundwater resources	Strategy 1-10: Groundwater risk zone identification and develop of management plans

conservation and modelling to support water supply	
Objective 4: The water supply infrastructure is capable of operating at design capacity	Strategy 1-11: Improve the efficiency of water supply infrastructure
Objective 5: Sustainable asset management practices are in place for all the water supply infrastructure	Strategy 1-12: Develop and implement water supply asset management plans

5.2.2 Key Area 2: Water for Development

This area is mainly to improve the socio-economic situation of the residents of RSCB. Thus it concerns development of irrigation, hydropower, livestock and fisheries including multipurpose water resources infrastructure which is important for economic development. Some of the infrastructure will be multipurpose e.g. water supply and sanitation or dams for flood, drought and environmental flow management. While developing these structures protection must be given to downstream riparian rights and ecosystem needs, social and cultural aspects and immediate environmental management. The objectives and strategies are presented below.

Table 5-2: Objectives and Strategies of Key Area 2

Objectives	Strategies
Objective 1: Developed irrigation systems should have considered water availability, social and environmental needs	Strategy 2-1: Develop irrigation infrastructure in a sustainable manner
Objective 2: Achieve sustainable Participatory Irrigation Management (PIM) in existing and developed irrigation schemes	Strategy 2-2: Promote and facilitate participatory irrigation management
Objective 3: Develop livestock watering infrastructure to provide sustainable water resources for livestock development	Strategy 2-3: Develop livestock watering infrastructure (dips, charco dams and dams)
Objective 4: Develop aquaculture systems to increase the fish production	Strategy 2-4: Encourage aquaculture to increase fish production
Objective 5: Utilisation of excess water for water storage	Strategy 2-5: Develop water resources schemes
Objective 6: Utilise the hydropower potential of the sub-basin	Strategy 2-6: Develop mini-hydropower schemes Strategy 2-7: Develop multipurpose international and multipurpose dams
Objective 7: All water development infrastructure to be capable of operating at design capacity	Strategy 2-8: Apply appropriate measures to increase efficiency of irrigation water use (mainly for improved schemes)
Objective 8: Sustainable asset management practices should be in place for all water-related infrastructure in the basin	Strategy 2-9: Prepare and implement asset management plans for all water development infrastructures in the Upper Ruvuma sub-basin

5.2.3 Key Area 3: Water for Environment

This area is mainly to meet the environmental demand of the RSCB. Environmental reserves, flow management and protection of the environment have all been recognised as important as socio-economic use of water. The environmental degradation in the sub-basin is minimal but pollution of

water resources, both surface and groundwater, from domestic wastes, artisanal mining, erosion and deforested catchments is starting to have an effect on the available water resources. The main impacts of this pollution are on the biodiversity of the aquatic habitats of the stream and also the terrestrial habitats and preventative action is required. The objectives and strategies are presented below.

Table 5-3: Objectives and Strategies of Key Area 3

Objectives	Strategies
Objective 1: Prepare watershed development plans, including appropriate agricultural best management practices, to reduce erosion and to increase the economic value of the land	Strategy 3-1: Develop watershed development plans for the degraded sub-basin
Objective 2: Protect forest resources from illegal logging and deforestation activities	Strategy 3-2: Develop and implement reforestation programmes
Objective 3: Provide sufficient water for wildlife in forest and game reserves	Strategy 3-3: Develop water resources plan for the forest and game reserves
Objective 4: Ensure adequate environmental flows are released for ecological maintenance	Strategy 3-4: Environmental flow requirement update and flow management
Objective 5: Reduced pollution load entering into the water resources	Strategy 3-5: Develop restoration plan for the polluted areas Strategy 3-6: Provide buffer zone for water resources and ecosystem protection Strategy 3-7: develop and implement solid waste management plans for cities and towns
Objective 6: Enhance the capacity of the sub-basin to adapt to climate change	Strategy 3-8: Develop Climate Change Adaptation Plan
Objective 7: Determination of the reserve and allocation of reserves in line with the requirement as per WRMA 2009	Strategy 3-9: Reserve for future needs
Objective 8: Develop landslide risk management plan	Strategy 3-10: Landslide risk management plan
Objective 9: Management of estuaries	Strategy 3-11: Protection of estuaries from the Ruvuma river in the south to the Somanga river estuary in the north
Objective 10: Arresting salt water intrusion of aquifers	Strategy 3-12: Conducting detailed salt water intrusion study along the coast and setting up monitoring procedure

5.2.4 Key Area 4: Community Participation

Participation of all stakeholders, especially the local community, is essential for effective water resources management. Since the communities do not have wider knowledge outside their immediate area it is important to create awareness of the importance of public participation for a wider benefit. Participation helps decision making in terms of development and implementation of strategies at local levels and sometimes provides resources during implementation. The plan sometimes needs a change of socio-economic activity and the involvement of communities from the planning stage is

essential to achieve this. Community participation is possible through various strategies such as creation of forums, awareness campaigns, classroom education and also by using communication channels such as radio, television, internet and messaging services. It does also cover inclusive participation with greater care to gender, vulnerable group and youths. The objectives and strategies are presented below.

Table 5-4: Objectives and Strategies of Key Area 4

Objectives	Strategies
Objective 1: Awareness programmes to the local communities, non-governmental organisations, civil society organisations, media on water resources management, mainly conservation, efficient use and protection of the resources	Strategy 4-1: Develop and implement an Information, Education and Awareness Strategy Strategy 4-2: Undertake awareness programmes for technical areas The technical areas identified are a) the dangers of inappropriate use of agricultural chemicals b) Advantages of saving water for the domestic consumers c) Protection of water resources points d) Safe use of mercury in the gold mining e) Land and water management for the artisanal miners f) Disadvantages of deforestation and advantages of forest conservation g) Watershed development h) Soil and water conservation i) Livestock water management j) Environmental management issues in the livestock sector k) Safe fishing techniques l) Safe disposal of wastes m) Coastal management n) Increasing water use efficiency for the irrigators
Objective 2: Create a forum or opportunity for the local communities to participate in the planning, implementation and monitoring of IWRMD Plan	Strategy 4-3: Develop appropriate institutional arrangement to allow the communities to participate in water resources management
Objective 3: Community participation should be inclusive of women and vulnerable groups	Strategy 4-4: Undertake awareness programmes for management areas and cross cutting issues Strategy 4-5: Undertake awareness programmes in the schools

5.2.5 Key Area 5: Institutional Capacity Building

There are several institutions in the water resources management organisational set up in Tanzania and they have been established with policies, strategies and laws. The Ruvuma and Southern Coast Basin Water Board (RSCBWB) has been established as part of this institutional arrangement and the next level of Catchment Water Committees (CWCs) are yet to be formed. The RSCBWB is currently fulfilling its roles in water and discharge permits and revenue collection from these permits. However there are areas where the RSCBWB needs support to manage the water resources of the basin efficiently and sustainably. One such area is the linkage between regional/district authorities and the RSCBWB.

The other area for RSCBWB institutional strengthening is in monitoring, data collection and analysis. The support is needed in hydrology and in the environmental and socio-economic areas as well. The objectives and strategies shown below will provide a robust information system that will give reliable and timely information for decision making.

Table 5-5: Objectives and Strategies of Key Area 5

Objectives	Strategies
Objective 1: An effective advisory and coordination mechanism for transboundary water resources management	Strategy 5-1: Continuation of Ruvuma Joint Water Commission (RJWC) tasks and enhancement of its action areas
Objective 2: Strengthen the BWB	Strategy 5-2: Strengthen the BWB by employing sufficient staff and providing office furniture and equipment
Objective 3: Capacity building programme for the BWB and CWC	Strategy 5-3: Conduct training programme for the BWB and CWC staff
Objective 4: An effective advisory, coordination and funding mechanism for water resources management at sub-basin level	Strategy 5-4: Establish Sub-basin Water Committee (CWC) for ten sub-basins and provide sufficient logistics Strategy 5-5: Establish Water User Groups (WUGs) and provide sufficient logistics Strategy 5-6: Operationalisation of National Water Investment Fund (Maji Trust Fund) in the Water Supply and Sanitation Act 2009
Objective 5: A holistic, accountable, transparent and integrated sub-basin water resources planning mechanism in place	Strategy 5-7: Implementation, monitoring, review and update of sub-basin plans
Objective 6: An optimal water resources monitoring network is established to cover both quantity and quality aspects	Strategy 5-8: Upgrade the water resources monitoring network
Objective 7: Comprehensive water resources database with sharing arrangement for all water related features and structures to support decision making on sustainable water resources management	Strategy 5-9: Develop database for water resources related sectors Strategy 5-10: Update the developed DSS Model and link with MIKEBASIN model

5.3 IWRMD Plan including implementation action plan

		Activities	Time period & Activity			Cost ('000 USD)			Responsibility	Remarks	Capital Expenditure ('000 USD)			Operational costs needed ('000 USD)		
			Short term (to 2020)	Medium term (2021-2030)	Long term (2031-2040)	Short term (to 2020)	Medium term (2021-2030)	Long term (2031-2040)			Short term (to 2020)	Medium term (2021-2030)	Long term (2031-2040)	Short term (to 2020)	Medium term (2021-2030)	Long term (2031-2040)
Key Area 1: Water for Domestic Purposes																
	Objective 1: Achieving water supply and sanitation to all the urban people of the sub-basin															
		Songea Water Supply	Feasibility & Implementation	Operation and Maintenance	Operation and Maintenance	2,700	500	500	Songea MC		2,700				50	50
		Masasi and Mangaka Water Supply from the Ruvuma river	Feasibility study	Implementation		800			Masasi and Nanyumbu DCs	Costs include only for feasibility studies	800					
		Mtwara-Ruvuma water supply	Implementation			1,700			MTUWASA		1,700					
		Mtwanya well fields	Feasibility study and implementation			800			MTUWASA		800					
		Lindi Water Supply	feasibility and implementation			200			LUWASA	Only for feasiblity study	200					
		Songea and Mbinga Urban Sewerage Master Plan	Plan Preparation	Implementation	Operation and Maintenance	2,100	1,600	500	Songea MC and Mbinga DC		2,100	1,600				50
		Sewerage facilities to Masasi, Tandahimba and Newala	Master plan and feasibility study			1,200			Respective DCs	Only for feasiblity study	1,200					
		Sewerage facilities to Mtwara and Mikindani	Master plan and feasibility study			1,200			MTUWASA	Only for feasiblity study	1,200					
		Sewerage facilities to Lindi MC	Master plan and feasibility study			800			LUWASA	Only for feasiblity study	800					
	Objective 2: Achieving water supply and sanitation to all thrural people of the sub-basin															
		Transboundary water supply to Mbinga	Feasibility	Operation and Maintenance	Operation and Maintenance	1,700	500	500	Mbinga DC		1,700				50	50
		Makonde Water Supply Scheme Rehabilitation	Implementation			1,700	500	500	MoW		1,700				50	50
		Improvements to Kilwa water supply	Feasibility study	Implementation		300			Kilwa DC	Costs include only for feasibility studies	300					
		Liwale town water supply	Feasibility study	Implementation		300			Liwale DC	Costs include only for feasibility studies	300					
		Rural Water Supply coverage	70%	90%	100%	19,595	21,260	18,578	All DCs		19,595	18,848	16,411			
		Sewerage facilities to Nachingwea town	Master plan and feasibility study			400			Nachingwea DC	Only for feasiblity study	400					
		Sewerage facilities to Ruangua town	Master plan and feasibility study			400			Ruangua DC	Only for feasiblity study	400					
		Sewerage facilities to Kilwa	Master plan and feasibility study			400			Kilwa DC	Only for feasiblity study	400					
		Sewerage facilities to Liwale town	Master plan and feasibility study			300			Liwale DC	Only for feasiblity study	300					
		Sewerage facilities to Tunduru town	Master plan and feasibility study			400			Tunduru DC	Only for feasiblity study	400					
		Rural sanitation investments	Pilot study	Training	Training	2,200	1,000	1,000	All DCs		2,200				100	100
	Objective 3: Surface and groundwater resources conservation and modelling to support water supply															
		Rainwter harvesting	Pilot study	Monitoring & Support	Monitoring & Support	1,250	1,000	1,000	All DCs		1,250			100	100	100
		Groundwater modelling and management plans	Plan & Implementation	Monitoring and Management	Monitoring and Management	203	50	50	BWB		203				50	50
	Objective 4: The water supply infrastructure is capable of operating at design capacity															
	Objective 5: sustainable asset management practices are in place for all the water supply infrastructure															
		Urban Water Supply Asset Management System (Songea, Masasi, Mtwara and Lindi MCs)	Asset Plan	Management	Management	650			Operators (UWASAs)		650					
		Rural Water Supply Asset Management	Asset Plan	Management	Management	500			Operators (WUGs and DCs)		500					
Sub-Total						**41,798**	**26,410**	**22,628**			**41,798**	**20,448**	**16,411**	**100**	**400**	**450**
TOTAL								**90,836**					**78,657**			**950**

Key Area 2: Water for Development																	
	Objective 1: Developed irrigation systems should have considered water availability, social and environmental needs																
		Irrigation Development	92 schemes (10,273 ha)	76 schemes (20,765 ha)	57 schemes (27,606 ha)				MoAFC and DCs								
		- Feasibility study				514	1,038	1,380			514	1,038	1,380				
		- Construction /Rehabilitation				71,397	144,317	191,862		More details in Annexure 1	71,397	144,317	191,862				
	Objective 2: Achieve sustainable Participatory Irrigation Management (PIM) in existing and developed irrigation schemes																
		Improved Agricultural Practices							MoAFC and DCs								
		- Development of best management practices and desseminating procedures	Development			50					50						
		- Volumetric measurements installation	116 schemes	77 schemes	60 schemes	1,775	2,090	2,775			1,775	2,070	2,755				
		- Maintenance and Monitoring	116 schemes	150 schemes	176 schemes	485	2,815	5,243						81	282	524	
	Objective 3: Develop livestock watering infrastructure to provide sustainable water resources for livestock development																
		Livestock watering infrastrcuture	110	177	352	1,650	2,655	5,280	MLFD and DCs		1,650	2,655	5,280				
		Pollution abatement training	60 (once every year for each sub-basin)	100 (once every year for eaxh sub-basin)	100 (once every year for each sub-basin)	1,200	2,000	2,000	MLFD, DCs and BWB					200	200	200	
	Objective 4: Develop aquaculture systems to increase the fish production																
		Aquaculture systems (fish ponds)	31	109	219	465	1,635	3,285	MLFD and DCs		465	1,635	3,285				
		Training on legal fishing systems and awareness creation among river and lake fishermen	60 (once every year for each sub-basin)	100 (once every year for eaxh sub-basin)	100 (once every year for each sub-basin)	1,200	2,000	2,000	MLFD, DCs and BWB					200	200	200	
	Objective 5: Utilisation of excess water for water storage																
		Number of planned small dams (18 schemes)	Feasibility study	Implementation		6,780			MoW		6,780						
	Objective 6: Utilise the hydropower potential of the sub-basin																
		Lupilo and Lumeme sites	pre-feasibility study	Implementation		400			MEM, TANESO, and private	only feasibility	400						
		Kwitanda HP	pre-feasibility study	Implementation		200			MEM, TANESO, and private	only feasibility	200						
		Multi purpose dams across Ruvuma river (HP1 to HP6)	pre-feasibility study	Implementation	Implementation	3,200			RJWC, MoW and SADC	only feasibility	3,200						
	Objective 7&8: Capable of operating and design capacity and sustainable asset management practices																
		Asset management plans				1,000			BWB and operators		1,000						
Sub-Total						**90,316**	**158,550**	**213,825**			**87,431**	**151,715**	**204,562**	**481**	**682**	**924**	
TOTAL								**462,690**					**443,708**			**2,087**	

Key Area 3: Water for Environment																	
Objective 1: Watershed development plans and best management practices																	
		Community based watershed development programme in the eastern and southern part of the basin	Planning and implementation			3,200			All DCs		3,200						
		Restoration of Chidya lake supply channel	Planning and implementation			800			MoW		800						
Objective 2: Forest resources protection																	
		Restoration and maintenance of the forest areas	Planning and implementation			7,200	720	720	MNRT and DCs		7,200				72	72	
Objective 3: Provide sufficient water for wildlife																	
		Wildlife watering points in forest areas and WMAs	Planning and implementation			870			Reserve Management, MNRT, DCs		870						
Objective 4: Ensure adequate environmental flows																	
		River health assessment and restoration of riparian rights	Planning and implementation	repeating once every five years	repeating once every five years	400	800	800	Ministry of Water /					80	80	80	
Objective 5: Reduced pollution load into the water resources																	
		Pollution control at mining sites in UR sub-basin (mainly Lumeme river)	Planning and implementation			200			MEM, NEMC & BWB		200						
		Pollution control at Mironji and Likonde rivers	Planning and implementation			200			MEM, NEMC and BWB		200						
		Pollution control at Lukwika and Muhuwesi rivers	Planning and implementation			200			MEM, NEMC and BWB		200						
		Pollution control at Lukwika and Muhuwesi rivers	Planning and implementation			200			MEM, NEMC and BWB		200						
		Pollution control at Mbangala and Miesi catchments	Planning and implementation			200			MEM, NEMC and BWB		200						
		Pollution control at Mambi catchments	Planning and implementation			100			MEM, NEMC and BWB		100						
		Pollution control at Lukuledi catchment	Planning and implementation			200			MEM, NEMC and BWB		200						
		Pollution control at Mbwemkuru catchments	Planning and implementation			200			MEM, NEMC and BWB		200						
		Pollution control at Mavuji catchment	Planning and implementation			200			MEM, NEMC and BWB		200						
		Pollution control at Matandu catchments	Planning and implementation			200			MEM, NEMC and BWB		200						
		Solid waste management to Liwale town	Master plan and feasibility study			250			Liwale DC		250						
		Solid waste management to Kilwa town	Master plan and feasibility study			200			Kilwa DC		200						
		Solid waste management to Ruangua town	Master plan and feasibility study			200			Ruangua DC		200						
		Solid waste management to Lindi MC	Master plan and feasibility study			300			Lindi MC		300						
		Solid waste management to Nachingwea town	Master plan and feasibility study			200			Nachingwea DC		200						
		Solid waste management to Mtwara-Mikindani MC	Master plan and feasibility study			400			Mtwara-Mikindani MC		400						
		Solid waste management to Masasi, Tandahimba and Newala	Master plan and feasibility study			800			Respective DCs		800						
		Solid waste management to Tunduru town	Master plan and feasibility study			250			Tunduru DC		250						
		Solid waste management to Songea MC and Mbinga town	Master plan and feasibility study			700			Songea MC and Mbinga DC		700						

		Water resources protection	Planning and implementation	Implementation	Implementation	1,000	1,000	1,000	BWB and respective water supply authorities		1,000	1,000	1,000			
	Objective 6: Ehance the capacity of the sub-basin to adapt to climate change															
		Development of disaster management plans and response systems	Planning and implementation			1,300			DMD of PMO and BWB		1,300					
		Climate change adaptation plan	Planning and implementation			100			BWB		100					
	Objective 7: Determination of the reserve and allocation of reserves for future															
		Development of criteria and plan	BWB and MoW could plan						BWB and MoW	No cost required						
	Objective 8: Development of landslide risk management plan															
		Planning and implementation of the landslide risk management plan	Planning and implementation			200			DCs		200					
	Objective 9:Management of Estuaries to improve															
		MBREMP Area protection plan and training	Planning and implementation			450			MBREMP		450					
		Lindi DC Estuaries Area protection plan and training	Planning and implementation			150			Lindi DC		150					
		RUMAKI Area (Mbwemkuru estuary to Rufiji estuary protection plan and training	Planning and implementation			750			RUMAKI and Kilwa DC		750					
	Objective 10: Arresting salt water intrusion of aquifers															
		Monitoring of the wells along the coast and conduct specific study on salt water intrusion	Planning and implementation			200			BWB		200					
Sub-Total						**21,820**	**2,520**	**2,520**			**21,420**	**1,000**	**1,000**	**80**	**152**	**152**
TOTAL								**26,860**					**23,420**			**384**
Key Area 4: Community Awareness Creation and Participation																
	Objective 1: Awareness programmes to the communities, NGOs and CSOs															
		WUA establishment and Strengthening	10 WUAs per year per sub-basin	11 WUAs per year per sub-basin	12 WUAs per year per sub-basin	25,531	42,551	42,551	CWC		25,531	42,551	42,551			
		Awarenss for water users on WRMA No.11 of 2009 and EMA 2004	6 trainings x 2 days x 20 participants from 10 WUAs per year per sub-basin	6 trainings x 2 days x 20 participants from 10 WUAs per year per sub-basin	6 trainings x 2 days x 20 participants from 10 WUAs per year per sub-basin	1,389	2,314	2,314	BWB and MCDGC					231	231	231
		Ruvuma river awareness kit	Development	Maintenance and update	Maintenance and update	110	10	10	RJWC & BWB		110			10	10	10
		RSCB awareness kit	Development	Maintenance and update	Maintenance and update	110	10	10	BWB		110			10	10	10
		Information and Dissemination Costs other above kits(leaflets, video documents, photos, press, etc..)	Printing and distribution	Printing and distribution	Printing and distribution	138	230	230	BWB					23	23	23
	Objective 2: Create forum for the local communities to participate in the planning															
		through legal means							MoW							
	Objective 3: Community participation should be inclusive of women and vulnerable groups															
		Development of inclusive participatory plan and implementation	Development and implementation			200			MCDGC and BWB		200					
Sub-Total						**27,477**	**45,115**	**45,115**			**25,951**	**42,551**	**42,551**	**274**	**274**	**274**
TOTAL								**117,708**					**111,053**			**823**

Key Area 5: Institutional Development																	
	Objective 1: Operationalisation of RJWC																
		Complete establishment of RJWC and operational costs	Establishment by 2016 and running	Running	Running	850	1,000	1,000	RJWC		450			100	100	100
	Objective 2: Strengthening of BWB																
		Salaries for Basin Employees	USD 923k per annum	USD 923k per annum	USD 923k per annum	3,355	5,592	5,592	BWB					559	559	559
		minor repairs and office rehabilitation works BWB and its offices	USD 50k per annum	USD 50k per annum	USD 50k per annum	182	303	303	BWB					30	30	30
		Operating costs for RSCBWB	USD 90k per annum	USD 90k per annum	USD 90k per annum	327	545	545	BWB					54	54	54
	Objective 3: capacity building programme jointly for the BWB and CWC staff																
		Awareness for BWB on good governance, performance and sensitisation on HIV/AIDS awareness	5 trainings twice a year for every year at basin level	5 trainings twice a year for every year at basin level	5 trainings twice a year for every year at basin level	322	537	537	BWB					54	54	54
		Technical training and workshops	6 trainings per annum at basin level	6 trainings per annum at basin level	6 trainings per annum at basin level	617	1,028	1,028	BWB					103	103	103
		To prosecute defaulters in the Basin	A lumpsum of USD 1000 per annum	A lumpsum of USD 1000 per annum	A lumpsum of USD 1000 per annum	4	6	6	BWB					1	1	1
		to conduct conflict resolution in the Basin	A lumpsum of USD 5000 per annum	A lumpsum of USD 5000 per annum	A lumpsum of USD 5000 per annum	40	67	67	BWB					5	5	5
	Objective 4: An effective advisory and coordination mechanism at sub-basin level																
		CWCs formation and running	Establishment and running	Running	Running	6,400	10,120	11,890	BWB		1,084			890	1,012	1,189
		Technical and Management Training	10 days training per annum for 5 staff for each sub-basin	11 days training per annum for 5 staff for each sub-basin	12 days training per annum for 5 staff for each sub-basin	3,000	5,000	5,000	BWB and CWC					500	500	500
		Intersectoral coordination meeting	Establishment and running	Running	Running	60	100	100	CWC					10	10	10
	Objective 5: IWRM Plan implementation monitoring, auditing and reviewing																
		Monitoring, auditing and reviewing (once in five years)	once in 2020	twice before 2030	twice before 2040	500	1,000	1,000	BWB	for each sub-basin separately				100	100	100
	Objective 6: water resources monitoring network																
		Automatic weather stations	new stations establishment,maintenance and data collection	maintenance and data collection	maintenance and data collection	364	423	423	BWB	maintenance and data collection by CWCs	138			42	42	42
		rainfall station	new stations establishment,maintenance and data collection	maintenance and data collection	maintenance and data collection	93	117	117	BWB	maintenance and data collection by CWCs	26			13	13	13
		Surface water resources monitoring	new stations establishment,maintenance and data collection	maintenance and data collection	maintenance and data collection	460	724	724	BWB	maintenance and data collection by CWCs	25			76	76	76
		Groundwater resources monitoring	new stations establishment,maintenance and data collection	maintenance and data collection	maintenance and data collection	638	31	31	BWB	maintenance and data collection by CWCs	620			3	3	3

		Water quality monitoring	new stations establishment,maintenance and data collection	Sample collection	Sample collection	135	225	225	BWB	BWB lab with the support from CWCs				23	23	23
		Lab establishment	Establishment cost			33			BWB		33			-		
		Other monitoring establishment cost	Establishment cost			413			BWB		413			-		
		Reporting on water resources monitoring	consultancy for first one year	then produced by RSCBWB staff	then produced by RSCBWB staff	220			BWB	Employing consultants	220			-		
		Database costs	Database establishment, data management and reporting			122					122			-		
	Objective 7: Comprehensive water resources database in plan															
		Sector level database establishment, management and reporting	Database establishment, data management and reporting	Data management and reporting	Data management and reporting	550	100	100	BWB and respective Ministries		550			10	10	10
		Updating of water permit system database and control	Software development and running	Running database	Running database	110	20	20	BWB		110			2	2	2
		Updating of wastewater discharge permit system database	Software development and running	Running database	Running database	110	20	20	BWB		110			2	2	2
		Updating the decision support system	Updating of the DSS developed in this Project			100			BWB		100					
Sub-Total						**19,004**	**26,957**	**28,727**			**4,001**	**-**	**-**	**2,578**	**2,699**	**2,876**
TOTAL								**74,687**					**4,001**			**8,152**
TOTAL						**200,415**	**259,552**	**312,815**			**180,601**	**215,714**	**264,524**	**3,513**	**4,207**	**4,676**
								772,782					**660,839**			**12,396**

5.4 Summary of costs

Sub-Basin		Upper Ruvuma	Likonde	Upper Middle Ruvuma	Lower Middle Ruvuma	Lower Ruvuma	Mambi	Lukuledi	Mbwem-kuru	Mavuji	Matandu	RSCB Total
Key Area -1: Water for domestic purposes	Short term (to 2020)	8,363	741	8,351	1,326	7,883	4,777	4,345	2,650	1,415	1,744	**41,798**
	Medium term (2021-2030)	4,394	1,290	1,711	2,429	7,898	915	3,322	2,612	615	1,174	**26,410**
	Long term (2031-2040)	3,704	1,387	1,711	2,629	5,314	813	3,005	2,367	573	1,075	**22,628**
	Total	**16,461**	**3,418**	**11,773**	**6,384**	**21,095**	**6,505**	**10,672**	**7,629**	**2,603**	**3,993**	**90,836**
Key Area -2: Water for development	Short term (to 2020)	9,444	6,915	6,226	4,433	14,427	10,459	25,905	5,900	2,685	3,872	**90,316**
	Medium term (2021-2030)	34,295	11,167	8,305	3,760	50,795	13,397	27,161	5,570	2,000	2,100	**158,550**
	Long term (2031-2040)	22,565	9,625	8,615	3,208	113,075	10,030	32,002	10,205	2,155	2,345	**213,825**
	Total	**66,304**	**27,707**	**23,146**	**11,401**	**178,297**	**33,886**	**85,068**	**21,675**	**6,840**	**8,317**	**462,690**
Key Area -3: Water for environment	Short term (to 2020)	2,345	1,245	1,395	1,490	3,800	1,490	2,125	2,515	1,690	1,725	**21,820**
	Medium term (2021-2030)	180	160	150	180	180	150	180	180	180	180	**2,520**
	Long term (2031-2040)	180	160	150	180	180	150	180	180	180	180	**2,520**
	Total	**2,705**	**1,565**	**1,695**	**1,850**	**4,160**	**1,790**	**2,485**	**2,875**	**2,050**	**2,085**	**26,860**
Key Area -4: Community participation	Short term (to 2020)	2,692	2,692	2,692	2,692	2,692	2,692	2,692	2,692	2,692	2,692	**27,477**
	Medium term (2021-2030)	4,487	4,487	4,487	4,487	4,487	4,487	4,487	4,487	4,487	4,487	**45,115**
	Long term (2031-2040)	4,487	4,487	4,487	4,487	4,487	4,487	4,487	4,487	4,487	4,487	**45,115**
	Total	**11,665**	**11,665**	**11,665**	**11,665**	**11,665**	**11,665**	**11,665**	**11,665**	**11,665**	**11,665**	**117,708**
Key Area -5: Institutional capacity building	Short term (to 2020)	1,191	1,036	1,125	1,129	1,277	1,152	1,259	1,188	1,106	1,188	**19,004**
	Medium term (2021-2030)	1,806	1,649	1,793	1,771	1,841	1,739	1,813	1,795	1,704	1,830	**26,957**
	Long term (2031-2040)	1,983	1,826	1,970	1,948	2,018	1,916	1,990	1,972	1,881	2,007	**28,727**
	Total	**4,980**	**4,510**	**4,888**	**4,848**	**5,136**	**4,807**	**5,061**	**4,955**	**4,690**	**5,024**	**74,687**
Total	**Short term (to 2020)**	**24,035**	**12,628**	**19,789**	**11,070**	**30,079**	**20,570**	**36,326**	**14,945**	**9,587**	**11,220**	**200,415**
	Medium term (2021-2030)	**45,162**	**18,752**	**16,446**	**12,627**	**65,201**	**20,688**	**36,962**	**14,644**	**8,985**	**9,770**	**259,552**
	Long term (2031-2040)	**32,919**	**17,484**	**16,933**	**12,451**	**125,074**	**17,396**	**41,663**	**19,211**	**9,275**	**10,093**	**312,815**
	Total	**102,115**	**48,865**	**53,167**	**36,148**	**220,353**	**58,653**	**114,951**	**48,799**	**27,847**	**31,084**	**772,782**

5.5 Highlights of the IWRMD Plan

(1) Water supply and sanitation projects
   a. Provision of basic water supply to all the urban and rural inhabitants: individual village level borehole schemes to meet 100% coverage from the current 41%, 49% and 60% for Lindi, Mtwara and Ruvuma regions respectively
   b. ECOSAN initiative pilot study and expansion
   c. Preparation and implementation of sewerage master plans for cities (Mtwara, Masasi, Songea and Lindi) and towns (Tandahimba, Newala, Mangaka, Tunduru, Mbinga, Nachingwea, Ruangua, Kilwa and Liwale)
   d. Comprehensive water supply schemes such as (a) Mtwara-Ruvuma, (b) Mtwara-Mangaka and Masasi, (c) Matandu-Kilwa and (d) Muhuwesi-Tunduru

(2) Environmental management
   a. Chidiya lake supply channel restoration
   b. Pollution control at mining sites
   c. Determination of the reserve and allocation of reserves for the future
   d. Implementation of climate change adaptation plan
   e. Watershed development plans and best management practices
   f. Forest and wildlife water management plan preparation and implementation
   g. Solid waste management plan preparation and implementation
   h. Landslide risk management especially on the Makonde and Ronde plateaus
   i. Estuary management, mainly Mnazi Bay Ruvuma Estuary Management Park (MBREMP) and Rufiji-Mafia Island-Kilwa landscape (RUMAKI)
   j. Environmental flow management. It may be delayed as it will be easy once the proposed reservoirs are constructed.

(3) Economic development projects
   a. Development of irrigation potential of 58,644 ha by 2025
   b. Livestock water supply: construction of 110 charco dams by 2020 including water demand due to livestock migration from Ihefu wetlands
   c. Fishing development activities
   d. Mini-hydropower schemes –mainly Lumeme, Lupilo, Nakatuta and Kwitanda projects
   e. New reservoir developments
   f. International multi-purpose hydropower schemes

(4) Community awareness
   a. RSCB awareness kit
   b. Ruvuma awareness kit
   c. Awareness programmes for WUGs

(5) Institutional Development
   a. CWC formation
   b. Filling up all the positions in BWB
   c. WUG formation and formalisation
   d. Establishment of water resources monitoring network
   e. Comprehensive water resources database development
   f. Awareness programmes

The costs required to implement this IWRMD Plan are USD 200m, USD 260m and USD 313m, at the current rate, for short term (to 2020), medium term (2021-2030) and long term (2031-2040).

5.6 Institutional arrangement for IWRMD Plan implementation

5.6.1 Water Resources Management

Table 5.6 provides a summary of the regional and national institutional framework for the management of water resources.

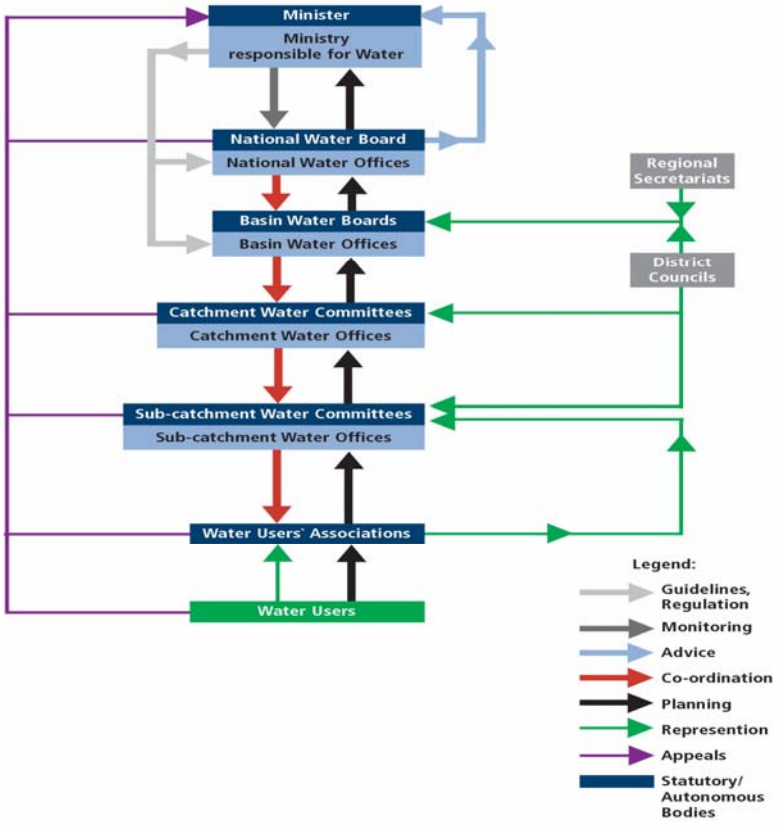
Table 5-6: Institutional Framework Summary

Institution	Regional	National
Sector Coordination	SADC Council of Ministries for Water	National Water Board
Ministry	The SADC Water Division, within the SADC Directorate of Infrastructure & Services	Ministry of Water
		Water Resources Division
		Trans-boundary Water Resources Management Section
River Basin Institutions	Ruvuma Joint Water Commission	Ruvuma River and Southern Coast Basin Water Board
Stakeholder Institutions		Basin Water Board
		Catchment and Sub-catchment committees
		Water User Associations
		Water User Groups

The MoW consists of four implementing divisions: Water Resources, Urban Water Supply and Sanitation, Rural Water Supply and Water Quality Services. The organisational structure of the Ministry is shown in Figure 5-1 below.

The Director of the Water Resources Division is responsible for advising the Government on all matters pertaining to water resources and for coordinating the activities of the BWBs and is therefore responsible for the development and implementation of IWRM plans.

Figure 5-1: Institutional Arrangements for Water Resources Management in Tanzania



The responsibility for the implementation of IWRM Plan is as follows

Table 5-7: IWRM Plan implementation responsibility summary

Sectors	Responsible Authorities*
Urban water supply	MTUWASA, LUWASA, MAWASA and SOUWASA
Rural water supply	DCs, NGOs
Irrigation	DCs and MoAFC
Livestock	MLFD and DCs
Fisheries	MLFD and DCs
Hydropower	MEM, TANESCO and RJWC
Mining	MEM, Zonal Mining Office, Private companies
Forestry and wildlife	MNRT, DCs, VFMCs
Environmental management	Division of Environment under VPO, DCs
Flood management	Disaster Management Department, Regional Commissioner's Office (RCO) and DCs
Drought management	MoAFC, RCO and DCs
Environmental flow management	MoW, BWB and water storage system operators
Solid waste management	MCs and DCs
Capacity building	MoW, BWB, CWC, MCDGC (for women involvement), Ministry of education and vocational training (for youth and children awareness programmes)
Economic development	NDC, MtDC and MNRT (tourism)

* - Village and ward level implementers and private parties involved are not included in this list.

The responsibilities of individual activities of the plan are presented in Section 8.3 above.

5.7 Funding Options for Key Areas

The primary source of funding for this IWRM Plan is from Government but the funding constraints experienced by the Government of the Republic of Tanzania are well known. This means that additional funding sources will need to be identified from the following possible sources:

(a) The MoW shall promote the introduction of the **Public-Private Partnership (PPP)** and the privatisation of the water supply projects and the irrigation projects (large-scale) in order to decrease the Government's direct capital investment

(b) The MoW shall make intensive efforts to get 'Financial Aids' or 'Loans' from **International Development Partners (IDPs)** such as the World Bank, African Development Bank, European Union, USAID, AusAID and other bilateral Government aid such as DFID. These plans should be shared among all IDPs in the donors' coordination platforms.

(c) The MoW shall create awareness among the public to obtain their contribution (**Users' Pay**) towards the use of water. Every user of water (water supply or irrigation) must pay the charge according to the volume they receive.

Funding options for each of the key areas are presented in Table 5-8 below.

Table 5-8: Capacity Building Framework for Implementation of this IWRMD Plan

Key Area 1	Funding opportunities
Urban Water supply and Sanitation	WSDP, EU funding to Mtwara and Lindi, GIZ
Rural Water Supply Sanitation	URT's Big Initiative, AfDB, WSSP, NGOs
Rainwater Harvesting	NGOs, GoT funding, Climate Change funds
ECOSAN Initiative	NGOs
Groundwater Modelling	Involve Universities with funding from other international universities
Asset Management Plans	UWASAs, DCs and BWB own funding
Key Area 2	
Irrigation	ASDP, Private funding
Livestock and Fishing	ASDP, URT's own funding, private participation
Water resources structures (dams) construction	WSDP and to be explored
Hydropower	SADC and Private partners
Key Area 3	
Watershed development plans	ASDP, Climate Change Funds
Forest programmes	REDD, Climate Change Funds, FIN
Ecosystem protection, Protection from pollution, estuary management, landslide risk management and climate change adaptation and mitigation	Climate Change Funds, National water investment fund (Maji trust fund)
Solid waste management	World Bank's TSCP (for Mtwara), additional funding to be sought
Key Area 4	
Community awareness programmes	BWB's own funds
Involvement of women	Funds of Ministry of Community Development, Gender and Children
Key Area 5	
Continuation of Ruvuma Joint Water Commission (RJWC) tasks and enhancement of its action areas	SADC
Establishment of sub-basin level Catchment Water Committee (CWC) for ten sub-basins and provide sufficient logistics	MoW and BWB funding
Establishment of Water User Associations (WUAs) and provide sufficient logistics	MoW, BWB funding and community
Implementation, monitoring, review and update of sub-basin plans	BWB's own funding
Upgrading the water resources monitoring network	WSDP
Development of database for water resources related sectors	Sector Ministries
Updating the DSS Model and link with MIKEBASIN model	MoW's own funding