Wami Basin

A Situation Analysis

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Report for the Wami/Ruvu Basin Water Office
Supported by IUCN

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1	2	3
4	5	6
7	8	9

Photo 1: Baobab tree in Sadaani National Park
Photo 2: Woman and child at pump in Chanzuru village
Photo 3: Treatment pond at Mtibwa Sugar
Photo 4: Salt mining in the Wami Estuary
Photo 5: Hippo in the Wami Estuary
Photo 6: Gauging station along the Wami River
Photo 7: Diwale River
Photo 8: Hombolo dam irrigation scheme
Photo 9: Mkondoa gauging station

Photo back cover: Hippos in the Wami Estuary

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Preface

The Wami/Ruvu Basin Water Office (WRBWO) with funding and technical support from the International Union for Conservation of Nature (IUCN), conducted field-work to produce situation analyses of natural resource management in the Wami, Ruvu and Coastal Rivers sub-basins in July 2008. Professor James Ngana from the University of Dar es Salaam was engaged as a consultant to carry out the field-work and draft the reports. Katharine Cross from IUCN and Florence Mahay from the WRBWO were recruited from within their respective organizations to take part in this work.

The Situation Analyses of the Wami and Ruvu (including coastal rivers) sub-basins were produced as separate analyses of the status, conditions and key issues affecting ecosystems in each basin using existing available information. The analyses provide information on natural resources (including water), socio-economic issues and the governance structure of water resource management. The purpose of each situation analysis is to provide an assessment that will be sufficiently adequate for priority themes or areas for actions to be developed in each basin according to the objectives of the National Water Sector Development Programme. This situation analysis will be used as background material for proposed project interventions.

Data and information were derived from literature review and interviews carried out with key stakeholders in the Wami and Ruvu basins. The interviews were semi-structured and aimed to determine activities as well as challenges and opportunities in hot spot areas of the sub-basin.

A first draft of the Situation Analysis for the Wami sub-basin was completed in late 2008 and distributed to stakeholders for review and comment. At a workshop hosted by the Wami/Ruvu Basin Water Office (WRBWO) and IUCN in Morogoro in December 2008, stakeholders gathered to comment on the Situation Analysis and suggest amendments. The workshop provided an opportunity to identify priority areas where the Basin Office should spend their time and resources, and identify mechanisms (activities) by which the priority areas for action can be implemented. A framework was also produced at the workshop to guide the staff of the WRBWO in producing a work-plan to implement priority areas of action.

Executive Summary

The Wami/Ruvu Basin Water Office (WRBWO) and Wami/Ruvu Basin Water Board (WRBWB) were established in July 2002. The vision of the WRBWO is to ensure basin water resources are sustainably managed for the socio-economic and environmental needs, interests and priorities of the basin population. The mission of the WRBWO includes facilitation of IWRM efficiently and effectively in order to address the resource needs, interests, and priorities of the Basin population while protecting and conserving the water resources (WRBWO 2008a). This situation analysis concentrates on the Wami sub-basin; a separate report contains information on the Ruvu sub-basin.

From its source in the Eastern Arc Mountain ranges of Tanzania, the Wami River flows in a south-eastwardly direction from dense forests, across fertile agricultural plains and through grassland savannahs along its course to the Indian Ocean. The Wami River Sub-Basin extends from the semi-arid Dodoma region to the humid inland swamps in the Morogoro region to Saadani Village in the coastal Bagamoyo district. It encompasses an area of approximately 43,000 km2 and spans an altitudinal gradient of approximately 2260 meters (WRBWO 2008a).

The population of both the Wami and Ruvu basins combined is approximately 5.4 million. This includes Dar es Salaam (3 million) and the smaller cities of Morogoro, Kibaha and Dodoma. About 80% of the basin population lives in urban areas and 20% in rural areas, thus the population is very urbanized compared to the rest of the country which is 20% urban and 80% rural. Outside of major urban areas, approximately 75% of total household income in the basin is earned from agriculture.

Nature resources in the Wami sub-basin

The catchment forests within the Morogoro Region form part of the Eastern Arc Mountains (including the Ukagurus and Ngurus in the Wami sub-basin) and protect and regulate water flow for the Rufiji (Kilombero and Ruaha), Ruvu and Wami Rivers, Tanzania's three major rivers. The Eastern Arc Mountains are renowned in Africa for high concentrations of endemic species of animals and plants. The flows in the Basin are used to generate power at the Kidatu and Kihansi hydropower stations. Large- and small-scale irrigation schemes also depend on these rivers. Forests in the catchment are important for water, soil and biodiversity conservation as well as maintaining a climate that ensures reliable rainfall and favours continuous agricultural production.

The Ukaguru range contains six catchment Forest Reserve with Eastern Arc forest habitat (Ikwamba, Mamboto, Mamboya, Mamiwa Kisara North, Mamiwa Kisara South and Uponera). The Nguru Mountains contains four catchment Forest Reserves supporting Eastern Arc forest (Kanga, Mkindu, Nguru South and Magotwe). The area has lowland, submontane and montane forest surrounded by extensive areas of woodland, subsistence agriculture, sugar and teak plantations and human settlements. Threats to the Ukaguru and Nguru Mountain forests include encroachment from farmers and the plantation forest, fuel-wood collection and fires spreading from lowland areas. There is a high level of destruction of the forests in the Nguru Mountains, which have more than 40 endemic species (Tanzania Forest Conservation Group 2003).

The river network in the Wami sub-basin drains mainly the arid tract of Dodoma, the central mountains of Rubeho and Nguu and the northern Nguru Mountains. The Wami sub-basin river network (WRBWO 2008a) comprises the main Wami River and its five major tributaries—Lukigura, Diwale, Tami, Mvumi/Kisangata and Mkata. Many of the rivers in the Wami sub-basin are intermittent and ephemeral during the dry season and experience high flows during periods of heavy rainfall. Seasonal flows like rainfall are not uniform across the sub-basin.

Wami sub-basin contains four wetlands systems including the palustrine, riverine, lacustrine and estuarine wetlands. The major wetlands threats are poor farming practices in the highlands and the resulting consequences of siltation.

The main groundwater well field that is used is in Makutopora and supplies Dodoma Municipality with water supply. Shallow ground water sources provides water to most districts in the Dodoma Region. Recent analysis of the well field water quality showed that most parameters monitored were within acceptable standards (WRBWO 2008b). Kongwa and Mpwapwa Districts rely primarily on ground water and less so on a few springs. In other areas such as Kongwa, stakeholders stated that many boreholes were abandoned after drilling due to the presence of saline water. Although the Districts in the Morogoro region have several rivers, remote villages use shallow wells. Similarly, in the Bagamoyo District, rural communities that cannot access rivers due to distance use ground water.

In the Wami sub-basin, the major source of water pollution has been pinpointed as the Mtibwa Sugar factory. For example, the Wami Water Supply, Sadaani National Park and Wami Mbiki Wildlife Management Area (WMA) have reported water contamination problems due to the effluent releases from treatment ponds when earth dams fail at Mtibwa Sugar Estate, which is upstream of Wami River. Another source of contamination is agricultural and charcoal making activities which pollutes spring sources in areas such as Mpwapwa and Kongwa.

An environmental flow assessment (EFA) was carried out in the Wami sub-basin with funding for the project provided by the US Agency for International Development (USAID) and the Coca-Cola Company, as a component of the Tanzania Water and Development Alliance (WADA). The information generated as part of the Wami EFA project is intended to provide decision-making support to the Wami/Ruvu Basin Water Office.

Several protected areas have been established in the Wami sub-basin to promote wildlife conservation. Nguru Forest Reserve of the Eastern Arc Mountains protects mountain torrent streams in the northern part of the sub-basin and the headwaters of the Mkata River are situated within the Mikumi National Park. The Wami-Mbiki WMA (Wildlife Management Area) and the Zaraninge Forest Reserve are two additional protected areas in the sub-basin. The Wami-Mbiki Society runs a conservation project that involves local communities focusing on the conservation and protection of natural resources. The newest addition to Tanzania's system of national parks is the Saadani National Park, which encompasses much of the Wami River estuary and covers both coastal forest and marine areas. Saadani National Park is the only coastal wildlife conservation area in Tanzania and provides a significant site for tourism and a good source of government revenue. Saadani National Park also contains part of the Wami Estuary where many people practice fishing.

The main challenge confronting the fishing industry in the sub-basin is the use of nets with illegally small mesh sizes. Consequently, the fish population in the Wami River is no longer adequate to support local communities in the basin, and communities are forced to find other sources of food. Stringent measures are required to curb this unsustainable practice.

Socioeconomics in the Wami sub-basin

In the basin, there are no significant industrial developments. The Mtibwa Sugar Company, located in Mtibwa village in the Mvomero District, is the only large-scale manufacturing industry in the basin. The Wami River provides the main source of water for its industrial uses (WRBWO 2007b, 2007d). Another large-scale industrial activity in the basin is salt-making, which is an important economic activity, especially in Bagamoyo District where more than 30 salt-works have been identified. The business has resulted in the clearing of coastal forests for fuel-wood used in salt production processes (WRBWO 2007b, 2007d).

There are a number of water projects in almost every district in the basin. The main water sources are rivers (with water delivery via pumps or gravity), 'charco dams', boreholes and shallow wells fitted with hand pumps. Many projects were constructed as long ago as the 1950s. The status of most water supply projects in rural areas is poor. Most villages have non-operational water systems and therefore rely on open traditional sources, such as hand-dug ponds or seasonal rivers. In addition to relying on seasonal and traditional water sources, villagers in some villages occasionally have to buy water from vendors because either the water sources are too far away or their low yield necessitates a long wait. Insufficient water supply in rural communities negatively impacts livelihood security such as low labour productivity arising from poor health of villagers who do not have access to safe water.

Water supply for Dodoma Urban is supplied by DUWASA from 11 out of 20 boreholes located at Makutupora basin.

A large water supply project (Wami Water Supply Scheme) has recently been completed downstream of the Wami River to provide water for Chalinze Township and surrounding villages. The Wami Water Supply Scheme entirely depends on the Wami River, but has reduced the burden of searching for water for longer distances and longer queuing periods in the Chalinze town and nearby villages. Other major infrastructures include intakes for Mtibwa sugar estates, Dakawa rice farms and the Makutupora well field, which supplies water to Dodoma town. Small dams in the upper dry part of the basin (Hombolo, Dabalo and Ikowa) have important infrastructure that impacts the basin's socio-economic activities

The two agricultural activities in the Wami sub-basin are rain-fed crops, largely grown in semi-arid areas in Dodoma, Mpwapwa and Kongwa and irrigation schemes that are found in wetter districts such as Kilosa and Movomero in Morogoro Region. In the Kilosa District, 30% of the farms employ irrigation using the perennial rivers. These include large-scale schemes such as Kimberu Sugar, and smaller village schemes that use traditional methods. Water usage is high and the quantity appears to be decreasing, as the acreage for irrigation is declining. However, there are strategies for conserving the catchment area with the district environment department.

The Wami sub-basin region continues to attract pastoralists because of abundant pasture and water. Dodoma, Mpwapwa , Kongwa , Kilosa and Mvomero Districts are major livestock centers in the sub-basin. Conflicts over access to water and land are relatively common, often occurring between farmers and pastoralists. For example, in irrigation scheme areas, there may be conflicts over cattle using the dam, or livestock walking over irrigation canals and down river-banks, resulting in severe degradation. Consequently, by-laws need to be passed and enacted by district councils to clarify land use.

Water Resource Management in the Wami sub-basin

The Water Utilization (Control and Regulation) Act No. 42 of 1974, with its subsequent amendments, previously governed water resources management in Tanzania. In 1989, by authority of this Act, the Minister for Water gazetted nine water basins for the purposes of water resources administration and management. The Basin Water Offices have been mandated with management of the water resources and implementation of the water law at the basin level.

The Water Resources Management Act, No. 11 of was passed in May 2009 and is operational as of July 2009. The Act provides for the institutional and legal framework for sustainable management and development of water resources and outlines principles of for water resources management. It also provides for the prevention and control of water pollution and for participation of stakeholders and the general public in implementing the National Water Policy (NAWAPO) of 2002. Since water resources management and water supply and sanitation are multidisciplinary and multi-sectoral activities, the individual health, environmental, local government reform, rural development, land, settlement and forestry policies provide strategic linkages to the NAWAPO, and supplement the aims and objectives of NAWAPO as envisaged under this programme.

The government adopted the National Water Sector Development Strategy (NWSDS) to implement NAWAPO. Emphasis is on IWRM, which is also reflected in the Water Sector Development Programme (WSDP) 2006-2025. The WSDP provides a strategic background for the implementation of plans and interventions for the achievement of national targets and calls for development partners to actively engage and support the water policy/strategy.

According to the NAWAPO, water resources management in Tanzania should be organized around participatory and representative forums, starting at the national level and spreading to the basin and sub-basin level. The policy identifies five levels of basin management—national, basin, catchment, district and community or water association level. The institutional framework for water resources aims to integrate sectors at different levels, and this is formalized in the new water law. Each basin office is required to implement the decisions made by the board and carry out operations. At the catchment level, the aim is to have a catchment council that will provide integrated planning and district councils will participate fully in basin boards and catchment councils. Districts are also responsible for planning and developing water resources. The community level and Water Users Associations (WUAs) are responsible for local-level management of allocated water resources (IUCN Eastern Africa Programme 2003).

The Wami /Ruvu Basin Water Office, was established in 2001, and reports to the Wami / Ruvu Basin Water Board, which consists of seven to ten members appointed by the Minister of Water. The board meets at least twice a year and last year they met three times. A sub-committee of the board meets more frequently to discuss water rights. The WRBWO is the executive office of the Board and is headed by the Basin Water Officer. For daily technical work the Basin Officer reports to the Director of Water Resources. WRBWO has its headquarters in Morogoro and two sub-offices in DSM and Dodoma.

Communication between the district and WRBWO has been *ad hoc* and often at a personal level. However, recently, staff members from some of the district and municipality offices

have received awareness and facilitation training from the basin office. The WUAs or Water User Groups (WUGs), which are the lowest level of management within the Tanzanian water management structure, aim to assist the WRBWO in managing water sources in the basin. Such associations are responsible for local level management of allocated water resources, mediation of disputes among users and between groups within their areas of jurisdiction, collection of data and information, participation in the preparation of water utilization plans, conservation and protecting water sources and catchment areas, efficient and effective water use and ensuring return flows, enforcement of the law and implementation of conditions of water rights, and control of pollution. In the future, WUAs will form sub-catchment committees and provide representatives on the Basin Board and Catchment Committees.

Opportunities and Constraints in the Wami sub-basin

The main problems and issues in the Wami sub-basin can be broadly categorized into water resources, socio-economics and conflict, policy and law enforcement, and management and administration.

The main issues around water resources have to do with encroachment of water sources, water scarcity and increasing demand, upsteam abstractions, groundwater pollution and abstraction, and pollution of all sources. Threats to the Ukaguru Mountain forest include encroachment from farmers and workers from the plantation forest, fuel-wood collection and fires spreading from lowland areas. Protection of water intake areas is crucial to maintaining water sources. However, encroachment activities such as cultivation along the river-banks cause degradation. Many communities have environmental committees, which help to raise awareness about the protection of water sources, although their power and ability to influence is varied.

The Wami sub-basin is among the basins with a high potential for irrigated agriculture and the government is investing in the area to improve existing irrigation schemes and possibly build new ones. Extraction of water by these schemes needs to be carefully monitored as there may be significant impact on water flows especially during the dry season. Upstream abstractions for irrigation schemes are of concern as they affect downstream water allocation. For example, at the Mtibwa Sugar Estate water levels are very low during the dry season and they cannot abstract their full water allocation. It is vital to maintain environmental flows going downstream that reflect the seasonality of flow in the river, in order to maintain a healthy environment that continues to provide natural resources to support people's livelihoods. Ground water overpumping and contamination in the Wami sub-basin is also of concern.

Downstream communities in the basin are often affected by upstream pollution, including sedimentation from erosion as a result of deforestation and agricultural practices and contaminated water. This reduces access to safe drinking water and water for livestock and agriculture, and investment must be made in other water resources such as ground water. Contamination can come from industry, agriculture, fishers that use poison to catch fish and domestic sewage.

In regards to socio-economics and conflict, there are usually conflicts between upstream and downstream users regarding water quality. For example, Mtibwa Sugar Estate has been identified as a source of pollution when their effluent ponds fail resulting in contamination of the river and impact on the Wami Mbiki WMA and Sadaani National Park. At the same time, poor agricultural practices result in increased siltation, and illegal fishing using harmful chemicals can have devastating impacts on the riverine ecosystem. There are also significant increasing conflicts between pastoralists and farmers over access to land and water, especially in the Kilosa district. Finally, there are conflicts over financial resources between village governments and water committees. Funds obtained from water fees are seen as a possible source of income for other activities in the community rather than investing in developing and maintaining the water supply infrastructure.

Under the area of policy and law enforcement, the main issues identified were around water permits and protection of sources, and water quality. The WRBWO reports low payment rates for water user fees, as it is often difficult to get users to register for water rights, especially if a community has been historically extracting water from the river without previously paying. Water usage without water rights impacts the operation of the Basin Office as they rely on the fees to manage the water resources. For example, protection of water resources is often inadequate, not because of the lack of laws and regulation, but due to limited enforcement from lack of capacity and financial resources within the WRBWO. This is compounded by a lack of awareness on the need to protect water sources within communities.

Issues around management and administration include weak stakeholder linkages, limitations on information gathering and coordination, and weak capacity to manage water resources. Firstly, the WRBWO is still becoming known and stakeholder involvement in the management of water resources in the sub-basin is weak. The basin would benefit from a stakeholder forum to discuss common issues impacting their activities as well as promote the sharing of information between institutions. Secondly, there is inadequate equipment to gather up-to-date information on the status of water resources, and transfer of information among departments at district, regional and national level is often limited. Finally, a challenge faced by many of the institutions in the Wami sub-basin is a lack of capacity. Many stakeholders generally lack awareness about water permits and the role of the Basin Office in issuing the permits.

On the basis of the key problems and issues the following priority areas of action were identified for the Wami sub-basin – strengthened stakeholder capacity and participation, reliable information to support planning and management, resources efficiently planned and managed, strengthened regulation and compliance, and ensuring sustainable financing.

Strengthened stakeholder capacity and participation can be achieved through identification of stakeholders, improving communication, building stakeholder capacity, improving stakeholder linkages and collaboration. The WRBWO needs to understand its stakeholders—from industrial to irrigation to domestic users—perhaps through stakeholder mapping or analysis. There also needs to be increased communication and awareness from the WRBWO on their activities, and how it contributes to water resource management. The majority of stakeholders stated that they want to see where funds are being spent and demonstration of tangible outputs. Communication with the Basin Office can improve through sharing data and information on sources, as well as monitoring of source capacity.

To build stakeholder capacity, there needs to be improved awareness and education on water rights so that water users are aware of when they need to get a water permit and what process needs to be followed. To reduce the information and capacity gap between the Basin and districts there needs to be further integration of district plans in the Basin plans and vice versa. This requires communication and knowledge sharing between WRBWO with Districts. This has been started through the establishment of District Facilitation Teams that are intended to put integrated water resource management into practice.

Improved communication and increasing stakeholder capacity is a step in achieving effective coordination and collaboration among stakeholders. Through stakeholder platforms such as catchment forums to mange water resources, districts can assist in the formation of WUAs. The same platform can contribute towards conflict resolution using District Councils that have mandates over natural resource use in their districts.

Under the priority area of ensuring reliable information to support planning and management, there must also be strengthening of database management as well as strengthening of monitoring of the quantity and quality of available resources. The data collected by the WRBWO and partners provide information on the available water resources in the Basin. Thus it needs to be stored and processed for use in decision-making. There needs to be investment in the Basin Office's capacity for not only data collection, but also data management. The WRBWO must also ensure adequate instrumentation for both surface and ground water resources in the basin. Abstraction rates and water quality must be measured regularly, for surface and ground water resources. Communities can be trained and encouraged to co-operate in collecting monitoring information. For example, there are often persons that are responsible for collecting data from monitoring stations which includes water levels and sometimes flow rates. This can improve ownership of the monitoring station and possible reduce the incidence of vandalism.

Resources can be efficiently planned and managed through effective planning, improving water used efficiently, water abstraction and pollution control, and catchment protection. IWRM planning is essential at all levels from the basin to sub-catchment to streams. The WRBWO needs to understand how multiple users will access, use and manage the resource. This could mean designing structures for different users, such as livestock keepers and farmers, promoting conservation farming and exchanging information on how to resolve conflicts. Improving water use efficiency can include a range of activities such as improving existing infrastructure by, for example, lining irrigation canals to reduce leakage. Other possibilities include creating awareness on efficient technologies and conservation strategies such as harvesting rainwater. To address water abstraction and pollution control, support for implementation of the new Water Resource Management Act, 2009 is crucial. The WRBWO needs to have the resources to monitor compliance on the quantity of abstractions approved to have a better idea of the available water resources in the basin. This is essential for determining future allocations. In regard to catchment protection, protection of the forests is vital for water management and can only be achieved through adequate monitoring and patrolling. This means a greater level of capacity in the Catchment Forest Project. In the case of ground water, improved protection of well fields can be achieved by demarcating and zoning the sub-catchment so that polluting activities are limited.

Strengthened regulation and compliance includes harmonizing laws and strengthening interagency cooperation and enforcement. There are cases of conflicting legislation, such as is the case of the distance allowed to build a structure from water source, so there is a need for harmonization and enforcement of all laws that improve catchment protection. WRBWO also needs to collaborate with other institutions to monitor effluent quality from industries in order to safeguard downstream users

Under the final priority area of ensuring sustainable financing, it was recommended that the Basin office should undertake research on the current water tariff and its rationale. Furthermore, it may wish to consult with SADC and neighboring countries on how financial sustainability can be achieved.

Table of Contents

List of Tables

List of Figures

List of Photos

Abbreviations

ASDP	Agriculture Sector Development Programme
BBM	Benchmarking, Building Block Methodology
BOD	Biological Oxygen Demand
CBO	Community Based Organisation
COD	Chemical Oxygen Demand
CRC	Coastal Resources Center
DDCA	Drilling and Dams Construction Agency
DFT	District Facilitation Team
DGIS	Dutch Ministry of Foreign Affairs
DODEP	Dodoma Integrated Development Programme
DRIFT	Downstream Response to Imposed Flow Transformation
DUWASA.	Dodoma Urban Water Supply and Sewerage Authority
EAMCEF	Eastern Arc Mountains Conservation Endowment Fund
EFA	Environmental Flow Assessment
EIA	Environmental Impact Assessment
EMPAFORM	Empowering Forest Management
GDP	Gross Domestic Product
GWP	Global Water Partnership
IAEA	International Atomic Energy Agency
IPCC	Intergovernmental Panel on Climate Change
IUCN	International Union for Conservation of Nature
IWRM	Integrated Water Resources Management
JICA	Japanese International Co-operation Agency
LGRP	Local Government Reform Programme
LVIA	Lay Volunteers International Association(Italian)
MAMADO	Maji na Maendeleo Dodoma
MasI	Metres above sea level
MDG	Millennium Development Goals
MoWI	Ministry of Water and Irrigation Development
MoWLD	Ministry of Water and Livestock Development
NAFCO	National Food Corporation
NAWAPO	National Water Policy

NEMC	National Environment Management Council
NGO	Non Governmental Organisation
NPRS	National Poverty Reduction Strategy
NWSDS	National Water Sector Development Strategy
PADEP	The Participatory Agricultural Development and Empowerment Programme)
PEMA	Participatory Environmental Management Project
PRA	Participatory Rapid Appraisal
RDPS	Rural Development Policy and Strategy
SACCOS	Savings and Credit Co-operative Societies
SANAPA	Saadani National Park
SEKAB	Swedish Ethanol Chemistry AB
SNV	Schweizerische Normen-Vereinigung(Netherlands Development Organisation)
SWOT	Strength, Weakness, Opportunity, Threat
TANAPA	Tanzania National Parks Authority
TANESCO	Tanzania Electricity Supply Company
TCMP	Tanzania Coastal Management Partnership) and the
TFCG	The Tanzania Forest Conservation Group
TZS	Tanzania Shilling
UNESCO	United Nations Education and Scientific Organization
URT	United Republic of Tanzania
USAID	US Agency for International Development
USDA	United States Department of Agriculture
VSL	Village Saving and Loans
WADA	Tanzania Water and Development Alliance
WAMACHA	Wanachama wa Maji Chalinze
WANI	Water and Nature Initiative
WHO	World Health Organisation
WMA	Wildlife Management Area
WRBWB	Wami/Ruvu Basin Water Board
WRBWO	Wami/Ruvu Basin Water Office
WSDP	Water Sector Development Strategy
WUA	Water Users Associations
WUG	Water User Groups

1 Introduction

In 1989, the Minister for Water gazetted nine water basins for the purposes of water resources administration and management through the Water Utilization (*Control and Regulation*) Act No. 42 of 1974, as amended by Act No. 10 of 1981. Figure 1.1 shows a map of all 9 river basins in Tanzania. Figure 1.2 shows the Wami/Ruvu Basin with its sub catchments. This report concentrates on the Wami sub-basin.

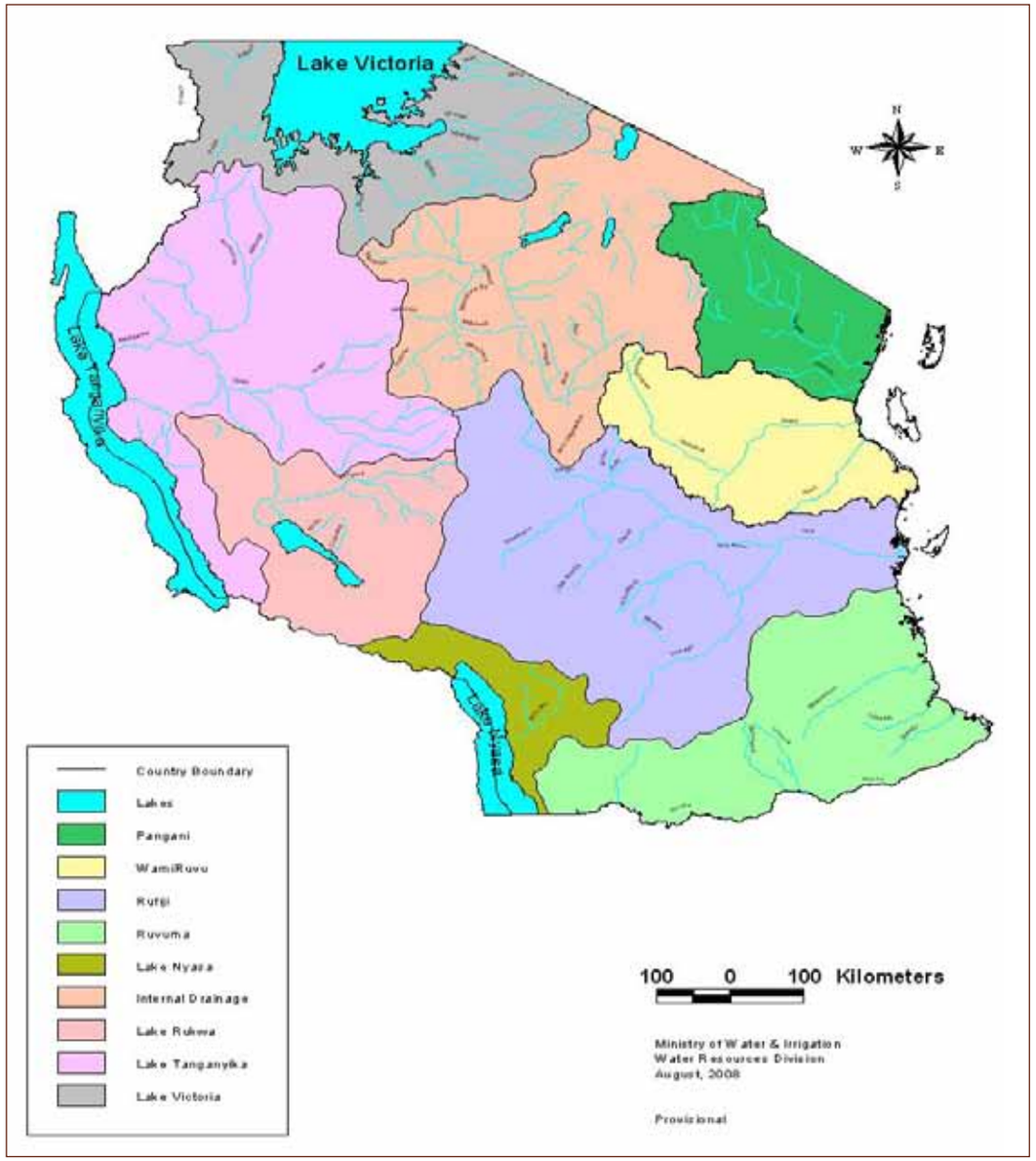


Figure 1.1. Map of Tanzanian River Basins

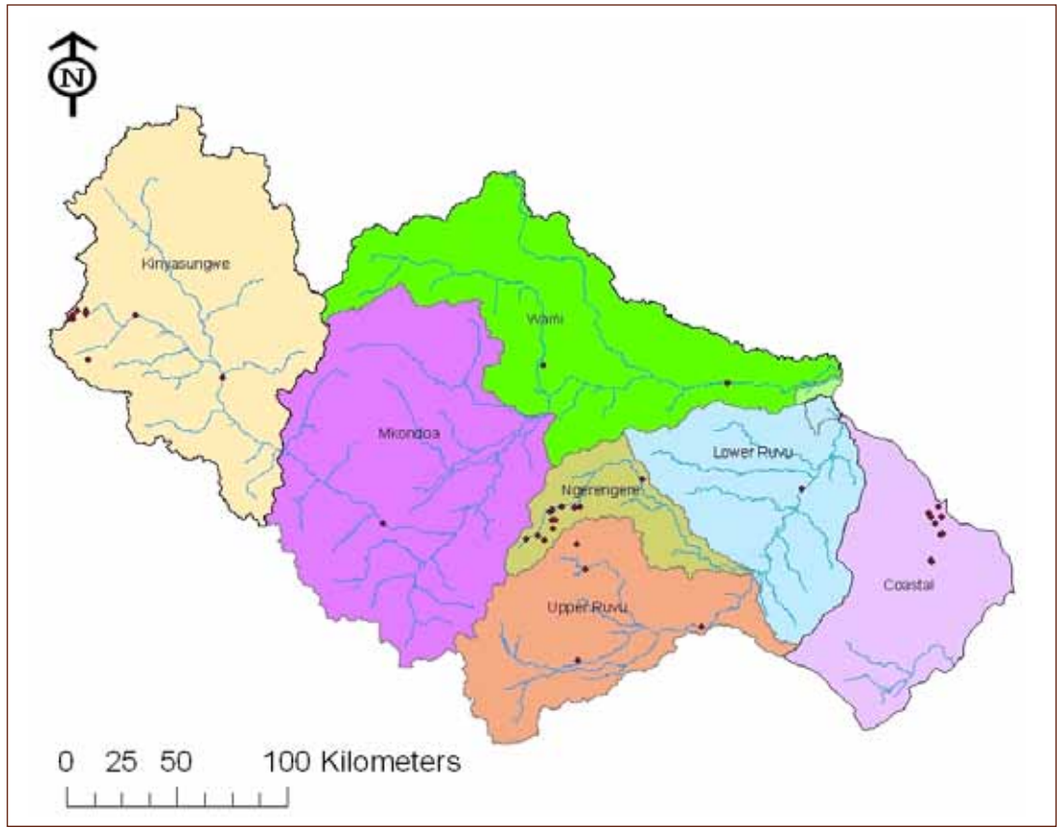


Figure 1.2. Map of Wami/Ruvu Basin with water quality stations

1.1 An overview of the Wami sub-basin

From its source in the Eastern Arc Mountain ranges of Tanzania, the Wami River flows in a south-eastwardly direction from dense forests, across fertile agricultural plains and through grassland savannahs along its course to the Indian Ocean. Located between 5°–7°S and 36°–39°E, the Wami River Sub-Basin extends from the semi-arid Dodoma region to the humid inland swamps in the Morogoro region to Saadani Village in the coastal Bagamoyo district. It encompasses an area of approximately 43,000 km^2 and spans an altitudinal gradient of approximately 2260 meters (WRBWO 2008a).

The Wami sub-basin (Figure 1.3) remains relatively intact from an ecological perspective, with fewer water withdrawals and infrastructural developments than its neighbor, the Ruvu River sub-basin (WRBWO 2008a). According to a 2002 census, the sub-basin is home to 1.8 million people in 12 districts: Kondoa, Dodoma-urban, Bahi, Chamwino, Kongwa, Mpwapwa, (Dodoma Region) Kiteto, Simanjiro (Manyara Region), Mvomero, Kilosa (Morogoro Region), Handeni, Kilindi, (Tanga Region) and Bagamoyo (Coast Region). It also comprises one of the world's most important hotspots of biological diversity: the Eastern Arc Mountains and coastal forests (Burgess et al. 2007; WRBWO 2008a).

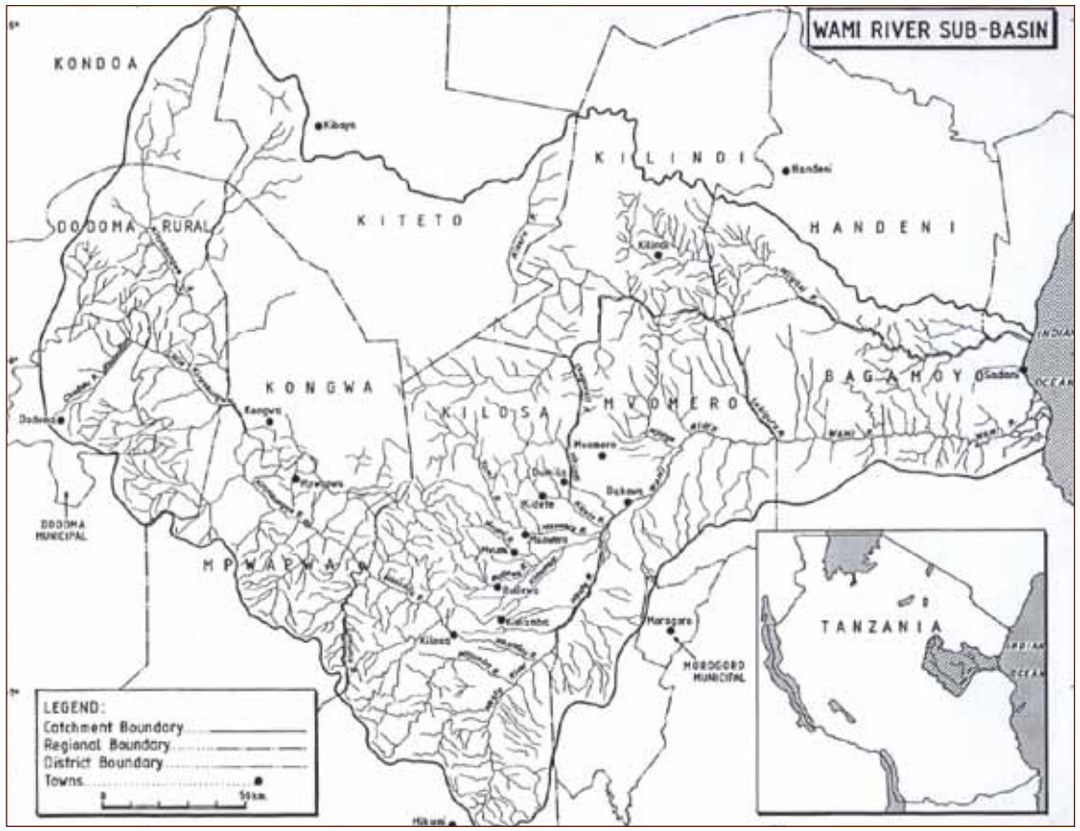


Figure 1.3. Wami Sub-basin (WRBWO 2007a)

1.1.1 Climate

Average annual rainfall across the Wami sub-basin is estimated to be 550–750 mm in the highlands near Dodoma, 900–1000 mm in the middle areas near Dakawa and 900–1000 mm at the river's estuary. Most areas of the Wami sub-basin experience marked differences in rainfall between wet and dry seasons. Although there is some inter-annual variation in timing of rainfall, dry periods typically occur from July to October and wet periods from November to December (*vuli* rains) and from March to June (*masika* rains) (WRBWO 2007b).

1.1.2 Geology

The basin's sediments are of diverse lithologies. The sediments are derived from cratonic granitoids of the Precambrian age in the west, high metamorphosed rocks of the orogenic belts in the central area of the basin and a Neogene deposit in the east. The basin has been affected by faults, causing terrace and cascade flows at the western boundary of the coastal plain. The rivers are flowing in the West-South trending fault zone that forms a gorge before entering the coastal plains.

The Wami River drains the cratonic shield rocks in the Dodoma area, Usagarani and Quaternary Sediments in Morogoro Region and the Jurassic, Cretaceous, Tertiary and Quaternary sediments in the coastal region. The cratonic rocks composed of granite, basic

and ultra-basic, are the oldest plutonic rocks in the region. . These rocks exist on isolated hills and mountains in the Dodoma area. The Usagara systems (orogenic belt) are the oldest metamorphic rocks composed of gneiss and dolomite marble. The Jurassic and Cretaceous sequence are thin beds of sandy limestone and calcareous limestone, which alternate with thicker beds of mudstone marls. The South West – East West trending plain consists of quaternary sediments, which are alluvial sediments deposited by rivers. Above 200 m the plains consist of mbuga soils and in the coast are beach ridges, salt-pans and the deltaic mangrove swamps. The Wami River forms a wide deltaic deposit of about 20 km that extends southernwoods from Saadani centered at Ras Utondwe (WRBWO 2007c).

1.2 Definition of Integrated Water Resources Management (IWRM)

Integrated Water Resource Management (IWRM) is an approach that promotes co-ordinated development and management of water, land and related resources in order to maximize the resultant economic and social welfare in an equitable manner without compromising the sustainability of the vital ecosystems (GWP 2000). IWRM integrates water use basin-wide for sustainable livelihoods. The environment that will enable IWRM to function is policy and legislation whereby an overview of governance and institutional structures are clearly stipulated to ensure stakeholders' participation.

Major challenges that have confronted the water sector in Tanzania have been increasing population and its related water needs, severe land degradation leading to river pollution. Unco-ordinated sectoral planning has lead to water use conflicts between upstream and downstream users. There is weak stakeholder participation in the governance of water resources in most of Tanzania's basins.

In order to address the above challenges the government of Tanzania decided to adopt the IWRM approach in managing water resources. Currently, basins across the country are developing such plans. The approach involves integration of various attributes as follows:

- Integration of freshwater management and the coastal zones management. Fresh water managers should consider the requirements of coastal zones when managing water resources.
- Integration of land and water management. Land use developments and vegetation cover influence the physical distribution and quality of water and must be considered in the overall planning and management of water resources. Good catchment and river basin management is important.
- Integration of surface water and ground water management. The widespread use of agro-chemicals and pollution from non-point sources pose significant threats to ground water quality and force managers to consider the linkage between surface and ground water.
- Integration of quantity and quality in water resources management. Water resources management entails the development of appropriate quantities of water with adequate quality
- Integration of upstream and downstream water related interests. Consumptive losses upstream will reduce river flows. The pollution loads discharged upstream will degrade river quality.
- Land use changes upstream may alter ground water recharge and river flow seasonality.
- Flood control upstream may threaten flood dependent livelihoods downstream.

1.3 Information on key partners funding the analysis (IUCN WANI, WRBWO)

1.3.1 IUCN Water and Nature Initiative

IUCN, the International Union for Conservation of Nature, helps the world find pragmatic solutions to its most pressing environment and development challenges. IUCN supports scientific research, manages field projects throughout the world, and brings governments, non-government organizations (NGOs), United Nations agencies, companies and local communities together to develop and implement policy, laws and best practice.

IUCN is the world's oldest and largest global environmental network. It is a democratic membership union with more than 1000 government and non-government member organizations, and some 10,000 volunteer scientists in more than 160 countries. IUCN's work is supported by 1100 professional staff in 62 offices and hundreds of partners in public, NGO and private sectors around the world. The headquarters are located in Gland, near Geneva, in Switzerland (IUCN 2008).

IUCN launched the Water and Nature Initiative (WANI) in 2001. WANI is an action-based programme that has worked with more than 80 partners in more than 30 countries to mainstream environmental and social issues into water resources planning and management. The initiative uses ecosystem management as a strategy for integrated management of land, water, biodiversity and communities. WANI helps to solve the dilemma between fulfilling development options and conserving aquatic resources by resolving water conflicts, reviving rivers and spurring local economic development.

WANI develops and demonstrates practical approaches to the implementation of IWRM. It supports and catalyses national water reforms and builds needed capacities in local communities. The first phase of WANI operated in 12 river basins and in over 30 countries worldwide from 2001 to 2008, with funding exceeding USD 40 million, with core funding provided by the Dutch Ministry of Foreign Affairs (DGIS). WANI demonstration projects showed how to improve the well-being of both people and ecosystems using sustainable river basin management. WANI projects are essentially partnerships among local communities, IUCN members, civil society and governments.

WANI helps to catalyse change by integrating development priorities, ecosystem services, good water governance, stakeholder participation, sustainable financing, learning and leadership.

The first phase of WANI has worked extensively in the Pangani River Basin and the current situation analysis in the Wami/Ruvu Basin intends to build on the knowledge that has been developed in the Pangani region. A situation analysis was conducted at the beginning of work in the Pangani and laid a foundation for subsequent projects.

1.3.2 WRBWO

The Wami/Ruvu Basin Water Office (WRBWO) and Wami/Ruvu Basin Water Board (WRBWB) were established in July 2002. According to their 2008 Business Plan, the WRBWO's vision is to ensure that basin water resources are sustainably managed for the socio-economic and environmental needs, interests and priorities of the basin population. The mission, among other things, is to facilitate integrated water resources management (IWRM) efficiently

and effectively in order to address the resource needs, interests and priorities of the basin population while protecting and conserving the water resources.

The WRBWO has a strong commitment to:

- equitable and fair allocation of water that is socially desirable, economically
- viable and environmentally sustainable
- transparent and accountable service provision to all people in the Wami/Ruvu Basin
- promotion of integrated water resources management (IWRM) in the basin
- efficient and effective delivery of quality services to basin stakeholders
- responsiveness to the basin stakeholders' needs and queries.

1.4 Objectives and outputs

The purpose of the situation analysis is to provide an assessment that will be sufficiently adequate for priority themes or areas for actions to be developed in the Wami sub-basin. The situation analysis provides a baseline of information that highlights the main challenges and opportunities in the Wami sub-basin, and will be used as background material for proposed project interventions.

A situation analysis of the Ruvu sub-basin and Coastal Rivers is being produced in parallel with this situation analysis for the Wami sub-basin. Both documents are analyses of the status, conditions, and key issues affecting ecosystems in each basin using existing available information. These analyses provide information on the area's socio-economic, natural resources (including water) and environmental issues.

1.5 Summary of data and information sources

Data and information were derived from literature review and interviews carried out with key stakeholders in the Wami sub-basin (see Annex 1). The interviews were semi-structured and aimed to determine activities as well as challenges and opportunities in hot spot areas of the sub-basin (See Annex 2)

1.6 Structure of report

Following the introduction, the situation analysis provides an overview of the resources in the basin that provides some information on the current status of these resources and some of the threats to conservation. Natural resources that are discussed include forests, water and wetland resources, ground water, environmental flows, water quality, protected areas, biodiversity, fisheries and soils. The third chapter examines the socio-economic situation of the Wami area, identifying key stakeholders, their roles and responsibilities, interests and impact of activities on the basin. Industry, water infrastructure, agriculture and irrigation, pastoralists, rural and urban interests and non-governmental organization (NGO) interventions are examined. There is also a discussion on conflict issues. The fourth section focuses on natural resource management, including government management, legislation and policy at the institutional and organizational level, which focuses on the WRBWO and later on the district level. Financial issues, particularly viability of the institutional structure and future income generation, are considered. Also in this section, gender issues are addressed, policies on other natural resources are summarized, and data collection and monitoring are reviewed. The fifth section combines the previous information to examine the opportunities and constraints in the Wami Sub-basin and priority areas for action are identified. The final section provides conclusions and identifies any gaps in information.

2 Natural Resources in the Wami sub-basin

This section documents the existing natural resource base and the current and potential threats facing the sub-basin. Highlights are brought forward on what needs to be done in order to minimize future environmental degradation. It also examines various types of resources in the sub-basin: forests, wetlands, surface and ground water resources, water quality and flows. The existing protected areas and biodiversity are assessed in order to understand the ecosystem values within the sub-basin. Fisheries, soils and the impact of climate change are also evaluated for how they may impact on resources in the sub-basin now and in future scenarios.

2.1 Sub-Basin forests

The catchment forests within the Morogoro Region form part of the Eastern Arc Mountains and protect and regulate water flow for the Rufiji (Kilombero and Ruaha), Ruvu and Wami Rivers, Tanzania's three major rivers. The flows in the Basin are used to generate power at the Kidatu and Kihansi hydropower stations. Large- and small-scale irrigation schemes also depend on these rivers. Forests in the catchment are important for water, soil and biodiversity conservation as well as maintaining a climate that ensures reliable rainfall and favours continuous agricultural production. Adjacent forest communities depend on these forests to meet their daily wood and non-wood requirements (Catchment Forest Project Overview 2007).

The Eastern Arc Mountains, renowned in Africa for high concentrations of endemic species of animals and plants are one of the 34 globally important "hotspots" according to Conservation International (Burgess et al. 2007; Schösler and Riddington 2006).

Thirteen separate mountain blocks comprise the Eastern Arc (see Figure 2.1), supporting approximately 3300 km^2 of sub-montane, montane and upper montane forest, less than 30% of the estimated original forested area (Burgess et al. 2007).

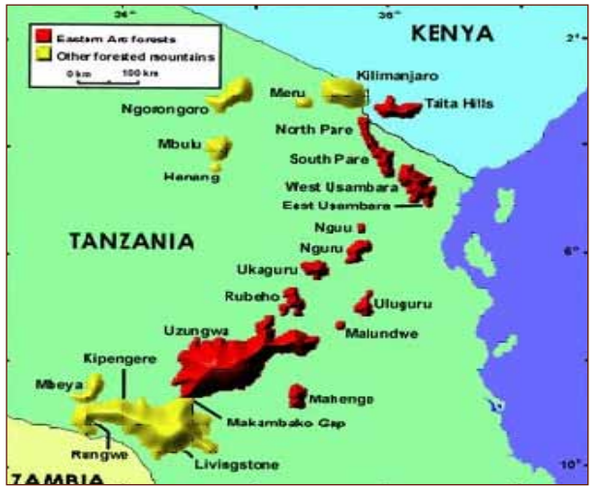


Figure 2.1. Map showing the extent of the Eastern Arc Mountain Range - (Source: EAMCEF, 2007)

2.1.1 Ukaguru Mountains

The Ukaguru mountain block, an elongate ridge extending up to 2250 m, is part of the Eastern Arc Mountain Range within the Kilosa District of the Morogoro Region. The human population surrounding the forest is at least 75,720 people and land outside the reserves is generally farmland (EAMCEF 2007).

The Ukaguru range contains six catchment Forest Reserve covering an area of 18,168 hectares containing Eastern Arc forest habitat (Ikwamba, Mamboto, Mamboya, Mamiwa Kisara North, Mamiwa Kisara South and Uponera).

A large softwood plantation in the mountains occupies an additional 3600 hectares. The main Ukaguru ridge is largely covered by forest with moist forests on the wetter eastern side. Heath lands occur on the summits with upper montane forest whilst montane forest and dry submontane forest occurs on the lower slopes. The drier south-west slopes of the whole ridge are covered by dry evergreen forests, bushes and wooded grasslands. The forest edges are bordered by grassland and maintained by fire (EAMCEF 2007).

2.1.2 Nguru Mountains

The Nguru Mountains, comprising the main Nguru block and a large isolated outlier at Kanga are also part of the Eastern Arc Mountain block and are located in Morogoro Rural District in the Morogoro Region. These mountains range up to 2400 m in Nguru South. Villages from nine wards surround the reserves. The total population in the immediate vicinity of the Nguru Mountain is over 61,250 people (EAMCEF 2007).

The Nguru Mountains contains four catchment Forest Reserves supporting Eastern Arc forest (Kanga, Mkindu, Nguru South and Magotwe), with a total area of 31,409 hectares. The area has lowland, submontane and montane forest surrounded by extensive areas of woodland, subsistence agriculture, sugar and teak plantations and human settlements. The mountains are part of the Wami River catchment basin, which provides water for Chalinze, the Mtibwa Sugar plantation and many villages (Doggart and Loserian 2007).

Lowland rain forest occurs between 300 and 900 m in valleys of the eastern slopes. Submontane forest covers a large area between 900 and 1400 m in the eastern valleys with fragments on the western slopes at 1400 to1500 m. Montane forest occurs between 1400 and 1800 m with moss covered upper montane forest at higher altitudes and drier montane forests on the western side above Maskati mission at 1600 to 2000 m. Heath occurs on the upper ridges above 2000 m, with some isolated stands as low as 1200 m where soil conditions do not permit forest growth (Eastern Arc Mountains Conservation Endowment Fund 2007). The mean annual temperatures vary between 12°– 24°C with rainfall records of between 1000–2100 mm, with considerably more rainfall estimated at higher altitudes. There is a drier period between June and August while rainfall peaks in March and April. (Doggart and Loserian 2007).

2.1.3 Conservation threats and status

Threats to the Ukaguru Mountain forest include encroachment from farmers and the plantation forest, fuel-wood collection and fires spreading from lowland areas. There is a high level of destruction of the forests in the Nguru Mountains, which have more than 40 endemic species (Tanzania Forest Conservation Group 2003). The threats to the Nguru forests are agricultural encroachment and under planting of forest with cardamom and banana, pit sawing of timber and fires ((EAMCEF 2007).

Other disturbances include timber harvesting; livestock grazing; pole cutting; firewood collection; hunting for duikers, bush pigs, primates, hyraxes and other mammals; wild bird and insect collection for trade; gold mining; and fire and charcoal production (Doggart and Loserian 2007). Doggart and Loserian (2007) state that the level of disturbance caused by cardamom cultivation, hunting and timber harvesting has reached critical levels and urgent action is needed.

The district committee that deals with environment, water and natural resources in Kongwa is supposed to issue permits and control the number of trees being cut down for charcoal production. However, the committee has only been able to meet twice this year and the amount of charcoal being made is not being controlled, but is being taxed per bag right now.

2.2 Water and wetlands resources

The Wami River is one of the major rivers draining the Eastern Arc Mountains. Located within 5–7°S and 36–39°E, its basin area extends from the upper catchments in the semi-arid Dodoma region through the humid inland swamps of the Morogoro region to discharge into the Indian Ocean at Saadani in Bagamoyo, Coast Region. The sub-basin (as it is commonly referred in country's hydrological divisions) covers an area of approximately 40,000 km^2 (WRBWO 2007b).

2.2.1 Hydrological zones

The river network in the Wami sub-basin drains mainly the arid tract of Dodoma, the central mountains of Rubeho and Nguu and the northern Nguru Mountains. The Wami sub-basin river network (WRBWO 2008a) comprises the main Wami River and its five major tributaries—Lukigura, Diwale, Tami, Mvumi/Kisangata and Mkata (Figure 2.2). The Mkata tributary is the largest and includes two major sub tributaries, the Miyombo and the large Mkondoa. The Mkondoa River includes the major Kinyasungwe tributary with the Great and Little Kinyasungwe draining the dry upper catchments in Do

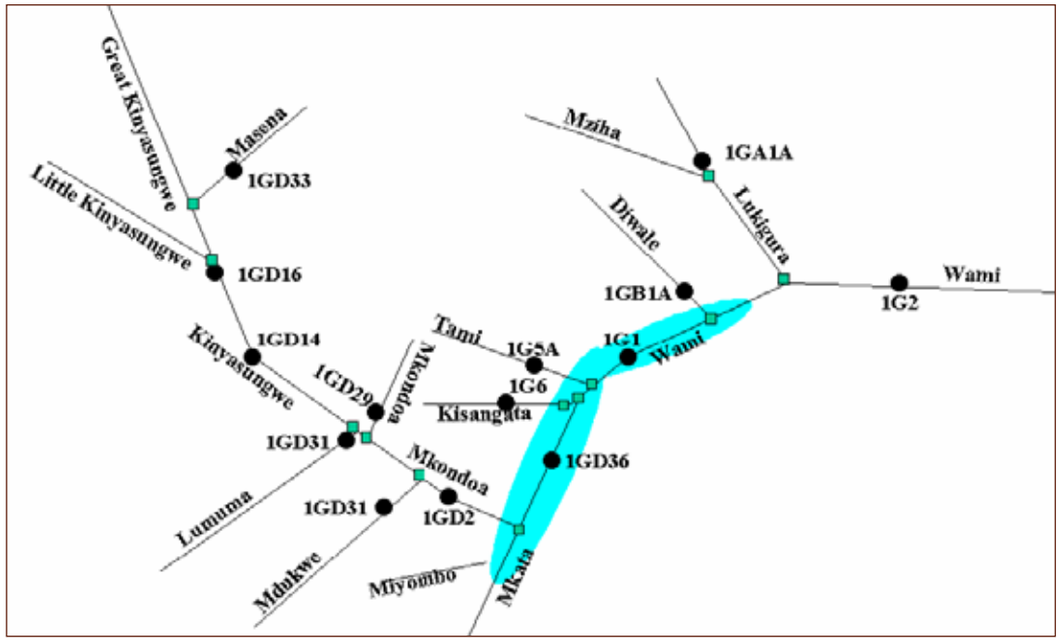


Figure 2.2 Schematic representation of the Wami river network (WRBWO 2007d)

The Wami River sub-basin can be divided into six hydrologic zones: Kinyasungwe, Mkondoa, Mkata, Diwale, Lukigura and Wami. Rivers in the Kinyasungwe zone, regardless of size, are predominantly seasonal and typically flow only between November and May. The Mkondoa zone contributes the highest volume of flows to the sub-basin and rivers in this hydrological zone are mostly perennial. The Mkata zone covers mostly inland plains and the Tendigo swamps. Rivers of the Diwale zone are mainly perennial and drain parts of the Turiani plains and wetlands; it is hypothesized that the Diwale River and its tributary, the Divue,

have continuous interactions with the Turiani wetlands and swamps in the zone. Rivers of the Lukiguara zone drain relatively small catchments and consequently are predominantly seasonal. The main Wami zone, which includes the Wami River and its tributaries the Tami and Kisangata Rivers are mostly perennial systems.

The Kinyasungwe River with its headwaters in the arid areas of Dodoma is the major river that drains the upper catchments of the sub-basin. It flows south-east to discharge into the Mkondoa River (Figure 2.2) with its headwaters in the southern Ukaguru Mountains. Similarly, the Mkondoa River flows south-east, joined by its major tributaries of Lumuma and Mdukwe, which drain the Rubeho Mountains, to discharge into the Mkata River (with its headwaters in the eastern Rubeho). The Mkata River flows northeast through the Tendingo swamps and is joined by the Tami River and Kisangata (which drain the eastern Ukaguru mountains) to form the Wami, about 16 km from Wami Dakawa. The main Wami continues flowing north-east and is joined by a Diwale tributary, which drains the Nguru Mountains through the Dakawa swamps, after which it flows eastwards towards the Indian Ocean.

The only tributary draining the Nguu Mountains, River Lukigura, joins the Wami River some 47 km downstream of the confluence with Diwale. Table 2.1 summarizes the major rivers in the Wami sub-basin and provides information on their source and catchment area.

Table 2.1 Major rivers of the Wami River Sub-Basin (WRBWO 2008b).

River Name	Source/Catchment	Flow
Kinyasungwe	Arid areas of Dodoma; upper parts of Wami sub- Basin	Seasonal
Mkondoa	Ukaguru mountains	Perennial
Lumuma	Rubeho mountains	
Mdukwe	Rubeho mountains	
Mkata	Eastern Rubeho mountains Tendigo swamps	Perennial
Tami	Eastern Ukaguru mountains	
Kisangata	Eastern Ukaguru mountains	
Diwale	Nguru Mountains; Dakawa Swamps	Perennial
Lukigura	Nguu mountains	Seasonal
Wami	Various	Perennial

Many rivers are intermittent and ephemeral during the dry season and experience high flows during periods of heavy rainfall. Seasonal flows like rainfall are not uniform across the sub-basin. Many large rivers in the sub-basin such as the Wami, Mkata and Mkondoa (and a few small rivers) are perennial while others like the Kinyasungwe and many small rivers are ephemeral. Long-term average monthly flows from select sites suggest that the Wami River sub-basin experiences a transition pattern of intra-annual flow variation between the bimodal (two peak periods) regime in the north and the unimodal (single peak period) regime in the south. All sites have a defined peak during the long rains and a second smaller peak in larger catchments during the short rains. The lowest flow periods of the year are typically in October for all sites whilst low or no flow periods extend longer for seasonal rivers like the Kinyasungwe and Lukigura (WRBWO 2008a).

The Mkindu River springs from the Nguru Mountains and crosses the road bridge at Morogoro-Dodoma at Dumila with sometimes devastating flooding. The river is sediment laden and poses danger to the bridge, which can collapse. The sediment it carries ultimately finds it way down to the Wami River adding to the sediment load form other rivers upstream. Ultimately this will reduce the river's carriage capacity of the incoming suspended sediment.

2.2.2 Wetlands

Wami sub-basin contains four wetlands systems including the palustrine, riverine, lacustrine and estuarine wetlands. Figure 2.3 shows wetlands within the Wami sub-basin.

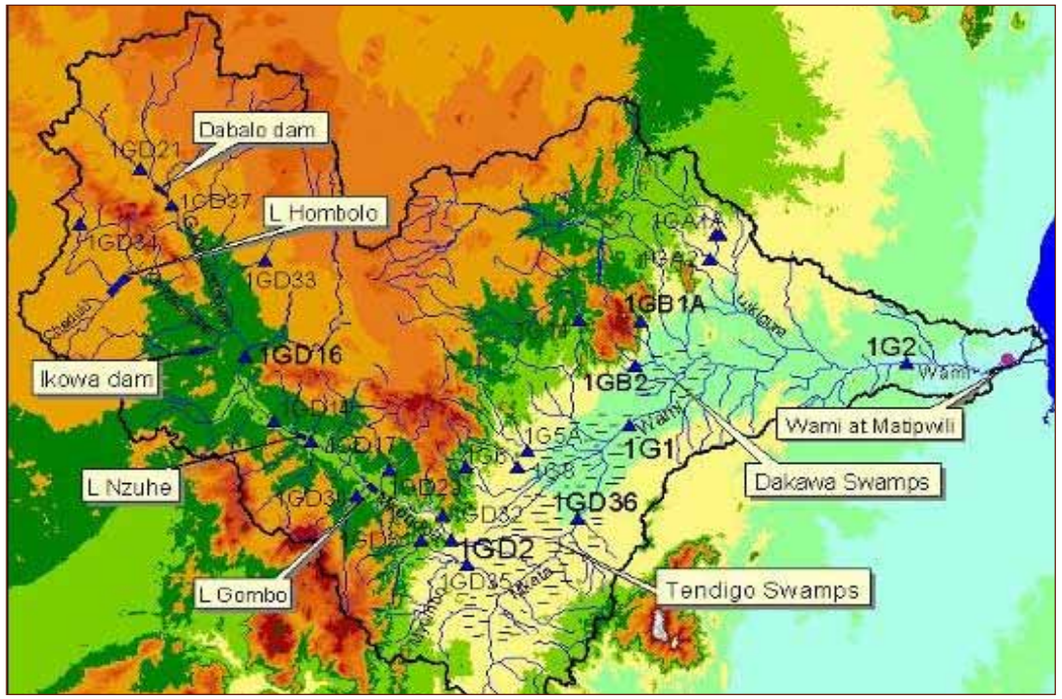


Figure 2.3. Wetlands systems of Wami Basin (WRBWO 2007d)

Palustrine wetlands include vegetated wetlands from marshes to springs to other forms including lagoons, ponds, pans, swamps and dambos. This wetland is a spongy-like land area that stores substantial amounts of water during wet seasons and releases it gradually during the dry season. Such wetlands include the Tendingo and Dakawa swamps, which are the major vegetated wetlands in the zone. These swamps are perennial and seasonally expand during the rainy season between November and May and shrink during the dry season to the smallest spatial extent in late October.

Riverine wetlands are the most common along large rivers, such as the Wami, Mkata and Mkondoa, as well as along some of the smaller rivers with floodplains found along the widest channel sections of the rivers and are of different width depending on the locations. Lacustrine wetlands, lakes found in depressions or dammed river channels, are natural or man-made lakes, and are perennial, mostly perennial, or seasonal. A few small natural lakes (Nzuhe and Gombo) as well as several man-made lakes (Hombolo, Ikowa and Dabalo) constitute the lacustrine wetlands of the sub-basin (WBWO 2008b). Most of these lakes are small and found mainly in the upper dry catchments.

Estuarine wetlands, which are found near the Indian Ocean coastline amidst mangroves, are characterized by mixed-origin volumes of water. This type of wetlands system in Wami sub-basin is found along the coastline of Bagamoyo at Saadani where the Wami River discharges into the Indian Ocean (WRBWO 2008a).

2.2.3 Conservation threats and status

The major wetlands threats are poor farming practices in the highlands and the resulting consequences of siltation. Increased livestock population in the area—particularly in Kilosa and Mvomero Districts—poses threats to wetlands in the two districts. The low level of irrigation efficiency leads to excessive water losses that drain away water resources through evapotranspiration.

Excessive usage of fertilizers and pesticides and unrestrained industrial waste destroys the habitats and biodiversity of wetlands. Poor land use planning leads to unplanned settlement in wetlands areas and destroys wetlands. Climate change is increasingly causing a change in the water balance, thereby changing the water resources. Increased droughts result in drying out of wetland areas, again leading to biodiversity loss.

In the Kongwa District there are several threats to springs such as livestock coming to the spring to drink water, farmers growing crops in the area and mining near the spring. Some measures have been taken to protect the spring. People living in the immediate vicinity have been removed, but this has not been fully successful as there is no (or inadequate) compensation. The district has attempted to convince people that the spring is for everyone and needs protection. The village government has created some by-laws stating that nobody can disturb the spring and its surroundings; this includes not cutting down trees and protecting it from cattle entering the spring. The consequence for breaking such laws is a fine in the form of money or in kind value of goats, hens, etc.

2.3 Ground water resources

Water abstractions in the sub-basin withdraw water from the ground water table or surface river network (including springs) (WRBWO 2008a).

2.3.1 Makutopora Aquifer

Makutopora basin lies in the Gregory Rift Valley system. The principal soil types are white sandy soil, red loam soil, and black clay soil (Shindo 1991). The white sandy soil is the most dominant one and covers an extensive area of pediplain uplands, mountains slopes and composed of granite rocks with high infiltration capacity and is considered to be the area of active ground waterground water recharge. The recharge area of the Makutopora well is field is the southwestern part of the basin in natural conditions (Shindo 1991)

The Makutopora well field is located 35 km outside of Dodoma. The catchment area is 34,000 hectares, and the area of the well field is 6000 hectares. The Dodoma Urban Water Supply Authority (DUWASA) holds the land lease for this area and it has been demarcated with beacons. The WRBWO will manage the remainder of the catchment, and will plant certain types of trees to protect the area. Currently, the Tanzanian Military help protect the well field in co-operation with DUWASA.

The boreholes extend 13 km to the east from the booster station, and 5 km to the west. Nine boreholes were drilled and used before December 2002. In 2002, the Chinese government drilled 9 new boreholes and rehabilitated 3 existing boreholes. There are also boreholes for the army and the Dodoma Integrated Development Programme (DODEP). The water quality is good and there is no salinity.

Photo 2.1 Makutopora well field

2.3.2 Ground water in the Districts

Apart from the Makutopora well field that supplies Dodoma Municipality with water supply, shallow ground water sources also provide water to most districts in the Dodoma Region. Kongwa and Mpwapwa Districts rely primarily on ground water and less so on a few springs. In Dodoma Municipality shallow wells also supply water to residents not served by DUWASA although the water is not of high quality.

Although the Districts in the Morogoro region have several rivers, remote villages use shallow wells. Similarly, in the Bagamoyo District, rural communities that cannot access rivers due to distance use ground water.

2.3.3 Conservation threats and status

One problem experienced in ground water exploration in the Dodoma Municipality is inadequate control of private shallow wells that, like those in Dar es Salaam, are highly polluted by pit latrines. Furthermore, protection of well fields is another key issue that should be examined in the Makutopora area. The WRBWO needs to plan ahead regarding the protection of future water sources e.g. Bubu and Hombolo depressions. Furthermore, climate change impacting semi-arid areas could result in increased drought frequency putting more pressure on available surface and ground water resources.

2.4 Water quality and pollution

2.4.1 Surface Water Quality

A water quality monitoring network analysis in the basin showed the following:

- All samples from rivers show that they are contaminated with faecal coliform bacteria ranging from 350 to 50,000 CFU/100 mL.
- Some of the rivers contain a high content of phosphate, with a range of 0.03 to 15

Photo 2.2 Treatment pond at Mtibwa

mg/L, which indicates nutrient pollution though nitrate content was found to be less than Tanzanian Standard of 10.0 mg/L.

- Samples that were analysed for organic pollution showed low dissolved oxygen content while biological oxygen demand (BOD) and chemical oxygen demand (COD) values were very high (WRBWO 2006).

The results of a study by Kemikimba (2006) to set up a water quality monitoring network in the basin showed that bacteriological contamination in rivers was a major problem. Physical chemical parameters were within the recommended values but the values were high on streams that were much stressed with human activities (Kemikimba 2006).
Water quality analyses results are shown in Table 2.2.

There are problems with contamination from upstream sources. For example, In Chanzuru village, drinking water is adequate but saline. Villagers in Ilonga are using water upstream for washing and bathing, so Chanzuru does not want to use the water for drinking. More seriously, the Wami Water Supply, Sadaani National Park and Wami Mbiki Wildlife Management Area (WMA) have reported water contamination problems due to the effluent releases from treatment ponds (Photo 2.2) when earth dams fail at Mtibwa Sugar Estate, which is upstream of Wami River. The main pollution problems are high BOD and pH (caustic soda is used for cleaning the evaporator). Wami Mbiki reports the contamination events to the WRBWO and provides them with samples of fish and water. The new Water Resources Management Act, No. 11 of 2009 aims to provide legislation that will give regulators sufficient authority to effectively penalize polluters.

Table 2.2 Water Samples Analytical Results (Kemikimba, 2006)

SAMPLING DATE	LAB No.	LOCATION	TURBIDITY NTU	COLOUR (mgPt/L)	pH	EC (ìs/cm)	TDS(mg/l)	Calcium (mg/L)	PHENOL-ALK mg/L	TOTAL-ALK(mg/L)	T-Hardness(mg/L)	Magnesium (mg/L)	Chloride (mg/L)	Fluoride (mg/L)	Iron (mg/L)	Manganese (mg/L)	Nitrate-N (mg/L)	Nitrite-N (mg/L)	Phosphate (mg/L)	Sulphate (mg/L)	Feacal coliform (CFU/100mL)
2/5/06	78/06	BH 117/75	3	16.0	7.3	2880	1420	84.0	NIL	360	300	21.9	134.3	0.46	0.009	NIL	NIL	0.009		95.0	NIL
2/5/06	79/06	BH C3/00	NIL	NIL	8.3	2550	1270	76.0	NIL	44.0	320	31.0	78.0	1.37	1.37	1.0	NIL	NIL		60	NIL
2/5/06	80/06	BH C8/02	NIL	35.0	7.5	2600	1280	40.0	NIL	200	220	29.2	329	0.47	0.5	1.0	NIL	0.005		55.0	NIL
2/5/06	81/06	BH C7/02	NIL	NIL	7.7	2930	1446	80.0	220	620	290	21.9	70.9	0.2	0.2	1.0	NIL	0.004		80.0	NIL
2/5/06	82/06	BH 147/75	4	5.0	7.6	2650	1370	68.0	NIL	460	300	31.6	56.0	0.47	0.13	0.5	1.2	0.038		60.0	NIL
2/5/06	83/06	BH C1/02	NIL	31.0	7.5	2550	1270	76.0	NIL	400	250	29.1	86.4	0.13	0.3	0.5	NIL	0.002		45.0	NIL
2/5/06	84/06	BH 119/75	8	14.0	7.4	2600	1290	84.0	NIL	340	280	21.9	70.9	0.39	0.09	1.0	2.0	0.127		90.0	NIL
2/5/06	85/06	BH/118/75	NIL	NIL	7.5	2830	1410	76.0	NIL	340	310	29.2	120.5	0.27	0.03	0.2	NIL	0.003		80.0	NIL
2/5/06	86/06	Tank 1+2	NIL	31.0	7.6	2670	1340	68.0	NIL	400	270	24.3	99.3	0.25	0.00	0.5	NIL	0.004		60.0	NIL
3/5/06	87/06	Hombolo	112	655.0	7.7	4460	2230	40.0	NIL	200	220	29.2	32.9	0.15	0.8	1.5	NIL	0.003		245.0	NIL
6/5/06	88/06	Mkondoa	98	503.0	7.8	730	366	28.0	NIL	120	140	17.0	21.3	NIL	1.03	3.5	NIL	0.001		40	
6/5/06	89/06	Mlali/ Mzumbe	78	431.0	8.1	1150	573	48.0	NIL	240	190	17.0	35.5	NIL	0.12	1.5	6.0	0.002		10.0	
13/5/06	90/06	Mambogo Intake	2	25.0	7.8	86.0	43.4	4.0	NIL	80.0	30.0	4.5	4.25	0.14	NIL	1.0	NIL	NIL		NIL	500
12/05/06	91/06	Duthumi	NIL	364.0	8			16.0	NIL	100.0	70.0	7.3	9.93	0.02	0.02	1.5	6.0	0.002		20.0	1400
24/5/06	92/06	Mzinga/ Luhungo	20	78	6.9	104	51.9	4.0	NIL	12	200.0	2.4	7.1	NIL	0.5	0.4	1.6	0.003		5.0	350

Water quality is also compromised by disposal of excess molasses from the sugar industry, cultivation, charcoal making, and mining activities upstream. For example, mercury is being used during mining. In addition, there is also the problem of illegal fishing using chemicals. This is blamed for many of the pollution issues, but it is difficult to pinpoint the exact source – whether the pollution problem is from industry of illegal fishing. However, the rapid change in the environmental condition in the basin has become a health threat to both people in the surrounding villages and wildlife (WRBWO 2007d).

2.4.2 Ground water Quality

Makutupora well field is crucial to the water supply for Dodoma. A study by the Japan-Tanzania Joint Research documented that there were initial problems with water quality of the well field due to human activities in the area. Measures to relocate residents of the basin were taken and the status of the water quality has improved (Shindo 1991). Recent analysis of the well field water quality showed that most parameters monitored were within acceptable stands (WRBWO 2008b). In other areas of the basin, such as Kongwa, stakeholders stated that many boreholes were abandoned after drilling due to the presence of saline water. In Mpwapwa, it was noted that water quality from boreholes is not uniform and can be slightly saline, thus people prefer water from spring sources. However, water from spring sources in areas such as Mpwapwa and Kongwa is usually from mountain areas and can be contaminated from agricultural and charcoal making activities.

2.4.3 Conservation threats and status

In the Wami sub-basin, the major source of water pollution has been pinpointed as the Mtibwa Sugar factory. Evidence of unprocessed molasses dumped into the river has been documented in some villages. Other sources of pollution include agricultural fertilizers and rapid unplanned urbanization. In some areas, there is evidence of chemical and herbal fishing which causes pollution to the river water (Madulu 2005).

Efforts should be directed towards convincing Mtibwa Sugar Estate to operationalize their waste water treatment ponds in order to avoid the frequent spills of untreated water into the river. Also patrols and enforcement around the Makutupora well field should be strengthened in order to avoid vacated residents returning to the area.

In addition there is support of the government and districts, to reduce pollution by using local by-laws. Consequently, there has been some improvement in water quality. In addition, efforts to reduce deforestation in the catchments forests have been reported to improve water quality.

2.5 Environmental flows

Environmental flow assessment (EFA) is a management tool that can assist the WRBWO to meet the challenges of balancing the diverse needs for water in a rapidly changing landscape. The National Water Policy of Tanzania, as revised in 2002, recognizes the flow needs of the environment as the second priority in allocation of water resources, following water requirements for basic human needs and domestic activities (NAWAPO 2002).

The estimated environmental flow requirements for the five sites are designed to give the Basin Water Office a better sense of how much water can be allocated for extraction while still maintaining a desired level of environmental protection for rivers and related ecosystems.

2.5.1 The Environmental Flow Assessment Process

An EFA was carried out in the Wami sub-basin with funding for the project provided by the US Agency for International Development (USAID) and the Coca-Cola Company, as a component of the Tanzania Water and Development Alliance (WADA).

The information generated as part of the Wami EFA project is intended to provide decision-making support to the Wami/Ruvu Basin Water Office.

The estimated environmental flow requirements for the five sites are designed to give the basin water office a better sense of how much water can be allocated for extraction while still maintaining a desired level of environmental protection for rivers and related ecosystems. While there is some uncertainty in these estimates for environmental flow requirements, these numbers are the most current quantitative values available and are based on the professional judgment of some of the most capable scientists in Tanzania for making these types of recommendations.

2.5.2 Recommended Initial Environmental Flows

Recommended environmental flows were estimated using the above approach at different sections in the Wami river sub-basin. The survey was done between October and the following September determining recommended flow levels for scenarios including the driest year, the same period in the average year and the wettest year. The assessments were undertaken at Kinyasugwe River at Kongwa, Mkondoa river at Kilosa, Wami River at Mtibwa, Wami River at Mandera, and Wami River at Matipwili. Table 2.3 shows an example of recommended environmental flows of Wami River at Mandera bridge.

Table 2.3 Recommended environmental flows for Wami River at Mandera (WRBWO 2008b)

	Wami at Mandera								
	Driest year			Maintenance year			Wettest year		
	Recom.	Available	Recom, Inst Peak	Recom.	Available	Recom, Inst Peak	Recom.	Available	Recom, Inst Peak
Oct	3.0	4.3					23.0	65.0	
Nov	3.0	5.9		13.3.	13.3		23.0	265.9	
Dec	7.7	15.9		14.0	26.0		59.8	503.9	
Jan	7.7	10.1		27.3	54.6		96.5	412.9	
Feb	7.7	12.3		24.6	49.2		133.3	325.1	
Mar	5.6	5.6		52.4	69.9		170.0	466.6	
Apr	21.7	102.1	48 (T = < 1 year)	65.0	192.9	53 (T = < 1 year)	170.0	1240.5	220 (T=1.5 years)
May	21.7	261.7		65.0	145.4		170.0	465.9	
Jun	15.5	42.6		37.5	49.9		91.4	182.8	
Jul	9.2	27.9		20.8	27.7		30.1	60.3	
Aug	3.0	15.4		14.0	21.1		23.0	51.3	
Sep	3.0	10.4		14.0	15.5		23.0	61.5	

2.6 Protected areas

Several protected areas have been established in the Wami sub-basin to promote wildlife conservation. These areas also serve to safeguard freshwater ecosystems in critical areas of the sub-basin. For example, the Nguru Forest Reserve of the Eastern Arc Mountains protects mountain torrent streams in the northern part of the sub-basin and the headwaters of the Mkata River are situated within the Mikumi National Park. The Wami-Mbiki WMA (Wildlife Management Area) and the Zaraninge Forest Reserve are two additional protected areas in the sub-basin. The newest addition to Tanzania's system of national parks is the Saadani National Park, which encompasses much of the Wami River estuary and covers both coastal forest and marine areas. While these parks and reserves are a positive step towards environmental conservation, other important areas of the Wami sub-basin are still in need of protected status, in particular wetland ecosystems and other Eastern Arc Mountain blocks (WRBWO 2008a).

2.6.1 Wami Mbiki WMA

The Wami-Mbiki Society runs a conservation project that involves local communities focusing on the conservation and protection of natural resources. The area, located in both Bagamoyo District in Coast Region and Morogoro Rural District in Morogoro Region, covers an area of 3000 km (core area) and approximately 1200 km of buffer area of 23 surrounding villages and their farmland. The area they work in cuts across the Wami and Mbiki rivers. The circumference of the area starts at Morogoro at Msamvu and continues all the way to Chalinze, then follows the north road to Mbwewe, then to Mziha, Turiani and Dakawa, and finally back to Msamvu (Figure 2.4). This area includes 24 villages that belong to two regions and three districts:

- Region: Pwane—District: Bagamoyo
- Region: Morogoro—District: Mvomero and Morogoro.

The conservation areas are based on the Wildlife Policy of 1999 and provides for villages to start their own participatory conservation areas. This means that development activities are restricted and land is used for conservation activities instead. The main objective of the society is for the villages to benefit from natural resources, and ensure sustainability for the future.

Since its establishment, the Wami-Mbiki WMA has faced several problems, including the sheer size of the WMA, which makes it difficult for patrols to cover the entire area and communicate with each other about poachers. There are high levels of poverty in the communities, as indicated by poor housing, food insecurity, high illiteracy rates, poor access to social service (including health and education) and reliance on traditional water sources. This has resulted in the population relying on and unsustainably exploiting natural resources for survival and led to deterioration of the basin ecosystem (Madulu 2005). New policies, laws and regulations are not well understood by the local communities thus enforcement and compliance is challenging. The cultural norms for some local people does not prevent water pollution; other strains on the water include cutting of trees for fuel-wood, charcoal burning and timber, illegal hunting and fishing with poisonous herbs (*utupa*) (WRBWO 2007d).

Saadani National Park is the only coastal wildlife conservation area in Tanzania and provides a significant site for tourism and a good source of government revenue. According to the Tanzania National Parks Authority (TANAPA), the number of visitors to the park is increasing rapidly, indicating an increase in government revenues in the near future. The reserve, located in the lower reaches of the Wami River, covers about 1062 km^2. Approximately 30 species of large mammals are present as well as reptiles, birds and marine species in the adjacent sea (Baldus et al 2001; WRBWO 2007c).

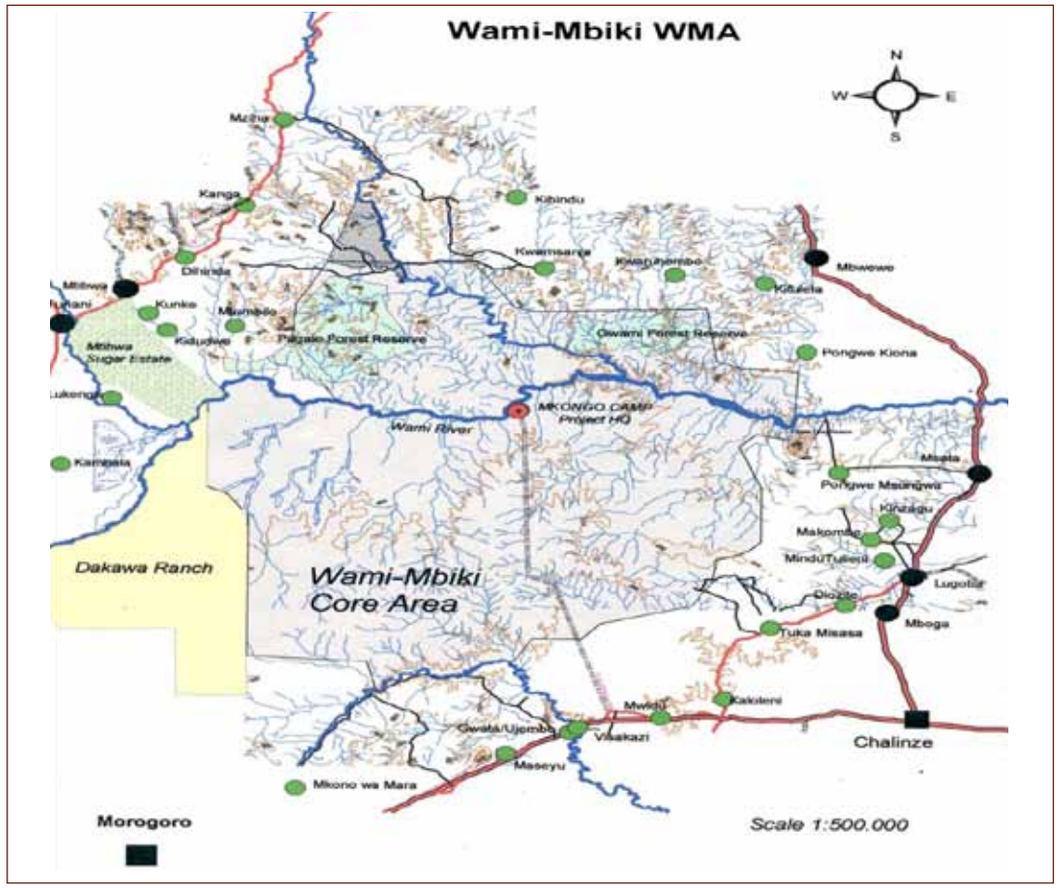


Figure 2.4 Location map of Wami-Mbiki areas (Madulu 2005)

2.6.2 Saadani National Park

The more than 40 marine species include 8 species of Carangidae, warm-water anchovies and other herring-like fish, jellyfish, cuttlefish, a variety of crabs, prawns and mantis shrimps. The terrestrial fauna is not entirely indigenous due to species being imported in 1968, 1969 and 1974 to stock the zoo (WRBWO 2007c).

The approximately 2000 km^2 of relatively intact continuous ecosystem around the Reserve includes Mkwaja North (280 km^2) as well as the Zaraninge Proposed Forest Reserve. The ecosystem falls into the three districts of Bagamoyo in the Pwani Region and Handeni and Pangani in the Tanga Region (WRBWO 2007c). The conservation of Zaraninge Forest is the focus of a WWF Lowland Coastal Forest Project. The forest has a large number of endemic species. Vines, epiphytes and parasitic plants are present next to the wide variety of forest trees, shrubs and herbs (WRBWO 2007c).

Land coconuts and cashew nut plantations line the Mkwaja–Pangani road to the north-east of the Reserve. Commercially grown sisal dominates the landscape to the north of the Saadani ecosystem. In the villages to the west a variety of fruit and vegetables are grown. Pineapples are one of the crops grown in the villages directly bordering Zaraninge Forest (WRBWO 2007c, 2007d).

The flora of the Saadani National Park covers a wide range of both forest and savanna species. The latter are dominated by *Acacia* spp., *Dichrostachys* spp. and other shrubs that provide good fodder for herbivores. Mangroves thrive in the saline soils along the coast; most of these fall into the families of the Rhizophoraceae, Avicenniaceae and Sonneratiaceae. Species present include *Avicenna marina, Rhizophora mucronata, Bruguiera gymnorrhiza* and *Ceriops tagal*. Some areas are so saline that only the so-called saltbush and salt tolerant *Sporobolus* spp. grass grow next to wide-open salt flats (WRBWO 2007c).

2.6.3 Conservation threats and status

Wami Mbiki WMA

Over the last decade, the Wami River forests, woodlands and wetlands have come under increasing pressure from, among other things, rapid population increase in the region, which has increased competition over resources among the poverty-stricken residents. This has led to unsustainable use of resources (WRBWO 2007d). As documented in the Wami Mbiki WMA, people have been forced to engage in environmentally unfriendly activities such as unsustainable and sometimes illegal timber harvesting and charcoal making, unsustainable wildlife hunting and over-fishing. The Wami Mbiki society is aiming to improve conservation by developing alternative sources for livelihoods such as tourism (safaris, photography and canoeing) and production of natural resource products (honey, fishing and hunting).

The basin environment has suffered environmental degradation including water pollution. For example, the Wami Mbiki WMA has been impacted by effluent from the Mtibwa Sugar Factory and the Dakawa Rice Project further upstream, which was originally identified as a source in declining water quality in the Wami River due to a large quantity of molasses discharged into the river that caused some fish to die in the middle watershed. Water abstraction by these industries is a source of declining water quantity. The Wami Mbiki Society has reported significant impacts on water quality. .

Due to population increase, the demand for agricultural land has grown, thereby applying pressure on protected areas such as the Wami Mbiki WMA. Conservationists are concerned over agricultural expansion. Small-scale farmers sometimes use non-sustainable and environmentally harmful techniques such as 'slash and burn', shifting cultivation to steep slopes. Large-scale farmers pollute the environment and water through disposal of industrial waste and use of chemical fertilizers, damaging the health of the local people (Madulu 2005; WRBWO 2007d).

Sadaani National Park

As Saadani National Park grows in popularity and more people visit the area, increasing demand for freshwater goods and services may place stress on the Wami River Estuary. For example, during the dry season there may be additional demand for freshwater from the river caused by an increase in the number of tourists visiting the park. More tourists could also mean more boat trips on the river and it is uncertain whether this increase driver usage would compromise habitat for hippos and other channel-dwelling species. These considerations are important for future tourist investment and lodge construction within the Saadani National Park and surrounding areas (WRBWO 2007c, 2007d).

In the 1990s there was a decline in the overall abundance of mangroves located along the coast between Saadani Village and the mouth of the Wami Estuary, as well as the areas located adjacent to the southern banks of the Wami River and Estuary. This trend was largely due to illegal cutting of mangroves by villagers and people from outside the region

for building materials, firewood and charcoal, as well as mangrove removal for salt making. According to a Participatory Rapid Appraisal (PRA) study conducted by the Tanzania Coastal Management Partnership (TCMP) and the Coastal Resources Center (CRC), the loss of coastal mangroves caused the beach near the mouth of the Wami River and nearby areas to recede considerably and become more susceptible to erosion (WRBWO 2007c, 2007d).

Furthermore, many of the artisanal shrimp fishermen have reported that that since the creation of Saadani National Park there has been a decline in the prevalence of mangrove cutting. Although the threat of mangrove cutting has decreased in recent years, it is essential for Saadani National Park staff to continue their enforcement efforts to ensure that the demand for charcoal in various areas of Tanzania does not result in the removal of mangroves within and around the Wami River Estuary (WRBWO 2007c, 2007d).

Figure 2.5 Eastern Arc Mountain and main rivers (WRBWO 2008b)

2.7 Biodiversity and conservation

2.7.1 Biodiversity in the Eastern Arc Mountains

The endemic fauna and flora in the Wami Basin are mainly concentrated in the Eastern Arc Mountains within the Wami sub-basin: Ukaguru, Nguru, Nguu and Rubeho (Figure 2.5). It is reported that there are 15 Eastern Arc endemic species in these mountains see table 2.4 below.

Table 2.4 Summary of the species richness and endemism in the South Nguru Landscape (Doggart and Loserian 2007)

Taxon	Total number of species	Number of South Nguru endemics	Number of Eastern Arc Endemics	Number of Eastern Arc Near Endemics
Plants	322	5	50	11
Animals				
Mammals	34	0	2	6
Birds	214	0	3	12
Reptiles	43	1	9	5
Amphibians	38	8	9	4
TOTAL	**651**	**14**	**73**	**38**

2.7.2 Wami River Estuary

The Wami River estuary stretches within Saadani village as the river approaches the Indian Ocean. The aquatic habitat of the estuary is influenced by spatial and temporal variability of freshwater and saltwater inflows. Saltwater intrusion is reported to move upstream 5 km from the coast and this serves the mangrove forest ecosystem. Prawn fishing is a key livelihood in Saadani village.

Emerging threats to the estuary include human population growth of nearby human settlements, increasing importance of Saadani National Park, mangrove cutting, fisheries and land use change and increasing water withdrawals in upstream areas. (WRBWO 2007c, 2007d).

2.7.3 Conservation threats and status

In the Eastern Arc Mountains there is increasing pressure from human activities including illegal logging (using temporary sawmills and selective logging of particularly valuable trees), agricultural encroachment, hunting, grazing, pole cutting, firewood collection, charcoal burning, mining and medicinal plant collection. Weak policies and inadequate governance of natural resources also contribute to the poor management of resources within the sub-basin (Newmark 2002).

High water abstraction in the area creates conflict in the area as Wami sub-basin is central to major irrigation estates, namely Mtibwa and Dakawa rice farms. Chalinze Water supply is causes stress to the water resources in the area also. Downstream the Saadani National Park, including the estuary, requires water for its survival.

One strategy to promote sustainable conservation through participatory community vegetation conservation.. People's participation, joint project management and bottom-up conservation planning must be included in environmental flow management plans, which will greatly help to conserve the riparian ecosystem and future endeavors of the Wami River sub-basin (WRBWO 2007d).

2.8 Fisheries

Fishing is an important social and economic activity for a number of people living alongside the Wami River. In addition to generating income, fish constitute an important source of protein in community members' households. Fishing provides value in the basin from the revenue it provides to fishermen and the government in the form of sales revenue and taxes, respectively. Several types of fish are caught in the river, mainly catfish (*kambale*), *Protopterus* spp. (*kamongo*) and tilapia (*pelege*) and prawns in the pre. (WRBWO 2007d).

2.8.1 Conservation threats and status

The main challenge confronting the fishing industry in the sub-basin is the use of nets with illegally small mesh sizes. Consequently, the fish population in the Wami River is no longer adequate to support local communities in the basin, and communities are forced to find other sources of food. Stringent measures are required to curb this unsustainable practice.

Uncontrolled livestock immigration is another concern in the area. Livestock trample soil along the river-banks; this contributes to soil erosion and consequent siltation of rivers, which in turn negatively impacts fish spawning areas. Industrial pollution such as excess molasses from the sugar industry can reduce dissolved oxygen leading to possible fish kills. Occasionally fishing is done using poison (Thiodan insecticide) that is also harmful to humans (Madulu 2007). Other challenges are mangrove destruction and expanding activities in Saadani National Park. These challenges need to be addressed by the Wami/Ruvu Basin Water Office and other government agencies to reduce impacts on people and the environment.

2.9 Soils

The lithology of Wami sub-basin is comprised of granite around the Dodoma area with late Precambrian crystalline rocks near Kongwa and Mpwapwa. In Kilosa and Mvomero Districts, there are quaternary sediments with Paleozoic and tertiary sediments towards the coastal area of Bagamoyo District (Hathout 1972).

The soils in Wami basin range from loamy sand with imperfect drainage around Dodoma area to loamy sand with perfect drainage around Kongwa and Mpwapwa. Towards the lowlands of Wami sub-basin, the soils range from sandy clay with excessive drainage to loam with moderately good drainage. Around Mkata plains in Mvomero District the soils range from loamy sand with good drainage to sandy loam and good drainage. As the sub-basin drains towards the coast, the soils range from sandy loam with imperfect drainage to loam with imperfect drainage (Hathout 1972).

2.10 Impacts of climate change and land use

Observed climatic changes indicate that there has been a warming of 0.7°C during the 20th century in Africa, with a decadal temperature increase of 0.05°C (Hulme et al 2001; IPCC 2001). In East Africa this warming has been associated with increased precipitation in some areas. Hulme et al. and IPCC (2001) predict further predict that there will be a warming ranging from 0.2°C per decade (low scenario) to more than 0.5°C per decade (high scenario), which will lead to a 5–20% increase in precipitation from December–February (wet months) and 5–10% decrease in precipitation from June-August (dry months).

According to the Initial National Communications, the mean temperatures in Tanzania will increase throughout the country—particularly during the cool months by 3.5° C, while annual temperatures are expected to increase between 2.1° C in the north-eastern parts and 4°C in central and western Tanzania (URT 2003). These changes in temperature will affect the coping strategies of local communities. Predictions also show that areas with two rainy seasons a year will experience increased rainfall of 5–45% and those with one rainy season will experience decreased rainfall of 5–15%.

The Initial National Communication (URT 2003) shows that rainfall patterns and soil moisture will vary due to changes in mean temperature, thus affecting the runoff into rivers. Climate change needs to be viewed in the context of land use change, which has a critical impact on hydrological regimes. In the Uluguru Mountains it has been observed that vegetation cover has changed considerably between 1995 and 2000 (Yanda et al., 2007). The disappearance of vegetal cover has lead to increased surface runoff and flash floods and reduced infiltration, ultimately resulting in reduced base flows in rivers, which contradicts the prediction above.

In addition, although it is difficult to prove, circumstantial evidence indicates that cloud-bases have moved higher up the hills and hence the catchment values of the Eastern Arc Mountains have probably declined. Although all of the Eastern Arc blocks report such phenomena, there are no hard data to either prove or disprove their effects on the catchment values of the forests (Burgess et al. 2007). Therefore for the future water resources management, WRBWO needs to undertake some further research to establish different scenarios anticipated in the Wami sub-basin.

2.11 Summary of key points- Natural Resources

2.11.1 Wami sub-basin Resources

The sub-basin resources include forests in the Eastern Arc Mountains, notably Ukaguru, Nguru, Nguu and Rubeho Mountains, which are water towers for the Wami River. Ground water is another important source particularly in the semi arid areas of Dodoma, Kongwa and Mpwapwa. Makutopora aquifer is the main water source for the entire Dodoma Municipality and surroundings.

Other sub-basin resources include the protected areas that comprise the Eastern Arc Mountains: Wami-Mbiki WMA, Saadani National Park and the Wami Estuary, which hosts much of the marine biodiversity along the coast.

Fisheries also form another important sub-basin resource where various types of fresh fish are found in the upstream river ecosystem while prawns and marine fish are found along the estuary towards the sea.

2.11.2 Threats and intervention measures to the Wami sub-basin Resources

The primary threats in the sub-basin include environmental degradation, depletion of the resource base and resource use conflicts. Some of the main causes include poor governance of natural resources and poor farming practices resulting in high siltation of rivers. Others include population growth, increased migration of livestock into the area (mostly in Kilosa and Mvomero Districts), weak enforcement of land use plans, uncontrolled industrial effluents, fertilizers and pesticides being deposited into the rivers. .
Interventions required include enforcement of pollution control measures, promotion and enforcement of land use planning, enhancement of participatory management of natural resources, studies on the impacts of climate change and adaptation on the sub-basin ecosystem.

3 Socio-economy in the Wami sub-basin

The chapter makes an assessment of the various socio economic activities in the sub-basin including industries, major infrastructure existing and planned, agricultural and irrigation interests, rural and urban water supply. Evaluation is made on how they impact on water resources both for the current and future situations. The chapter also examines the interventions undertaken in past, current and future plans. Types of conflicts and their causes are also assessed reflecting on existing management systems in the sub-basin.

This chapter will include a description of all stakeholders, roles and responsibilities, interests, impact on the river basin. Table 3.1 provides an overview of some of the elements such as land area, population, population density and land use in the Wami/Ruvu basin.

Table 3.1. Socio-Economic profile of the Wami/Ruvu Basin (National Bureau of Standards/ Regional Commissioner's Office 2003)

Total Area: km²	**72,930**	
Percent of National size	7.7%	
Population (2002)	5.4 million	
Density/km²	74	
Percent of Population of Tanzania	16.1%	
Total Number of (partial) Districts	19	
Land Use	Tanzania	Dodoma
Small Holder Cultivation	5%	
Large Scale Agriculture	1%	
Grazing Land	39%	
Forest/Woodlands	50%	27%
Other Lands	5%	

The population of both the Wami and Ruvu basins combined is approximately 5.4 million, including Dar es Salaam (3 million) and the smaller cities of Morogoro, Kibaha and Dodoma. About 80% of the basin population lives in urban areas and 20% in rural areas, thus the population is very urbanized compared to the rest of the country, which is 20% urban and 80% rural. Outside of urban areas, population densities are around 30-35 people per km². Regional population growth rates are 1.6–4.6%/per annum (WRBWO 2008b).

The average size of a household is five people with a patriarchal structure. Literacy rates in the area are about 65%, but this is higher for urban males and much lower for rural females. Life expectancy is 45-48 years of age. The eastern parts of the basin are predominately Muslim while western parts are approximately 50% Muslim and 50% Christian/other. Throughout the basin, the official language is Kiswahili (WRBWO 2008b).

Outside of major urban areas, approximately 75% of the total household income in the basin is earned from agriculture. Sugar cane, sisal and cotton are produced as cash crops. Surplus food crops such as maize, rice, sweet potatoes and beans are typically sold in local markets. Other rural livelihood activities include livestock keeping, hunting, bee-keeping and, to a lesser extent, fishing. Most other people in rural areas are self-employed in the informal sector. People living in urban and trading centers tend to be self-employed as merchants, traders, shop owners, or formally employed in public and private institutions. Unemployment rates are as high as 25-40 % in both urban and rural areas (WRBWO 2008b). The average annual cash household income in the basin is unknown but in predominately rural areas it is probably only about TZSTZS 75,000 (or USD 75) per year. Region-wide gross domestic product per capita estimates are USD160–214 per year (WRBWO 2008b).

Roads between major urban centres are generally high quality asphalt highways. The Dar es Salaam-Morogoro highway bisects the basin from east to west and links other major urban centres in the basin to Dar es Salaam. Roads in the rural areas are typically gravel or dirt, which are often impassable during the rainy season (WRBWO 2008b).

Electricity is also generally available in urban areas and mobile phones are widespread. Social infrastructure (such as schools and hospitals) is also well-developed, although often poorly maintained, in more urbanized areas of the basin. Potable water supply coverage ranges from 50-80% in rural areas to 90-100% in urban areas, but a reported 18-59% of these facilities are currently not working (WRBWO 2008b).

A specific socio-economic profile of the basin is not available, but Table 3.2 shows some key data from selected districts in the basin (WRBWO 2008b). Districts in the sub-basin include Morogoro Rural, Kilosa, Mvomero, Mpwapwa, Kongwa, Dodoma Rural and Dodoma Urban.

Table 3.2 Statistics for Selected Districts (WRBWO 2008b)

Statistics for Selected Districts:	Kilosa	Morogoro Rural	Morogoro Urban	Mpwapwa	Dodoma Rural	Dodoma Urban
General						
Population Growth Rate %(est.)	2.3	2.2	4.6	2.4	1.6	3.4
Population Density/ km^2	33	31	849	34	31	126
Urbanization %(1988)	17	5	100	16.7	2	48.3
Household Size (1988)	5.1	4.9	4.2			
GDP/capita/year USD (2000, Region)	214	214	214	160	160	160
Ratio Dependents/ Economically Active, 1988	0.97	1.03	0.72	1.06	102.4	0.898
Principal Occupations % (1988):						
Legislative/Administrative/Management	0.2	0.2	0.9			
Professional/Technical/Teachers	1.8	1.4	6.9			
Clerical Service and Shop Sales	1.8	0.6	9.4			
Cultivators/Mixed Farming/Agricultural Workers	67.7	71.3	20.1			
Craftsmen/Machine Operators	0.8	0.4	8.4			
Small Scale Traders/ Labourers/Other	2.2	1.2	12.2			
Unemployed	25.5	24.9	42.1			
TOTAL	100	100	100			
Agriculture						
% Arable Land Under Cultivation (2000/01)	10	12	-	47	12	47
% Food Crops/ Cultivated	35	47	100	78	78	82
% Cash Crops/ Cultivated	65	53	-	22	22	18
TOTAL	100	100	100	100	100	100
Principal Food Crops: (% area)						
Maize	62.1	57.4	59.7	43.3	29.0	14.0
Paddy	13.9	24.9	35.5	0.3	1.3	0
Sorghum	7.0	8.2	4.7	46.5	12.7	44.8
Cassava/Millet	3.1	1.0	0.1	6.0	50.9	32.3
Bananas	2.3	2.9	-	-	-	-
	11.6	5.6	0	3.9	6.1	8.9
TOTAL	100	100	100	100	100	100
Principal Cash Crops: (% area est.)						
Sugar Cane	15	5	-	-	-	-
Sisal	85	95	-	-	-	-
Groundnuts				98	67	85.5
Cotton/Coffee/ Sunflower/Sesame/ Other	-	-	-	2	33	14.5
TOTAL	100	100	-	100	100	100
No. of Existing Irrigation Schemes	31	10	-			

Statistics for Selected Districts:	Kilosa	Morogoro Rural	Morogoro Urban	Mpwapwa	Dodoma Rural	Dodoma Urban
Area Under Irrigation (ha)	14,521	12,536	-	1,629	1,546	-
% of Potential (Av. Region)	12	12	-	73	29	-
Infrastructure:						
All-Weather Roads %	68	36	100			
Railway	Yes	yes	yes	yes	yes	yes
Commercial Airport	No	no	no	no	no	yes
Electricity %	1	1.2	40			
Education						
Adult Literacy % (Av. All Region, 1988)	63	63	63			
Life Expectancy (All Region, 1988)	45-48	45-48	45-48			
Water Supplies: (2000)						
% Coverage Rural	-	49	-	79	78	
% Coverage Urban	100	90	-			
% Water Supply Facilities Not Working:						
Electrical	0	40	0			
Diesel	0	49	none			
Gravity	0	11	0			
Hand Pumps	59	18	43			

Basic data sources: NBS/Regional Commissioner's Office, Socio-Economic Profiles, Dodoma (June 2003) and Morogoro

3.1 Industrial interests

In the basin, there are no significant industrial developments. The Mtibwa Sugar Company, located in Mtibwa village in the Mvomero District, is the only large-scale manufacturing industry in the basin. The Wami River provides the main source of water for its industrial uses (WRBWO 2007b, 2007d).

Another large-scale industrial activity in the basin is salt-making, which is an important economic activity, especially in Bagamoyo District where more than 30 salt-works have been identified. The business has resulted in the clearing of coastal forests for fuel-wood used in salt production processes (WRBWO 2007b, 2007d).

SEKAB is the Swedish Ethanol Chemistry AB ('company') and was formed in the mid-1980s. It is the biggest 'green' chemical company in Europe. SEKAB, which was established in February 2007 in Tanzania, is identifying areas for ethanol production. They want to use 20,000 hectares around Bagamoyo and are looking at 200-400,000 hectares in the Rufiji basin. The land in Bagamoyo was occupied by the Rasaba Ranch, but there have been no cattle there since 1992. The park boundaries are near the proposed land and need to be clarified before any development proceeds.

The biofuel plant would employ more than 2000 people and require support services form the community such as food, infrastructure, schools, etc. They would also support outgrowing schemes and water for such irrigation could come from the Wami River and nearby boreholes. Outgrowers could possibly grow sweet sorghum that can be rain-fed. They could also be organized to grow food as well as crops for biofuels.

3.2 Major infrastructure impacting on the river sub-basin

A large water supply project (Wami Water Supply Scheme) has recently been completed downstream of the Wami River to provide water for Chalinze Township and surrounding villages. Before the completion of this project, many villages in the area had faced acute water shortages and relied on 54 water wells that were dug by the villagers under a self-help development scheme. Most of these wells dried up during the dry season; hence, there was not enough water to fulfill the residents' domestic need. The scheme consists of 160km of pipelines and it aimed at providing reliable, safe and clean water (about 7200 cubic meters per day) to about 105,000 residents in the Chalinze Township and neighbouring villages in the Bagamoyo District. The Wami Water Supply Scheme entirely depends on the Wami River. The completion of the Wami Water Supply Scheme has reduced burden of searching for water for longer distances and longer queuing periods in the Chalinze town and nearby villages (Madulu 2005). Surveying for the second phase of the scheme has stated and it is expected to cover 44 additional villages, and will take two years to complete. Phase 3 will cover the remaining villages in the Bagamoyo District.

Other major infrastructures include intakes for Mtibwa sugar estates, Dakawa rice farms and the Makutupora well field, which supplies water to Dodoma town. Small dams in the upper dry part of the basin (Hombolo, Dabalo and Ikowa) have important infrastructure that impacts the basin's socio-economic activities (WRBWO 2008b). The SEKAB project has applied for a water right and plans to build an intake downstream of the Mandera Bridge to abstract about 17 cubic metres per second. If this amount of water is available, this infrastructure will be the largest in the Basin.

3.3 Agricultural and irrigation interests

The two agricultural activities in the Wami sub-basin are rain-fed crops, largely grown in semi-arid areas in Dodoma, Mpwapwa and Kongwa and irrigation schemes that are found in wetter districts such as Kilosa and Movomero in Morogoro Region. The latter districts have high rainfall and good loamy soils in river valleys, hence high food productivity. The Eastern Arc Mountains bring about good rainfall.

Inefficiency in small-hold irrigation leads to lot of wasted water. The Wami sub-basin region continues to attract pastoralists because of abundant pasture and water. This trend brings about conflicts with farmers, mostly in Kilosa and Mvomero Districts. Irrigation expansion is anticipated in these two districts, which is expected to create shortages downstream. The Chalinze Water Supply scheme, Saadani National Park and the Wami Estuary are calling for comprehensive water resources management under WRBWO.

The agricultural areas surrounding the forests also have productive soils and, when combined with the favorable climate, this is responsible for their agricultural importance. The main estate crops are tea and coffee, with areas of other cash crops such as cardamom and cinnamon. The foothills of Nguru and Nguu, Ukaguru, Rubeho and Uluguru Mountains provide important sites for agriculture (WRBWO 2007d).

Many irrigation schemes are small to medium scales but DAKAWA paddy irrigation and Mtibwa Sugar Estates are large (Table 3.3).

Table 3.3 Potential and irrigated land in the Wami sub-basin (Zonal Irrigation Engineer Office Morogoro, Personal communication)

Region	District	Name of scheme	Irrigated area(ha)	Potential area(ha)
Morogoro	**Morogoro**	Kiroka	80	300
		Bonye	6	5000
		Mbwade	0	3000
		Tulo/kongwa	0	500
		Matuli	60	200
		Mlilingwa	80	200
	Kilosa	Mvumi	293	1800
		Kilangali	460	1820
		Lumuma	960	970
		Chanzulu	250	
		Ilonga	120	584
		Chanjale makambini	40	100
		Ibingu	0	40
		Iyogwe	1680	3600
		Kiboko asali	800	1500
		Kidogobasi - kimamba	915	2800
		Kitete msindazi	60	380
		Lukando - bogomo	74	200
		Madizini	240	440
		Makwambe	160	800
		Manyenyere (mlengeni)	290	2640
		Masenge	30	50
		Mwasa	700	1400
		Rudewa	580	1960
		Zombo	19	376
	Mvomero	Wami luhindo	250	720
		Dakawa	2000	3000
		Mkindo	100	130
		Mgeta	2000	
		Mlali	60	1000
		Kigugu	125	
		Dihinda	40	500
		Dihombo	24	320
		Kanga	160	180
		Komtonga	24	82
		Manza	20	160
		Mgongola		2750
		Mkata		200
		Mtibwa	1800	3500
		Ndole	8	120
		Pinde	170	300
		Tangeni	50	200
		Tchenzema	210	300
		Vikenge	100	250

Photo 3.1 Irrigating sugarcane at Mtibwa Sugar Estate

3.3.1 Role of Zonal Irrigation Office

The Zonal Irrigation Office is planning to undertake feasibility studies in Kongwa and Tulo villages (see section 4.8.1 for its structure).

The crops grown in irrigation schemes are usually onions and paddy rice. A few areas, such as Mlali, have problems with soil and water salinity. There are generally few areas with water quality problems. Irrigation schemes use mostly surface water, although some, mainly in the private sector, use ground water.

With traditional groups, the Office provides training to improve the schemes, which is the target of the directorate. There are few engineers at the district level, but the policy states that every district should have an irrigation engineer. Funding for the irrigation schemes is from the government and from donors via the government.

The Irrigation National Master Plan, initiated in 2002, will be completed in 2017. The aim is to improve current irrigation schemes and develop further areas for irrigation. The current acreage is 246,000 hectares irrigated area for whole country, projected to 570,000 hectares in 2017. Under the Agriculture Sector Development Programme (ASDP), irrigation has two funding streams:

- District Irrigation Development Fund—75%
- National Irrigation Development Fund—25%

To obtain funds, the district writes an application for irrigation funds, which is submitted to the zonal office for review, and then it goes to the Ministry of Water and Irrigation. Among the criteria to obtain funds is a stipulation that the internal rate of return of proposed project must be greater than 12%. This means that economic analysis is required before application.

3.3.2 Irrigation in the Kilosa District

In the Kilosa District, 30% of the farms employ irrigation using the perennial rivers. These include large-scale schemes such as Kimberu Sugar, and smaller village schemes that use traditional methods. The district provides training on how to reduce water losses and conservation. Irrigation schemes in the district include: Lumuma, Mvumi, Ilonga, Chanzuru, Kilangali, Rudewa, Msolwa, Madizini, Kisanga, Chogwe, Ukwamani and Chanjale.

Water usage is high and the quantity appears to be decreasing, as the acreage for irrigation is declining. There are strategies for conserving the catchment area with the district environment department. There are plans to plant trees around water sources, and the district carries out awareness campaigns for people near sources about the effects of excessive deforestation.

Cultivation is prohibited along the river-banks and must be 30 to 60 m from the river. There are different policies on this issue that need to be harmonized. Livestock water is prohibited around intake areas and nobody is allowed upstream of the catchment area, which is a protected forest area in the Rubeho, Ukaguru and Udzunga (Rufiji) Mountains. Organization of farmers using the irrigation schemes in the Basin is further described in section 4.6.2.

3.4 Pastoralist interests

Dodoma, Mpwapwa , Kongwa , Kilosa and Mvomero Districts are major livestock centers in the sub-basin. Currently pastoralists have increasingly moved in into Kilosa and Mvomero Districts for pasture and relatively abundant water. These migrants have engendered serious clashes with farmers, particularly due to inadequate land use planning and infrastructure for the livestock.

The government has tried hard to promote land use planning in the area and restricted movement of animals from one district to another. They have educated the livestock keepers about stocking high numbers. With the expanding livestock population water conflicts will increase parallel with expanding industrial and food requirements. Table 3.4 shows livestock population in Morogoro, Dodoma, Coast/Dar es Salaam and other Regions.

Table 3.4 Livestock Census 1984 and 1994/5 (National sample census of Agriculture 1994/95, Livestock census 1984 – WRBWO 2007d)

Region	Land Area (sq kms)	1984		1994/1995	
		Cattle population	Density per (sq km)	Cattle population	Density per (sq. km)
Dodoma	**41,311**	**1,000,184**	**24**	**1,587,093**	**38**
Arusha	**83,429**	**1,855,880**	**22**	**1,477,589**	**18**
Shinyanga	**50,781**	**1,882,081**	**37**	**2,262,809**	**45**
Mwanza	**20.095**	**1,357,535**	**68**	**2,450,396**	**122**
Morogoro	**72,939**	**332,683**	**5**	**237,857**	**3**
Singida	**49,341**	**939,821**	**19**	**1,944,271**	**39**
Coast/DSM	**33,539**	**93,700**	**3**	**40,490**	**1**

3.5 Rural Water Supply

In 2007, SNV (Netherlands Development Organisation) carried out a water point mapping in Mvomero District (Table 3.5). This exercise was focused at getting a clear picture of the current water supply status in terms of functioning existing water points. The findings as presented in following table and diagram show the shocking reality. Less than a quarter of the population in the 5 Districts has access to drinking water. Table 3.5. Ward League Table of Functional Water points coverage for Mvomero district (SNV 2007).

Table 3.5 Ward League Table of Functional water points coverage for Mvomero district (SNV 2007)

Ward	Functional WPT	Not functional	No of WPs	POP 1988	Rural population	Total WPT Coverage	Functionality	Functional WPT Coverage	Percentage of full coverage met by functionmal WPT	Current shortfall of functional WPT
Diongoya	15	14	29	10394	17402	1.67	51.72	0.86	21.55	55
Doma	29	13	42	8075	9778	4.30	69.05	2.97	74.15	10
Hembeti	49	6	55	10935	18285	3.01	89.09	2.68	66.99	24
Kanga	8	17	25	8191	14699	1.70	32.00	0.54	13.61	51
Kibati	1	42	43	11521	17742	2.42	2.33	0.06	1.41	70
Kikeo	5		5	12670	13571	0.37	100.00	0.37	9.21	49
Langali	7	2	9	9248	8520	1.06	77.78	0.82	20.54	27
Maskati	6		6	8256S	10628	0.56	100.00	0.56	14.11	37
Melela	35	11	46	6257	10206	4.51	76.09	3.43	85.73	6
Mhonda	11	13	24	11768	16759	1.43	45.83	0.66	16.41	56
Miali	29	26	55	12165	19366	2.84	52.73	1.50	37.44	48
Mtibwa	19	15	34	13612	27215	1.25	55.88	0.70	17.45	90
Mvomero	47	27	74	19331	29448	2.51	63.51	1.60	39.90	71
Mzumbe	11	15	36	14418	16444	2.19	30.56	0.67	16.72	55
Sungaji	19	17	36	10851	14054	2.56	52.78	1.35	33.80	37
Tchenzema	30		30	9201	9367	3.20	100.00	3.20	80.07	7

There are a number of water projects in almost every district in the basin. The main water sources are rivers (with water delivery via pumps or gravity), 'charco dams'*, boreholes and shallow wells fitted with hand pumps. Many projects were constructed as long ago as the 1950s. Some have outlived their design life and are in bad condition or not working at all due to mismanagement coupled with inadequate government funding. In places were there are no services, local populations have resorted to shallow wells or traditional water sources. The major problems affecting the provision of water services in Tanzania include inadequate funding for construction of new infrastructure and maintenance of existing water schemes, destruction of water source catchment areas due to deforestation, poor water quality and sanitation services, socio-cultural values and lack of appropriate working tools (Madulu 2005).

The status of most water supply projects in rural areas is poor. Most villages have non-operational water systems and therefore rely on open traditional sources, such as hand-dug ponds or seasonal rivers. In addition to relying on seasonal and traditional water sources, villagers in some villages occasionally have to buy water from vendors because either the water sources are too far away or their low yield necessitates a long wait. These conditions were reported in villages like Twatwa, Mkalama, Kieggea, Meshugi and Nguyami in Kilosa District. A study conducted by the Ministry of Water revealed that a majority of households in these villages collected water from 0.5 to 3 km away, as compared to the Ministry of Water standard walking distance of 400 metres. The long distance leads to compromises on sanitation issues such as washing, bathing, etc. due to the small quantity of water collected, thus exacerbating the substandard health situation (WRBWO 2007d).

Insufficient water supply in rural communities negatively impacts livelihood security such as low labour productivity arising from poor health of villagers who do not have access to safe water. Also, women need to spend a lot of time fetching water and could otherwise be using this time to earn income through such occupations as selling vegetables, cooking and vending food and brewing. Lack of clean water can result in continuous school absenteeism due to sickness and poor health. There are also ethnically based water use conflicts livelihood based conflicts, such as between farmers and pastoralists living in the same area.

Below are three examples of rural water supply in the Wami sub-basin.

3.5.1 Mpwapwa Rural

Rural areas have water committees, but these will become water user groups once the new water law is enacted. The district has 67 water committees. Some areas have established water user groups that are registered legal entities whilst others have outsourced the management of their schemes to private operators.

Prior to the implementation of a project, a community must have a village water fund, which is usually 5% of capital costs and is held in a bank account. The remaining funds come from donor or national programmes. During implementation of a project, management training is carried out.

3.5.2 Kongwa Rural

There are water committees throughout the district that manage the water supply and related equipment such as pumps and borehole engines. Water is sold to manage the supply scheme. In most villages, there is direct payment at the standpipe ranging from 10 TZS to 30 TZS for 20 liters, a rate decided by the village. In Tubugwe, people who cannot pay are not charged for a certain number of buckets per week.

Water from the boreholes tends to be hard and that from the springs is soft. There are no current issues of contamination from sanitation infrastructure as the boreholes are usually located away from the towns. The springs come from the mountains, but they can become contaminated along the way.

3.5.3 Wami Water Supply System

The Wami Water Supply System provides water to 20 villages in the Bagamoyo District. Water is extracted from the Wami River and travels through 160 km pipeline covering the following wards: Chalinze, Lugoba, Msata, Miono and Mbwewe.

In all the villages connected to the supply scheme, people are receiving water at a cost of 20 TZS per bucket (20 litres). The fees for providing water services are collected by private water agencies contracted by the Wami Water Supply Scheme that allows the water agencies to keep 10% of the service fees. Most villagers pay because it is currently less expensive to obtain water. Prior to the supply scheme, water cost 500 TZS per bucket. Private customers pay according to the meter rate, where 1 m^3 costs 860 TZS. There are different rates for institutions. They pay more than 1000 TZS per 1000 litres.

Phase 1 of the supply scheme has been completed, and phase 2 is expected to cover an additional 44 villages. The Wami Water Supply Scheme have started surveying for phase 2, which will cover 80% of villages, and will take 2 years to complete while phase 3 will cover the remaining villages.

Some areas have boreholes including Fokayosi and Kwaruhombo (although it is not working). Villages that are currently not supplied with water obtain their water from local dams or cycle or walk to fetch water from the nearest source.

The main threats from upstream are the effluent from Mtibwa sugar, and fisherman that use poison. Three years ago, fish were dying due to a high BOD (biological oxygen demand) resulting in a lack of oxygen. It was thought that the high BOD was caused by a malfunction in the Mtibwa effluent treatment plant, but the real cause were upstream fisherman using poison. Nonetheless, the Ministry of Water has told them to engineer dams to control their effluent.

Before the project was implemented to supply water there was a high incidence of cholera and typhoid, but this has decreased with the establishment of a safe drinking water supply. Water is treated using standard treatment process including flocculation (using aluminum sulphate) and chlorination (using sodium hypochlorite). The water undergoes physical, chemical and biological analysis.

The institutional organization to maintain the water supply infrastructure is described in section 4.6.

3.6 Urban water supplies in the basin

3.6.1 Dodoma Urban Water Supply and Sewerage Authority (DUWASA)

DUWASA has water rights for 67,000 m^3/day. However, they are currently paying for the actual abstraction of 30,000 m^3/day. Also there is some negotiation over whether DUWASA should pay for actual abstraction rather than capacity of the well field. However, DUWASA owns the lease of the well field so if they want to surrender some of their water rights, it will be difficult to provide water rights and monitor other water users in the well field.

Water supply for Dodoma Urban is supplied by DUWASA from 11 out of 20 boreholes located at Makutupora basin. Photo 3.2 shows one of the pumping stations for a borehole at the well field. The maximum depth is 200 m and the minimum is 50 m. The well field is located 35 km outside of Dodoma. The catchment area is 34,000 hectares, and the area of the well field is 6,000 hectares. DUWASA holds the land lease for this 6,000 hectares and the area has been demarcated with beacons. The WRBWO will manage the remainder of the catchment, and will plant certain types of trees to protect the area. Currently, Tanzanian Military personnel help protect the well field in co-operation with DUWASA.

Photo 3.2 Makutopora well field

DUWASA is only using 11 boreholes that produce 23,491.92 m^3/day. They use electricity to pump water to two storage tanks that hold a total of 72,000m^3/day and can hold a two-day supply. The safe yield of the area is 50,000 m^3/day. In 2002, the Chinese government helped raise DUWASA's capacity from 24,000 to 40,000 m^3/day. They drilled nine new boreholes and rehabilitated three existing boreholes. Pumping stations and 6,700 water metres were installed. They have also recently helped with installing 87 km of pipes and fittings. The Swiss government has invested in the water distribution network. They have helped install 8 km of lateral sewers. There is also funding through the Water Sector Development Programme (WSDP).

Some aid comes from small NGOs such as MAMADO, which is helping people in peri-urban areas with water and sanitation supply. They are collaborating with DUWASA, for example MAMADO will construct a tank and DUWASA will provide distribution.

Water is pumped through collector mains to 680 m^3 and 800 m^3 sumps. From the sumps, the water gravitates to a booster station equipped with five surface pumps that operate two pumps at a time. Water is pumped to consumers and to Malimbili booster station. From here water is piped to consumers and two storage tanks, each of 36,000 m^3 capacity, located at Kilimani area and a 400 m^3 tank at Nkuhungu. There is a shallow water table in the city but not many shallow wells.

The main problem at the well field is the lifespan of the pumps. In order for DUWASA to continue paying Tanzania Electricity Supply Company (TANESCO) 70-80 million TZS per month, they

need to optimize water production, which means using the larger pumps. The larger pumps produce 20,000 m^3/day and are run for longer than the smaller ones. Consequently, the pump capacity decreases and after 4-5 years, the cost is greater than production.

The current production capacity is about 37,000 m^3/day. DUWASA has been operating to meet the demand of Dodoma according to the capacity of the available distribution network, which covers 87% of the population; therefore DUWASA has limited its production to 24,000 m^3/day. Water production increased significantly in September 2008 with the enrollment of an estimated 10,000 students at the University of Dodoma, and other higher learning institutions in the city. Table 3.6 provides a summary of the current water supply statistics from DUWASA.

Table 3.6 Current situation of Water supply in DUWASA as of June 2008

Municipal population	**379,000 (2002 census) growth rate of 4%**
Demand	24,000 m^3/day
Production	37,000 m^3/day
Coverage	87%
Unaccounted for water (UFW)	43.3%
Length of distribution network	50.8 km^2 (50% of total urban area)
Total number of connections	17,146
Total number of customers	15,314
Number of active customers	11,778
Total number of metered customers	17,146
Average monthly revenue collection	See Table 3.7
Total number of staff	151 permanent employees and 2 contractual employees

Out of 15,314 billed customers, 11,778 paid their bills in June 2008, which is about 77% of the total billed customers. DUWASA is continuously educating and creating awareness on the need to pay bills promptly. More information on revenue and billing efficiency is provided in Table 3.7.

Table 3.7 Billing summary (Jun 2008) (DUWASA Office, Dodoma)

Quantity of billable water (m^3/month)	**548,600 m^3/month**
Actual quantity of water billed	388,684 m^3/month
Billed number of customers	15,314
Total billing value (TZS)	251,879,050
Total revenue collection (TZS)	256,211,477
Current	239,285,097
Arrears	16,926,379
Billing efficiency (%)	71
Collection efficiency (%)	105

Supply is provided through privates connections and water points, as well as public kiosks operated by private operators who share 50% of water fees with DUWASA. DUWASA supplies 95 households with free water, a total of 100 litres a day. These households are identified through ward and village representatives, and then DUWASA assesses them for need. Table 3.8 and 3.9 give more information on the customer profile of Dodoma.

Table 3.8 Customer profile—number and percentage of population served

Category	**Total population**	**Population served**	**Percentage served**
Institutional	77,210	67,172	87
Household	127,617	101,026	87
Kiosk	62,833	55,293	88
Total	267,660	232,864	87

Table 3.9 Customer profile—distribution of connections (all metered)

Category	**Distribution of connections**
Domestic	16,120
Institution	401
Commercial	529
Industrial	-

It is believed that if the remainder of the Dodoma urban area were covered, then water would be inadequate. The short-term plan is to drill five more boreholes to increase capacity and the long-term plan is to use other sources that include surface and ground water in Hombolo sub-catchment, and there are potential surface sources from the Bubu River (which is seasonal). The last option is to extract water from Mtera dam, but the priority of this dam is hydropower production.

The sewerage treatment system is comprised of four water stabilization ponds located at Swaswa area, about 7 km from the town. The trunk sewers have a maximum diameter of 1100 mm and design flow rate of 3,672 m^3/7 h and capacity of serving 423,000 people. However, due to inadequate lateral sewers, the system is currently serving only 13% of the population in the metropolitan area, which is 20 km^2 of the town. Table 3.10 provides the status of the sewerage system in Dodoma.

Table 3.10 Status on sewerage service

Coverage	13%
Connections	3393
Length of sewer (main and laterals)	Trunk sewers, 24.3 km Lateral sewers, 32.3 km

Water quality is not a major concern for DUWASA as the water comes from the Makutupora well field and the only people living in the area are employees of DUWASA and WRBWO, JKT (National Military) who assist with security, and DODEP (agricultural research institute). People living in the well field were paid to be relocated. More than 10,000 trees have been planted in the catchment to maintain the water supply. The water is treated by chlorination in the distribution tanks.

Two examples of urban water supply in towns in the Wami sub-basin are provided below.

3.6.2 Kongwa Urban

The urban area of Kongwa town uses boreholes and a spring that is 60 km from the town. In the rural areas there are gravity springs and more commonly boreholes, which can be up to 220 m deep. There are also a few shallow wells and small dams.

Access to an improved water source that is within 400 m of their home is 46% in the district. Coverage in Kongwa is less than 50% and a similar amount in Kibaigwa. The remainder of the population travel further distances, and are not able to obtain adequate amounts of water. There is a new World Bank project that will improve water supply.

3.6.3 Mpwapwa Urban

In the urban area, water is supplied by gravity systems from springs and by deep boreholes that are up to 150 m deep. There is a piped scheme, where water supply is being transmitted to storage tank, and then delivered to private users and standpipes. The Mpwapwa district has water rights for both sources. The rural areas tend to use shallow wells.

People pay 20-50 TZS for 20 litres of water. Tariffs for the private sector are 4500 TZS/m^3 up to 18 m^3 and thereafter the cost is graduated according to the amount used. The money collected goes towards operation and maintenance.

3.7 Past, current and future interventions by organizations

As a government department, the WRBWO has, since its inception in 2002, been building capacity to address its functions effectively and efficiently with different partners. Issues that have been of concern and addressed in collaboration with other partners are ground water resources, capacity building for basin staff, surface water resources monitoring and water quality monitoring.

3.7.1 Governmental Organizations

The office has worked with different governmental organizations in the basin to fulfill water management. For example, Saadani National Park supported a workshop on awareness of environmental flow assessment for Wami River and TCMP through which the initial environmental flow assessment for Wami River was carried out.

Districts provide considerable input into the planning of water resource development and management. The WRBWO generally works with the district in regards to getting information about water rights. In addition, the Zonal Irrigation office is mandated to implement the Irrigation National Master Plan, which includes development of irrigation schemes in the basin.

3.7.2 Non Governmental/International Organizations

The Japanese International Co-operation Agency (JICA) has worked with WRBWO with regard to provision of water supply services in the Basin. JICA's area of interest has been ground water(JICA 2005) and currently capacity building to the local government authorities and basin offices. The World Bank along with other donors is providing funding to implement the government's Water Sector Development Plan. This includes building water supply systems and creating capacity within villages and districts to manage the systems and protect the water sources. The International Atomic Energy Agency (IAEA) has been involved in facilitating the assessment of the Ground water Potential in the Wami Basin.

NGOs that have been working in the basin in direct collaboration with WRBWO include Inwent, which facilitated IWRM workshops in Morogoro, SNV who aided in preparing the terms of reference for this situation analysis and have agreed on working with the WRBWO to form water user associations, and IUCN who are facilitating the development of the situation analysis for the Ruvu and Wami basins.

Details of specific activities by a selection of NGOs in the Basin are provided below.

MAMADO

MAMADO (Maji na Maendeleo Dodoma), founded in 2000, is an NGO that operates in all six Districts of Dodoma Urban, Bahi, Chamwino, Kondoa, Kongwa and Mpwapwa. The three Districts of Bahi, Chamwino and Dodoma Urban access the daily services provided by MAMADO through its main office, located in Dodoma Municipality. There are plans to establish branch offices in each of these three districts to enhance effective provision of services to its customers. MAMADO's vision is to encourage strong, capable and self-dependent communities that are able to plan, implement and manage their water supply and sanitation services in a sustainable manner. Their funding comes from projects because it receives no core funding.

The organisation carries out the following activities:

- Builds awareness, insights, confidence, initiatives and participation among communities and community-based organisations (CBOs) in water, sanitation and health improvement.
- Assists communities and CBOs to plan and implement their water, sanitation and health projects by directly working with them.
- Supports organizations by working directly with communities in water, sanitation and health activities.
- Assists communities, CBOs and other organizations in various aspects of water, sanitation and health projects (e.g. technical, managerial, operational and training).
- Researches, documents and disseminates information on water, sanitation and health. Acts as a water, sanitation and health database centre.
- Publicizes the real situation of water, sanitation and health in communities and efforts made by them to improve their situation.
- Liaises and collaborates with district, regional and national authorities, NGOs, members of the private sector and individuals for smooth operation of the organization.
- Provides advisory services and consultancy services on water, sanitation and health.

MAMADO constructs shallow wells and structures for rainwater harvesting at government institutions such as schools and hospitals. The NGO collaborates with district water engineers for guidance on where to implement projects. Communities' water management skills are low,

so there is a need for capacity building, so MAMADO provides guidance in the operation, maintenance and management of these sources as well as gravity scheme. They also aid in the formation of water user groups and water user associations. Water user groups manage a single water supply point or shallow wells whilst several groups form a water user association. Water source protection is encouraged; for example, areas around shallow wells are protected by fencing and planting grass. For bigger catchment areas, MAMADO facilitates awareness creation of the need to prevent encroachment around the resource.

In the area of sanitation, MAMADO constructs latrines and carries out health and hygiene education. They aim to create and improve awareness of the national water policy. MAMADO is also exploring different water management options such as the use of private operators in individuals, companies and trustees (i.e. in Kibaigwa).

LVIA

Lay Volunteers International Association (LVIA), founded in 1966, is an Italian NGO that deals with solidarity and international co-operation. They aim to fight social inequality, food insecurity and poverty and they work concretely for peace and human development. They have 40 volunteers and 150 local experts in 12 African and eastern-European countries, where they operate with local partners to grant access to water and support the right to health. They also aim to strengthen agriculture and livestock farming, support vocational training, enhance craft skills and local enterprises, and improve the urban and rural environment.

The LVIA presence in Tanzania dates from 1986 when, in the wake of contacts made with the Dodoma Diocese, an integrated rural development project was initiated in Kongwa District. The NGO currently works in the areas of water, agriculture and health. In the water sector they help provide water schemes in the Dodoma and Morogoro region. They are currently implementing the European Water Facility Project, which has supported seven water supply schemes in total—four in Kongwa and three in Chamwino. They intend to construct the scheme and implement capacity building in the villages and the water department. LVIA designs the water supply projects in consultation with district offices. They also help form and strengthen water committees. Gender issues are included as a cross cutting filter in all projects.

LVIA develops skills within the district for GIS tools management. They are currently developing a database of water schemes in the Kongwa and Chamwino area, which will provide rich details in mapping of water points. They also intend to build a filter sanitation plant, which is an experimental plant to desalinate water from saline boreholes and springs. This is being done in the collaboration with the University of Siena. To ensure sustainability of water supply networks, LVIA supported a private company (Ufondico) to carry out technical and capacity building water management of the supply schemes.

Partners of LVIA include MAMADO, who are working on social issues related to water. They have completes a survey on sanitation issues that provides LVIA monitoring indicators for their projects. They also work with Ufondico, SNV and the districts. The NGO collaborates with the Geotechnology Center of the University Siena on GIS and filter remediation.

Care International and Tanzania Forest Conservation Group—LIVING Project

The LIVING project resulted from a Participatory Environmental Management (PEMA) Project implemented around the Nguru Mountains from January 2004 to December 2006. The PEMA project carried out various socio-economic studies, biophysical studies and forest disturbance surveys. Also, the project piloted pro-poor approaches to natural resource management.

Information collected was fed into a visioning process that fed into a Landscape Action Plan. The LIVING project, which operates in 24 villages in the Nguru Mountains, is based on some of the components of this plan.

The overall objectives are to improve the economic status of marginalized rural communities in the Mvomero District, specifically to strengthen representatives, community-based institution for natural resource management, economic development and to empower women around the South Nguru Mountains. The project operates in 24 villages and targets 46,000 poor women, men and children.

The implementation timeframe is January 2007 to December 2009. The key donors are the European Union and CARE Denmark in partnership with Tanzania Forest Conservation Group (TFCG) and the Ministry of Natural Resources through the Forest and Beekeeping Division, the Mvomero District Council and Local communities in the South Nguru Forest Landscape.

The LIVING project has three departments:

- Participatory Forest Management managed by TFCG
- Gender Equity, and Monitoring and Evaluation—managed by CARE
- Enterprise Development—managed by CARE

The Participatory Forest Management department sensitizes community members to form natural resource committees to collaborate in order to conserve the protected areas. Village councils have environmental committees that deal with environmental protection. PEMA identified the need for another committee on natural resource management that reports directly to village government. Through the village assemblies the LIVING project carries out awareness campaigns on the need for natural resource management. Committee members are chosen at a public assembly meeting and then trained in different phases of making by-laws and management plans. The committee also has an agreement with the Catchment Forest Office and Forest Department in the local government. So far, the LIVING project has facilitated the formation of five by-laws in five separate villages. Before the formation of committees, the community is sensitized on the need to have equal representation of men and women. Women's representation consists of 35% of the committee and they appear to be active. The committees provide an opportunity for women to be active in the community and be involved in decision-making.

The LIVING project is monitoring implementation of the natural resource committees and providing capacity building. The committee receives training at all phases up to and beyond the creation of the by-laws. The by-laws that have been enacted in five villages appear to be reducing destruction. The committees meet three times a month and give the LIVING project reports on their progress. Another important role of the committees is to patrol the forest areas.

To ensure the project's sustainability has been paired with another project called EMPAFORM, which works on advocacy activities to network natural resource committees. Before the project is phased out, EMPAFORM will create an umbrella organization to administrate the committees at the district level.

The results from PEMA indicate that communities are heavily dependent on forest products, so compensation for the possible loss due to protecting the area should be considered. The LIVING project has introduced Village Savings and Loans (VSL) groups that allow members

(around 30) to form their own institution and create by-laws for savings and loans. The members meet every week and buy shares for 500 TZS each, and they can buy up to five shares per week. The project, which trains groups to establish small businesses, serves people who usually cannot access loans; however, through the VSL one can acquire a loan up to three times the value of their shares. The small businesses include crops, small hotels, and poultry. Those who want a loan need to pay for the application and the interest rate is 5%. Borrowers have three months to pay back a loan. People are fined if they do not follow regulations. At the end of the annual cycle there should be a dividend which is shared among members according to their shares (100,000 TZS altogether).

The project has 10 active VSL groups started in July 2007, and most have been able to make a profit of 100,000 TZS. New groups were established in October and March, bringing the total to 38 groups.

3.8 Conflicts in the Basin

Over the last decade, the Wami River forests, woodlands and wetlands have come under increasing pressure from the rapid increase of population, among other factors. Due to this increase in population, competition over resources and extreme poverty among the rural population has led to unsustainable use of resources. Furthermore, the demand for agricultural land has increased.

3.8.1 Upstream – downstream

There have been conflicts between Chanzuru and Ilonga irrigation schemes. The Ilonga intake is upstream and Chanzuru believes they are taking too much water. The issue was resolved through discussion through intervention of the WRBWO. They agreed on rationing between villages. Now, Chanzuru is getting sufficient water for irrigation.

There have been conflicts in the past over pollution from the effluent from the Mtibwa Factory when water was not treated. When the company was under parastatal control, the government did not monitor itself. After privatization, there was more targeted pressure on polluters to clean up. This pressure coupled with new laws and the drive from within the company resulted in more pollution control. The stabilization ponds were constructed in 1999. There is very little discharge going to river, as the remaining effluent water is being used for irrigation. Monthly, the Mtibwa Estate monitors and sends water samples to Sokoine University. However, there are reports that the earthen dams containing the effluent ponds break down during the rainy season resulting in downstream pollution.

The Estate has engaged a contractor to modify the ponds by changing the position of sluice gates in order to increase the settling time in the ponds. After initial construction of the ponds there was no separation of the effluent from the flood water. Consequently, all the run-off went directly to the ponds resulting in effluent draining straight into the river. The company worked with the WRBWO to construct a separation gate in 2003. Despite efforts made by the company, they do not communication about how they intend to treat the effluent.

3.8.2 Water and land access

Conflicts over access to water and land are relatively common, often occurring between farmers and pastoralists. For example, in irrigation scheme areas, there may be conflicts over cattle using the dam, or livestock walking over irrigation canals and down river-banks, resulting in severe degradation. Consequently, by-laws need to be passed and enacted by district councils to clarify land use.

In Kilosa District, there are conflicts between farmers and pastoralists over water access, especially with Maasai and Sukumas. During the dry season, farmers cultivate near river-banks which also are used by animals. The only way for livestock to reach the river is through agricultural plots. There are cattle troughs, but they are not enough for the population of livestock.

There is mixed co-operation towards contributing to infrastructure by pastoralists. The Maasai contribute as they have established villages, but Sukumas do not have settlements in the area so they are less likely to contribute. The government is trying to resettle the migrants through land use planning. Furthermore, the government has issued a circular that prohibits settlement in a district without permission. Migrants need to apply to the district and report the number of livestock they are bringing; compliance is inconsistent. The government is trying to sensitize the village leadership on this issue and there are also livestock checkpoints on the main road. In addition, there was a previous district plan for land use but it is no longer functional, so the district is proceeding at the village level to carry out land use planning, including the establishment of villages specifically for pastoralists.

Livestock are destructive to infrastructure. In Kongwa, it has been reported that some livestock keepers are sabotaging the pipelines to access water. There are also conflicts over the access to the spring in Tubugwe. As a result, one of the design criteria for districts is to include a watering point for livestock, such as cattle troughs, as well as appropriate crossing structures. In addition, livestock can cause deterioration of water quality. For example, at Changalikwa secondary school there are water quality problems that have resulted in typhoid and dysentery, which is blamed on contamination from livestock.

Pastoralists sometimes encroach on the Mtibwa Sugar Estate to get water from the canals and consequently feed on the crops. There are also conflicts with hunters who set fire to grasses to flush out game but the fires can burn out of control near the cane fields. Between 2000 and 2008 the major problem with outgrowers' cane harvesting was malicious fires; at times, more than 24,000 tonnes of cane had been burnt in a single day while the factory crushing capacity is 3000 tonnes per day. More than 70,000 tonnes were lost by May 2008.

Conflicts over access to land and water can also occur when people are displaced when an area becomes protected. For example, people were displaced after the creation of the Sadaani National Park, and there has been conflict over their compensation. Sadaani village remained and the aim was to involve the community in tourism. Because the village does not have farming, firewood or building materials they rely on fishing. Park rules do not allow any activities in the park, so villagers cannot take firewood and grasses from the park area but the people sneak into the park to get firewood, grass and poles. The park, with a minimal assistance from NGOs, is trying to promote energy saving stoves to reduce firewood consumption.

Another conflict over displacement was in the Makutopora well field near Dodoma. Before the well field was developed it was surrounded by villages, but they have been relocated. There is still some livestock activity, but the government is trying to educate people to not graze in the area. People were relocated from the area in September 2007, and were compensated, although people were discontent about the upheaval. There is also a problem of bush fires that damage trees in the catchment area of the well field. These fires could be due to sabotage, or set by people trying to protect their cattle. The Tanzanian Military is assisting the village in stopping the fires from spreading.

Conflict arises over siting of wells, as the best location could be on an individual's plot, which means compensation. It can also be difficult to move people from the protection zone. Furthermore, if a water source is improved and water fees are required then the community can be reluctant to pay as they did not have to pay before.

There can also be conflict between villages that share supply schemes such as Mpwapwa and Kongwa can come into conflict when water is scarce. Disagreements can also occur within irrigation schemes, when farmers steal water when it is not their turn, although there are often by-laws to fine the offenders.

Finally, there is conflict over access to forest catchment areas. People benefit illegally from the forest and this creates conflict with the natural resource committees. There is even conflict between the committee and the village government as some member may be encroaching on the protected area. In general, people are not happy with conserving \ protected areas because they are no longer benefiting from its resources.

3.8.3 Finance

One financial conflict in the Basin is that that some people being supplied by DUWASA are not paying for their water. One solution is to disconnect them. About 40% of the water is not accounted for due to theft through illegal connections and people disconnecting water meters. In the last three months, 48% of water was unaccounted for, but this has been reduced with the replacement of 10,000 metres, provided by DUWASA.

Another conflict area is between village governments and water committees. The village government often wants to obtain some of the funds collected for water service provision. But the problem often occurs before this point, when fees are being paid for water as the community members cannot be always sure whether they are paying their water fees to the correct officials.

3.9 Summary of key points – Socio-economy

Major infrastructure in the basin includes Mtibwa and Dakawa irrigation schemes and the Chalinze Water supply. Irrigation is expected to increase in the sub-basin in the near future, which will increase pressure to the existing water resources. Therefore efficient water use should be promoted to enable multiple water users.

The sub-basin has been a destination for many pastoralists for fodder and water; this has led to conflicts with farmers in the area due to inadequate infrastructure for watering livestock and lack of adequate land use planning and weak enforcement. WRBWO needs to enhance its monitoring capacity to curb over-abstractions and compliance to industrial pollution, particularly from Mtibwa Sugar and the subsequent conflicts with downstream users.

The semi arid areas of Dodoma, Kongwa and Mpwapwa rely on limited ground water resources. Expertise from WRMWO is needed to assist in identifying potential sites for the Districts to mobilize resources for water supply. WRBWO is also urged to protect potential areas for future ground water from encroachment by human settlement that will require compensation. Makutopora aquifer basin requires further protection as the sole water source for the expanding population of Dodoma Municipality.

4 Water resource management in the Wami sub-basin

Water sources are generally considered community property but there is often a concern over a possible struggle for different uses of water—domestic, agricultural, industrial and environmental. Private sector participation in the water sector is limited although there are many NGOs and CBOs to facilitate community capacity building within the basin. For example Dodoma has about 45 such organizations. At the same time, there is willingness to pay for water even though the economic status of consumers generally limits their ability to pay (WRBWO 2008b).

4.1 Policy frameworks

The current policy framework for the sector is set out in the National Water Policy (NAWAPO 2002), which is oriented towards reaching the Millennium Development Goals (MDGs) for water and sanitation in Tanzania and incorporates the overall development goals set out by the Vision 2025 and the National Poverty Reduction Strategy (NPRS).

For water resources management NAWAPO (2002) emphasises:

(i) *Comprehensiveness*—a holistic basin approach for integrating, multi-sector and multi-objective planning, management that minimises the effects of externalities, and ensures sustainability and protection of the resource

(ii) *Sustainability*—water resources will be utilised within sustainable limits (safe yields of surface and ground water and assimilative capacities for discharge of pollutants)

(iii) *Subsidiary*—river basins would be the units of operational WRM, Basin Water Boards comprising basin stakeholders with decisions on water

(iv) *Separation*—water resources management and regulatory functions separated from service delivery functions

(v) application of *Economic, participatory and regulatory* instruments for managing water resources.

Following the adoption of the National Water Policy (NAWAPO) of 2002 Tanzania has introduced a decentralized and participatory approach to water governance. The National Water Policy was followed by the formulation of National Water Sector Development Strategy (NWSDS) to implement the policy. Emphasis is on IWRM, which is also reflected in the Water Sector Development Programme (WSDP) 2006-2025, which was launched in March 2007 during World Water Week. The WSDP provides a strategic background for the implementation of plans and interventions for the achievement of national targets, and calls for development partners to actively engage and support the water policy/strategy.

The NWSDS has been prepared with a time horizon up to 2015 in order to guide policy implementation and it sets a number of specific targets for both integrated water resources management and improvement of water supply and sanitation services.

4.2 Legal Frameworks

Water Resources Management in Tanzania was governed by the Water Utilization (Control and Regulation) Act No. 42 of 1974 and its subsequent amendments. In 1989, through the Water Utilization (*Control and Regulation*) Act No. 42 of 1974, as amended by Act No. 10 of 1981) the Minister for Water gazetted nine water basins for the purposes of water resources administration and management.

Under this legislation, the Government established Basin Water Offices in the Pangani River Basin (1991), Rufiji River Basin (1993), Lake Victoria Basin (2000), Wami/Ruvu Basin (2001), Lake Nyasa Basin (2001), Lake Rukwa Basin (2001), Internal Drainage Basin to Lake Eyasi, Manyara and Bubu depression (2004), Lake Tanganyika Basin (2004), Ruvuma and Southern Coast Basin (2004). These Basin Water Offices also have their Boards appointed and are now operational. Each Basin is headed by a Basin Water Officer. They are the institutions mandated with management of the water resources and implementation of the water law at the basin level.

The Water Resources Management Act, No. 11 of was passed in May 2009 and is operational as of July 2009. It provides for the institutional and legal framework for sustainable management and development of water resources, outlines principles of for water resources management, provides for the prevention and control of water pollution and provides for participation of stakeholders and general public in implementation of the National Water Policy.

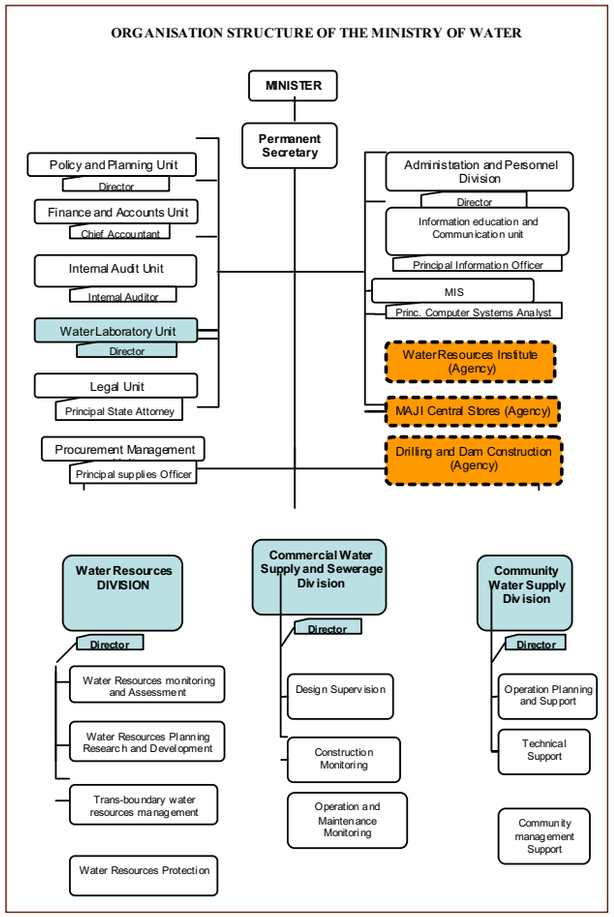


Figure 4.1 Organizational structure of the Ministry of Water, Tanzania, 2008.

4.3 Organisational structure

The Minister of Water and Irrigation (MoWI)—previously the Ministry of Water and Livestock Development (MoWLD).There are three technical directorates in the Ministry: Water Resources, Community Water Supply and Sanitation (previously Rural Water Supply and Sanitation), and Commercial water supply (previously urban water supply). Then there are support departments of policy and planning, and administration. Figure 4.1 shows the organizational structure of the Ministry of Water and Irrigation.

According to the NAWAPO of 2002, water resources management in Tanzania should be organized around participatory and representative forums, starting at the national level and extending to the basin and the sub-basin level (see Table 4.1). The policy identifies five levels of basin management—the nation, the basin, the catchment, the district and the community or water association level. The institutional framework for water resources aims to integrate sectors at different levels and is formalized in the new water law. At the national level, the irrigation, tourism, agriculture, etc. sectors interact through the National Water Board. At the basin level there are integrated boards (such as the Wami/Ruvu Basin Water Board) with different water users and sectors. Each basin office is required to implement the decisions made by the board and carry out operations. At the catchment level, the aim is to have a council that will provide integrated planning. District councils will participate fully in basin boards and catchment councils and are responsible for planning and developing water resources. The community level and Water Users Associations (WUAs) are responsible for local-level management of allocated water resources (IUCN Eastern Africa Programme, 2003).

Establishment of WUA is critical as they provide the institutional mechanisms for addressing water needs and conflict resolution at the local and sub-catchment levels. The challenge is that the WUAs are just beginning to evolve. However, those already established in Pangani basin and Great Ruaha catchment have proved to be successful and effective mechanisms for water resources management.

Table 4.1 Functional Responsibilities for Water Resources Management

Organization	Functions and Responsibilities
Minister responsible for Water	Presents national policy and strategy to the Government Ensures policies and strategies are implemented Appoints Chairman and members of Basin Water Boards Determines appeals from all levels in framework
Ministry responsible for Water	Sectoral co-ordination, monitoring and evaluation Policy development and review, including legislation and financing Formulates technical standards and WRM guidelines Co-ordinates trans-boundary water issues Ensures dam safety Water Quality Monitoring Development of water resources of national interest Co-ordinates data collection and assessment of water resources Supervises monitors and evaluates Basin Water Boards Supervises the Water Resources Institute. (Agency) Supervises the Drilling and Dam Construction Agency
National Water Board	Advises the Minister on: - Integration of inter-sectoral planning - Co-ordination of basin planning and management. - Inter-sectoral/inter-basin conflicts - Investment priorities and financing patterns - interbasin water transfer - transboundary water resources management
Basin Water Boards	Data collection, processing and analysis for WRM monitoring and resource assessment Co-ordinates technical aspects of trans-boundary issues in the basin Co-ordinate and approve basin WRM planning / budgets Approve issue and revoke water use and discharge permits Enforce water use permits and pollution control measures Co-operate between sectors at the local level Resolve conflicts and co-ordinate stakeholders Integrate district plans

Organization	Functions and Responsibilities
Catchment / Sub-catchment Water Committees	Coordination of catchment/sub-catchment integrated water resources management and planning Resolution of water resources conflicts in the catchment/sub-catchment, and other delegated responsibilities from Basin Water Board
Water User Associations	Manage allocation of water resources at local level Manage equitable allocation of resources during drought Mediate in local disputes
Regional Secretariat	Representation on Basin Water Boards
District Councils	Representation on Basin Water Boards Representation on Catchment Committees Formulate and enforce by-laws Promote efficient water utilization Preparation of district plans

Below the Director of Water Resources are four assistant directors: Water Resources Assessment and Monitoring, Water Resources Planning and Research, Water Resources Protection and Environment, and Transboundary Water Resources. The Water Resources department also manages and co-ordinates the nine river basin offices, which consist of four lake basins and five river basins that are listed above. Each basin is headed by a Basin Water Office with an appointed Board.

4.3.1 Wami/Ruvu Basin Water Board

The Wami/Ruvu Basin Water Office, established in 2001, reports to the Wami/Ruvu Basin Water Board, which consists of seven to ten members appointed by the Minister of Water. The present board members are drawn from institutions that represent the Government, public, private enterprise and NGOs. The Wami/Ruvu Basin Board is advised by the Basin Water Office on management issues such as the allocation of water at the basin level and collection of water user fees. They currently have ten members who represent the following stakeholders:

- Ministry of Agriculture
- Ministry of Water
- Wami/Ruvu Basin Water Office–Secretary
- Utilities–DAWASCO
- Large users–Mtibwa Sugar
- NGO from Dodoma–Mamado (dealing with water and development)
- Lawyer – representing women (Chair person)
- Ministry of Industry and Trade
- Kimango Farm
- Vice President Office–Environment

Board members are chosen through a process that starts by the WRBWO writing to different institutions to request for the CVs for possible candidates for the Board. The CVs are processed and a shortlist is submitted to the Ministry of Water and Irrigation, who chooses Board members from this list or from elsewhere. Under the new legislation, the number of board members will increase and include WUAs and more NGOs.

The board meets at least twice a yea and last year they met three times. A sub-committee of the board meets more frequently to discuss water rights. Each February they meet to approve the annual work-plan and budget, and in June the WRBWIO submits their progress report for review. In all sittings application of water rights submitted to the board are reviewed.

4.3.2 Wami /Ruvu Basin Water Office

WRBWO is the executive office of the Board and is headed by the Basin Water Officer. For daily technical work the Basin Officer reports to the Director of Water Resources. WRBWO has its headquarters in Morogoro and two sub-offices in DSM and Dodoma. The vision, missions and commitments of the Office were previously presented in section 1.3.2. Specific responsibilities of the Office include:

- to issue water use permits
- to monitor and regulate water use according to natural availability
- to control and take legal measures against water resource polluters
- to resolve water use conflicts
- to collect different water user fees and use them for office operation
- to sensitize stakeholders on the sustainable use of water resources
- to facilitate the formation of Water User Entities
- to facilitate the formation of catchment/sub-catchment committees
- to conduct operation and maintenance of water resource monitoring stations
- to assess and monitor the quantity and quality of water in the basin
- to coordinate the Integrated Water Resources Management plans
- to participate in water resources protection programs.

In the draft legislation, more responsibilities are being added to the Boards. As the basins move towards autonomy, the board will serve as an executive body and employ staff directly. This means that engineers and other staff will be paid by the Board.

Wami and Ruvu basins under one office because the Tanzanian government amended the water utilization act in 1991 and they realized that many small rivers drained into large drainage basins. They saw that if they provided a basin office to all rivers then there would be too many basins. Thus, basin offices were required to cover areas that contained several river basins draining into the ocean. Consequently, the Wami and Ruvu were combined to be administered by one board.

Using hydrological boundaries, the basin has been divided into seven sub-catchments that might be revised using more in-depth data on hydrology form the field. Each sub-catchment will have several WUAs which will form sub-catchment committees and define the boundaries of the sub-catchment.

In the past there were regional water engineers, but when the river basin structure was established in 2004, the regional focus was dissolved. There are still representatives in the regions, so the WRBWO has two sub-offices—one is Dar es Salaam and the other in Dodoma.

4.4 Water rights

One of the core functions of the WRBWO is water allocation. Under the current law every abstraction must have a water use permit. It is supposed to take 40 days to get a water right processed, but it often takes longer as the board needs to collect information from different stakeholders. The process starts by the water user filling in an application form that

asks for specifics about the reason for and amount of water requested to be abstracted. All applications are assigned a water right number and the request is submitted to the Ministry for publication to be registered into the official gazette. This is posted on relevant district notice boards for several days, so any objections can be raised at this time. If there are no problems, then after 40 days, the application can be submitted to the Board. However, the Board does not meet frequently, allowing for wider consultation with the district agriculture and livestock officers to see if the requested abstraction impact on others' water rights. If everything is in order, then the board will approve the rights and the applicant will receive the document within a week. For some schemes, it is necessary to carry out an EIA and obtain an environmental certificate from NEMC.

It is possible to obtain a provisional water right if works are not yet completed; applicants have a year to complete the infrastructure and will receive the water right once completed. In the new legislation, there will be a time-frame for each water right.

There are a number of problems that were identified with applying for water rights, such as water users being unaware of the requirement to file an application for an abstraction. The application forms are not readily available outside of major urban centres. District offices are encouraged to aid users in applying for water rights but regardless of their help the forms often have incomplete information. The WRBWO intends to address these problems with capacity building activities including training, workshops and awareness campaigns through media and television. For example there has been training in the Kizinga River Catchment where the communities were informed of the laws stressing what activities are against the law. The Board has presented education on water laws and rights through the media and during field trips and site visits.

Each year, the WRBWO formulates an annual work-plan that includes institutional capacity building within and outside the basin or country. They also offer capacity building for communities, although it is relatively *ad hoc* because there are no formal structures for such measures. Once WUAs are in place, it will be easier to conduct structured capacity building activities.

4.4.1 Payment for water rights

Clients of the WRBWO can pay fees for their water rights directly to the office or through a bank account, whereupon they will receive a receipt. Annually, in the month May or June, the WRBWO prepares bills for distribution that are then distributed by July. Water rights are billed whether or not a client is drawing water form their allocated abstraction point.

Many people do not respond to payment requests. Previously people used water as a free commodity, so many are not willing to pay for their water rights. In fact, only 30% of customers pay for their water rights. The WRBWO relies on income from larger users because small users do not pay very often because they see water as a gift from God. The rates are currently very low, as they were last reviewed in 2002. The cost of collecting money is often higher than the amount collected, especially from small users who may only be paying the minimum amount of 35,000 TZS.

The amount to be obtained from small-scale users (i.e. single borehole) is 500–600,000 TZS. There are seven large users which should pay a total of 300 million TZS. If large users are not paying then the Office has a funding problem. For example, DAWASCO is not fully paying for their allocation; instead they pay by extraction and claim that they are not using some of their allocated water sources.

The Basin Water Office is trying to develop a better mechanism for fee collection whereby different agencies could collect fees such as district agencies and WUAs. The WRBWO is attempting to raise its profile through awareness campaigns.

The law does not provide adequate power to ensure people pay for their water rights, and the WRBWO has never prosecuted anyone. If the Basin Office cannot take action, then people are not likely to pay in the future. The WRBWO needs to be able to exert the law to prosecute, but also wants to exercise social means through dialogue and raising awareness.

4.5 Financial issues of current institutional set up

4.5.1 Funding sources

The main source of funding for the basin, the central government, has been declining over the past ten years, whereby only 3–5% of the Ministry's budget allocation was for water resources management activities. Currently the Water Sector Development Programme, through the MoWI, is the main source of funding for the WRBWO at about 2.5% of 6 billion TZS.

The strategy for meeting the water resource management recurrent costs will be to:

- set water user fees to ensure that they reflect real value of water by using economic parameters such as inflation rate, market values and opportunity costs of water
- set abstraction and discharge charges based on the costs of providing effective water resources management as determined by approved annual operating budgets, taking into account any subsidies from Government
- increase water user fee collection capacity at basin and catchment levels
- allocate revenue from water charges to the organizations responsible for water resources management at different levels in a transparent manner (URT 2004).

4.5.2 Income generation

The income generation for the WRBWO has been through the user water charges which contribute only 30–40% of the Basin Office operational costs. However, both the level of recovery of the water charges and the lack of transparency in the retention of funds at the operational level has resulted in inadequate contributions to the recurrent cost of water resource management, both at the MoWLD headquarters and in the field (MoWI 2006).

In the short-term, the Basin Office expects that revenues will increase when all water users are registered, water use is more carefully monitored, tariffs more accurately reflect use-values, and collection rates improve.

In the longer term, willingness–to-pay economic water user fees should also improve as institutions at the basin level (WUAs, Catchment and basin level forums) increase in number and gradually become better informed about the need for astute water allocation and management in the basin (WRBWO 2008).

The Ministry of Water and Irrigation will further carry out studies to look for financing options of the Basin Water Resources Management. This will be key to the Basin's financial autonomy as that is one of the pillars of the sustainability. For example, a recent study by CARE Tanzania in payment for watershed services in Ruvu River suggests that buyers and sellers of watershed services may be identified and arrangements made in order to manage the upstream watersheds (WWF et al. 2007). In addition, the criteria for charging water user

fees will be subject to regular review and approved by the Minister responsible for Water (NAWAPO 2002).

4.6 Urban, District and community level management

4.6.1 Wami water supply scheme

Wanachama wa Maji Chalinze (WAMACHA) was initiated before the project started. All villages involved were organised to support construction of water supply infrastructure. After construction, water committees were formed. Each village has three members of WAMACHA – a chairman, secretary and one delegate. The village committee holds a meeting every month, and there is a general meeting of all committees every 3 months. Support is provided from the committees for transport and other allowances. Two out of three delegates in each are supposed to women.

When the future water board is formed, WAMACHA will only have three representatives on the board. It is not clear if the village structures will remain in place. Chalinze Water Supply Scheme carries out education and awareness to conserve the area and reduce pollution. This is facilitated through WAMACHA, which are water user committees that represent water users. The Supply Scheme communicates with WAMACHA on education and awareness to control pollution and protect water sources. WAMACHA then passes on this information to communities.

4.6.2 Urban water supply

Urban water supply authorities such as DUWASA have a water board that makes decisions about investment in infrastructure. The Board presides over the water resources management in the Makutopora well field, and water supply in Dodoma Municipality in general. It provides policy guidelines, conflicts management and makes decisions on water rights and overall future water management for Dodoma in general.

The DUWASA water board consists of 10 members, which include:

- Board chairman
- Secretary –Managing direct of DUWASA
- Representative of large consumers,
- Representative of business groups
- Ministry of Water
- Representative from domestic consumers
  - Must be a woman
- Representative of women's groups
- Regional administrative secretary
- Municipal director
- Ward Councilor representative within the Dodoma area
  - There are 7 wards

The Ministry of Water approves the board.

4.6.3 Irrigation schemes

Irrigation schemes in the Basin have their own organisational structure. In Kilosa district, farmers using irrigation schemes are encouraged to form water user groups, which include all the users of an irrigation scheme. Each subcanal has an irrigation committee to manage the area, as each subcanal can irrigate 50 acres. The chairperson of each subcanal is a member of the irrigation committee that manages the whole valley. For example, Malolo in Mwega River has 15 subcanals; the 15 chairpersons make up the irrigation committee for the entire scheme. The irrigation committee elects a chairperson and employs a secretary. The committees of the subcanal and the whole area are responsible for scheme operation and maintenance. Financial resources are obtained among the members; they agree how much each will contribute. This is usually according to acreage, such as 20 kg of product per acre.

During registration of water users, all members of a household over 18 years of age, including women are encouraged to register. This is to allow gender equity in the right to vote in the water user group and provide opportunities for leadership. Irrigation committees must have 40% women. The district says that women are active in the irrigation committees and water user groups as they are the ones farming.

During the initial stage of constructing a scheme there is training from the district for scheme operation and maintenance, record keeping, financial management, and water management.

Some examples of the organisation in specific schemes are provided below.

Hombolo

Water for irrigation is drawn from an intake to serve irrigation in the downstream areas consisting of more than 300 acres. The irrigation user group is comprised of members of the village whereby each member is requested to pay 5,000 as an entrance fee and given 1.5 acres. Within the village there is an irrigation committee which oversees the amount of water withdrawn from the dam so that the level does not exceed a certain level particularly during the dry season. There is also the water committee which oversees irrigation schedule in the irrigation scheme. In both committees gender is respected among men and women.

Main crops in the scheme include grapes, tomatoes, onions, and there are co-operative groups centered around crop type who share market information and put their individual earnings in a Savings and Credit Co-operative Societies (SACCOS). Maintenance is carried out from entrance fees accrued. The scheme has also got tractors whereby farmers use in farming and pay back during the harvest period. The Agricultural extension officer in the village provides training on irrigated farming.

Dihombo

The irrigation group in Dihombo, known as Mafaniku Irrigation Group, is independent of the village government. The irrigation scheme was built by the government. The irrigation group was started in 2000, at which time sand bags were used to control the intake. In 2005, the Participatory Agricultural Development and Empowerment Programme (PADEP) built the intake, which is controlled by gates, and the rest of the infrastructure is a traditional gravity system. The main activity of the irrigation group is irrigated agriculture growing rice and practicing aquaculture. The group has a management committee of 10 members which includes a chairperson, vice chairperson, secretary, vice secretary and a treasurer. The committee is elected by the entire irrigation group. The treasurer and chairperson of the irrigation are women. There are four women out of 10 people on the irrigation committee. There are 14 members in the irrigation group, and 6 are women.

Members contribute an entrance fee of 2,500 TZS when they join the group, and only members can use the scheme. Members also contribute 5-10,000 TZS towards operation and development of the irrigation scheme. This includes construction of a reservoir, fencing around the reservoir and pipes. The group also carries out other activities such as fish farming and horticulture.

Originally, members had to have farm plots by the irrigation scheme to join the group. Now it is possible to hire plots. For example, the group has a 2 acre farm where plots can be rented. The revenue generated from the harvest is shared among the people renting the land. Part of the money accumulated by group members from the harvest goes to a bank account; this amount is decided by the irrigation committee.

The water right is in the name of the WUA however the intake is actually owned by the village government. This happened because PADEP was administrated through the village government. It is understood the irrigation scheme is outside the government system. The intake is used for irrigation use only. The village government is responsible for collecting user fees. This has hindered the group to fail paying the water user fee for 3 consecutive years.

The water fees are used as a source of income for the village. However, the water right is paid by the irrigation group so money needs to be transferred to them from the village government. There are some problems in getting the money from the village government. Previously, the village government was not functioning properly and new one was put in place in May 2008, which is much more co-operative.

Chanzuru

The irrigation intakes for Chanzuru and Ilonga are very close together. The Chanzuru construction committee is looking after the intake. In addition, the Ilonga committee has by-laws to protect the intake and is looking after both intakes as they are close together. Ilonga have a committee and are paying for their water right. The irrigation layout in Chanzuru is currently not well designed and some people are not getting water. Therefore, people are not willing to pay and apparently the organizational structure will be in place once the three canals are constructed.

4.6.4 District Level

The District organization structure shown in Figure 4.2 indicates the main components of local government. The sector departments that deal directly with water resources development and environmental management are the District Water Engineer and the District Natural Resources. However, according to IWRM, water management is integrated with all sectors. It should be noted that considerable power and responsibilities have been devolved to the district level, but there is insufficient capacity to implement all government programmes.

NAWAPO prescribes that District Councils shall participate fully in Basin Boards and Catchment Committees. The Districts are responsible for planning and development of water resources in accordance with basin plans, protection and conservation of natural resources in the villages and wards, establishment of by-laws on the management of water resources and conflict resolution in accordance with established laws and regulations. In addition the District Councils will make assessment of water demands of their respective districts, and participate fully in the preparation of Basin plans.

Communication between the district and WRBWO has been *ad hoc* and often at a personal level. Recently, staff members from some of the district and municipality offices have received awareness and facilitation training from the basin office. They aim to bring water management knowledge to the districts and form District Facilitation Teams (DFT) with representatives that include employees from all departments and sectors. They use a technique called 'opportunities and obstacles in development' to generate water resources projects. The team goes to villages to promote integrated planning. The WRBWO has completed this training in 9 out of 17 districts.

The districts and municipalities sometimes receive information on water right applications and are asked to provide their recommendations. They might visit a site to determine whether water can be extracted from the proposed area. Some municipalities and districts, such as Temeke, have a checklist for examining various items such as the location of latrines in order to avoid potential conflict with neighbours. A municipality relates its recommendations with the applicant and the WRBWO.

Water rights awareness is higher at the district level than at the community level. The role of the district water engineer is to discover problems within the district and draw up plans for solving them. Community development officers work with the engineer in villages. Despite the low level of awareness in villages, some communities with irrigation schemes in the Wami sub-basin have applied for water rights, such as Dihombo and Ilonga.

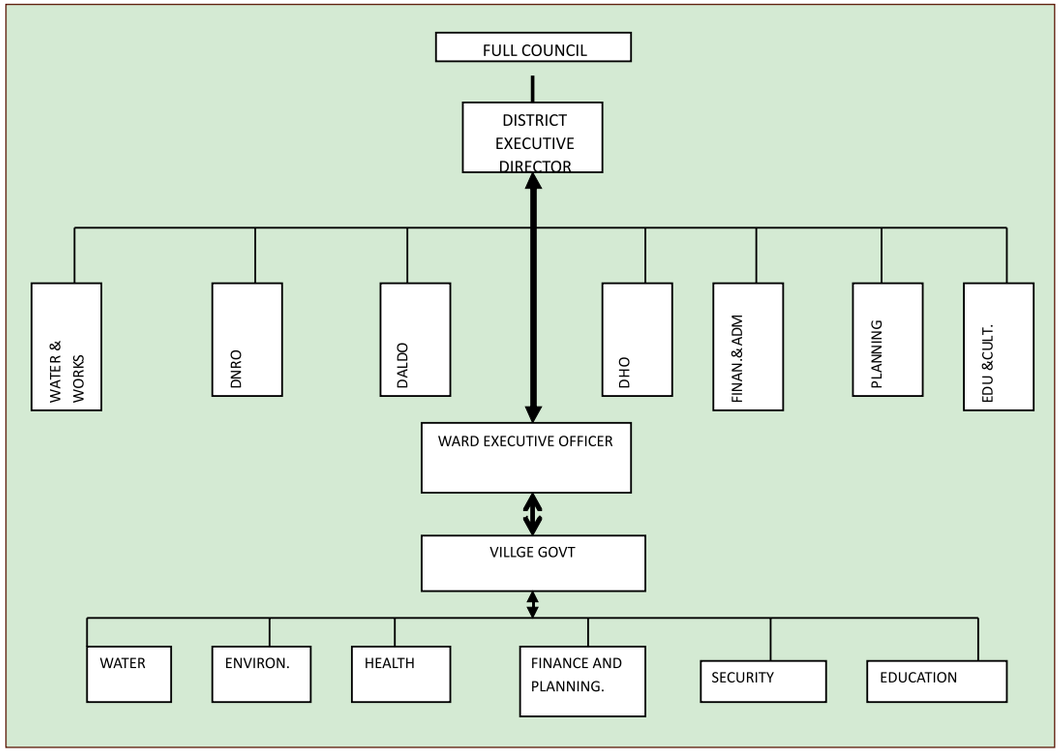


Figure 4.2 Generic Organisation structure of the District Council

4.6.5 Village level

In general, communities play a major role in the water sector because they are the primary users, guardians and managers of water sources. Participation of both men and women in decision-making, planning, management and implementation of water resources management and development must be enhanced. As future managers of water resources, youth need to be involved and educated for better management and future sustainability.

Section 3.5 mentioned that water committees are often formed at the local level to manage water supply. The members of the water committee are selected by the village assembly and report to the village executive committee (see Figure 4.3). The water committee is responsible to manage the water sources and collect fees to maintain the supply network

(pipes, pumps and taps), ensure sustainability and prevent of pollution. There are sometimes water committees for the entire ward and in sub-villages and in some cases, such as in urban areas, there is a water committee for each water source (i.e. borehole, tap). Water committees tend to be present where access to water is limited and supplies are scarce.

Water committees sometimes clash with village government over the division of finances. In most cases the financial and technical support has come from the government or from various donors such as NGOs. In some communities, there are farmers' associations that manage water for irrigation. These tend to be stronger in areas with irrigation infrastructure. They are not always within the village government structure.

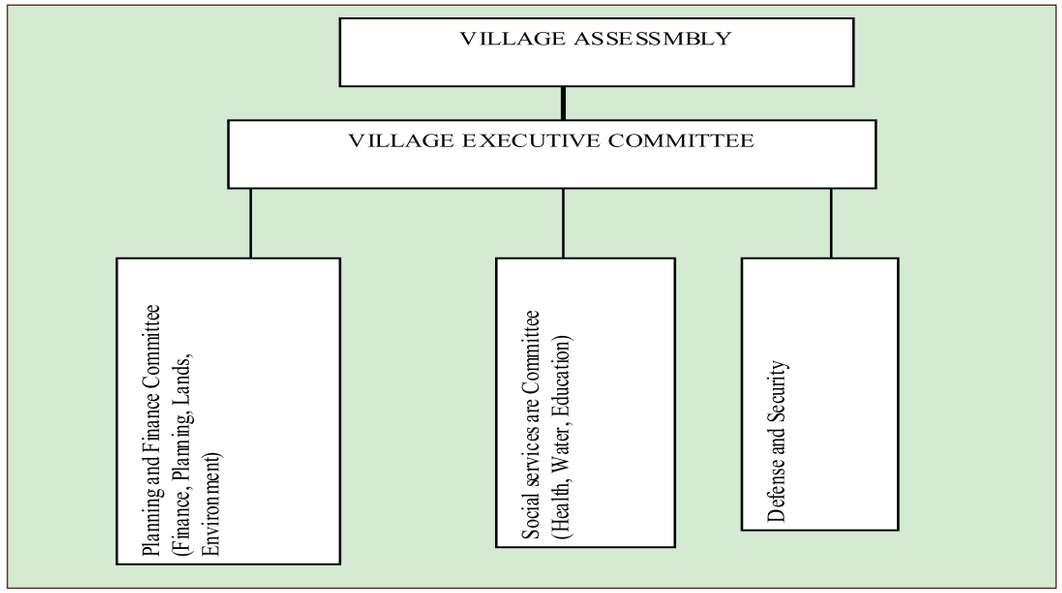


Figure 4.3 Generic Village Government structure

4.6.6 Water User Associations

WUAs are in the Water Policy, which was approved in 2002. WUAs or Water User Groups (WUGs) are the lowest level of management within the Tanzanian water management structure. WUAs aim to assist the Basin Water Office in managing water sources in the basin. Such associations are responsible for local level management of allocated water resources, mediation of disputes among users and between groups within their areas of jurisdiction, collection of data and information, participation in the preparation of water utilization plans, conservation and protecting water sources and catchment areas, efficient and effective water use and ensuring return flows, enforcement of the law and implementation of conditions of water rights, and control of pollution. In the future, WUAs will form sub-catchment committees and provide representatives on Basin Boards and Catchment Committees.

WUAs consist of multiple water users from a common source such as irrigation, domestic water supply and livestock owners committees for a single spring. organization. The WRBWO encourages the formation of WUAs as umbrella organizations for all water users in an area using one drainage system.

A WUA can apply for water rights for activities such as irrigation or livestock watering, which is intended to make administration easier, because then the Basin Office deals with a WUA alone and not multiple individuals. WUAs are also supposed to collect fees from water users that will ultimately be used to pay for their water right (IUCN Eastern Africa Programme 2003). The process of obtaining water use permits is outlined in section 4.4. In order to have a strong WUA, the WRBWO suggests that each association or group employ a member to allocate schedules and day-to-day activities. This position would be funded from water user fees, operation and maintenance fees.

There are approximately 34 WUGs in the Wami and Ruvu basins; these consist of water user committees that are responsible for domestic water supply, irrigator associations responsible for canals, livestock keepers and fisheries. Currently, there are no formal water user associations that would bring these disparate groups using the same water source under one umbrella association. The WRBWO is planning to use district facilitation teams to travel to different areas to enhance the formation of WUAs in various communities. Establishment of WUAs is critical because they provide the institutional mechanisms to address water needs and conflict resolution at the local and sub-catchment levels.

4.7 Gender aspects in Water Resource Management

Active and effective participation of women and men in rural water supply programs is mandated in the NAWAPO. In rural areas, women bear the burden of searching for water and are informally guardians of the environment. However, this pivotal role has seldom been reflected in institutional arrangements for the development and management of rural water supply and sanitation services. Rural water supply programs are required to improve of women's participation by the following:

(i) fair representation of women in village water user entities will be encouraged
(ii) rural water supply programs shall be based on what both men and women in rural communities know, want, and are able to manage, maintain and pay for.
(iii) raise awareness, train and empower women to actively participate at all levels in water programs, including decision making, planning, supervision and management.

Gender has been mainstreamed according to the water policy, which requires equal male and female representation. For many water supply schemes there are more women than men on the committees. Women are often elected as the chair and are commonly nominated as treasurers. However, the power of the women on the committees varies. For example in Kinole in the Ulugurus very few women attend the meetings because they are uneducated and lack awareness and they do not see the value of attending the meetings if their voices will not be heard.

4.8 Other Policies and Institutions

Water is a basic natural resource and a fundamental input to various socio-economic development activities, such as industrial production, irrigated agriculture, livestock development, mineral processing and hydropower production. Since water resources management and water supply and sanitation are multidisciplinary and multi-sectoral activities, the individual health, environmental, local government reform, rural development, land, settlement and forestry policies provide strategic linkages to the NAWAPO, and supplement the aims and objectives of NAWAPO as envisaged under this programme. Below are water related policies relevant to water resources management (URT 2002).

Health Policy: The vision of the Ministry of Health and Social Welfare is to provide health services of high quality that are effective and accessible to all, and delivered by an effective and sustainable national health care system. Health sector policy emphasizes the need for

adequate supply of water and basic sanitation in order to minimize water borne diseases and recognize that the health of individuals, families and the community at large is dependent on the availability of a safe water supply, basic sanitation and improved hygiene.

Environmental Policy: Environmental policy objectives for the water sector are geared to ensuring that planning and implementation of initiatives related to water resources are carried out in an integrated manner, and in a way that protects water catchment areas and their vegetation. Environmental policy promotes EIAs and sustainable water management by closely collaborating with NEMC, the Division of the Environment of the Vice President's Office and other agencies. Implementation of the environmental policy gives NEMC the authority to set standards and issue permits for the discharge of effluents into the environment, including into water bodies. The roles and responsibilities of the Basin Water Offices and the NEMC in controlling pollution will need to be reviewed and harmonised under this programme.

Forestry Policy: This policy recognizes that water sources are one of the key pre-requisites for local and international development. The policy stresses that population pressure and inefficient forestry management and protection have contributed to the deterioration of catchment forest areas, causing water shortages. The Forestry Policy in conjunction with the Land and Settlement Policy, (discussed below) needs to address measures for protecting important catchment areas, recharge areas, springs and other key water sources and zoning flood prone areas.

Local Government Policy: The overall objective of the local government policy is to improve service delivery by making local authorities more democratic and autonomous within the framework established by the central government. The policy identifies the provision and facilitation of water and sanitation services as an important responsibility of local government. The policy is intended to create viable entities, develop required local government and central government relations, establish the necessary legal framework and develop the necessary capacities for effective performance by local government organizations. The policy not only confirms the legitimacy of local authorities, but also helps them generate more revenue, reduce costs and operate water facilities more efficiently.

The policy also envisages that the future magnitude of grants to local government will depend on the performance of the authorities, the state of the economy and the financial consequences of reducing the implementation role of ministries through decentralisation and privatisation. Implementation of local government policy will provide an environment that is conducive and complementary environment for the WSDP to operate, although a prime challenge remains for the decision-making leadership and funding.

***Rural Development Policy and Strategy (RDPS)*:** The RDPS acts as a platform on which sector ministries' policies are coordinated, harmonised, and integrated, to give the rural development process a holistic view. In the case of the water sector, the RDPS states that:

- the central and local governments will pursue and/or promote an integrated approach to rural water supply and sanitation, productive activities and human consumption
- the central and local governments and other stakeholders will mobilize funds and attract private resources to ensure increased supply of safe water within household proximity
- the central government will create an environment conducive to private sector participation in developing rainwater-harvesting technology that is appropriate for rural areas.

The new implementation arrangements and requirements are in compliance with the overall principles of public sector reform and the Local Government Reform Programme.

Land and Settlement Policy: The National Human Settlement Policy and the National Land Policy are two distinct policies but they both recognize the existence of unplanned settlements in most urban areas. Unplanned settlements in rural areas can lead to significant degradation, soil erosion, pollution of streams, etc.—all impacting downstream and in-stream water users. In turn, these settlements will bring about unplanned water demands that can impact other users who have water user rights through permits. The former calls for the upgrading of those settlements through the provision of basic infrastructure services, such as roads, water supply and sanitation.

Energy Policy*:* Hydropower is emphasized as a viable and less expensive source of energy. More than 60% of electrical power is generated through hydropower plants, and more is available for development. Although hydropower is not a consumptive water user, it requires large storage reservoirs situated in areas with high evaporation losses, safe management of dams and reservoirs, resolution of conflicts with downstream and upstream water users, management of floods and minimisation of negative impacts to the environment.

Agricultural Policy: This policy advocates the use of irrigation to improve food security, increase agricultural productivity and income whilst producing higher value crops. Achieving anticipated agricultural and livestock targets will require a considerable contribution of water as a basic resource for agriculture development. With water resources being available in large lakes, reservoirs and rivers, there is good potential for agricultural development through irrigation, which will draw on these resources and, thus, require effective resource management practices in the future.

4.8.1 The Zonal Irrigation Office

Procedurally, the Zonal Irrigation Office designs irrigation schemes, and is also involved in water management issues, such as irrigation scheduling and promoting proper agronomical practices. The Office facilitates the formation of water user groups, which are sometimes formally registered with the WRBWO. The Office also carries out training on the proper operation and maintenance of schemes. Feasibility studies are carried out to establish new irrigation schemes. The Zonal Irrigation Office has also established guidelines on formulation, design and construction, and operation and maintenance of irrigation schemes.

The Office covers Dar es Salaam, the Coastal and Morogoro Regions. At the district level, there are irrigation technicians who make links with the Zonal Irrigation Office. The types of irrigations schemes include:

- Large scale—Ruvu, Dakawa rice farms
- Traditional—not technically designed schemes, canals, abstraction (larger groups)
- Small holders—improved traditional schemes

4.8.2 The Dams and Drilling Construction Agency (DDCA)

The primary activities of the Dams and Drilling Construction Agency (DDCA) are drilling boreholes and constructing small and medium-size dams in any basin. The DDCA, a publicly owned company, reports to the Permanent Secretary from the Ministry of Water. It collects revenue for its services, although the government provides some subsidies (0.43% of revenue). The DDCA has drilled 2062 boreholes in Dar es Salaam since 2007, where there are 3,500 boreholes, including those drilled by private companies.

DDCA's clients include the central and local governments, NGOs such as Plan International and WaterAid, the private sector and DAWASA. They are involved with the development of the Kimbiji well field, as they carried out a ground-water survey for all boreholes, and will be

consulted in the drilling process. The DDCA also builds small dams for small-scale irrigation and livestock but generally not for hydropower. However, in other basins they have been involved in larger dams.

DDCA has six zonal offices throughout the country, including the Eastern, Northern, Western, Lake, Central and Southern highlands zones. If the zone offices were not present, then drilling would be more expensive due to the cost of transporting equipment to a site. However, capacity in the zonal offices is inadequate so there are plans to improve this situation.

Apart from reporting to the Permanent Secretary, DDCA interacts with the Water Laboratory Department, which tests water quality of samples provided from new boreholes, which they pass on to customers. In addition, DDCA employs environmental specialists who are involved in surveying new boreholes and they report about and provide advice on environmental impacts. They also carry out or hire consultants to conduct EIAs prior to the construction of dams. Prior to drilling or construction at a new site, a survey is carried out that also involves discussion with the local government.

Under the new water law, the DDCA is supposed to consult the WRBWO when constructing a new borehole or dam basin office in a new arrangement. Currently they have no formal consultation, although information is sometimes shared through informal channels. Furthermore, DDCA currently does not facilitate water rights. Thus customers are not informed about the need to apply for a water permit when building water infrastructure. In the future, WRBWO will provide permits for drilling.

4.9 Data collection and monitoring

In order to carry out its functions effectively, WRBWO needs to collect data of different types, including hydrological data, weather data and water quality data. These data are processed and the information gained is used in decisions made on water allocation, monitoring for compliance and others (e.g. research, structures design, etc).

The Basin Office is establishing monitoring wells for the entire basin. There are 48 river gauging stations within the basin and only 29 are operational with automatic data loggers. Ten gauges have tendered documents to be rehabilitated, but the procurement process is lengthy. Within the existing network, the Basin Office conducts a monitoring programme that involves technicians gathering data every few months during both the wet and dry seasons. WSDP is planning to establish real-time data collection stations via remote transmission.

The WRBWO is collaborating with the Tanzanian Meteorological Agency for data sharing. WRBWO intends to establish a Water Quality Monitoring Programme in order to address key issues regarding water quality. Before the programme commences, they will conduct a baseline study on Wami and Ruvu River systems and the Coastal Rivers South of Dar es Salaam that drain to the Indian Ocean. A team that comprised of an Environmental Engineer, Hydrologist and Water Laboratory Technician made an inventory to the proposed monitoring areas.

4.9.1 Inventory of data

Inventory of data carried out in Wami sub-basin found that there were 15 river gauging stations. Most stations were established in the 1950s and 1960s and are not operating well. With regard to rainfall, there were 109 stations mostly established before 1950s. No water quality stations were found in the basin. Water quality was measured during specific projects and most data is on domestic water supply (CMEAMF, 2005). In a study by (WRBWO 2007b) it was shown that that the river network comprises the main River Wami, its 5 major tributaries (Lukigura, Diwale, Tami, Mvumi/Kisangata and Mkata). The Mkata tributary is the largest comprising two major sub-tributaries, the Miyombo and the large Mkondoa. Mkondoa itself includes a major Kinyasungwe tributary with its two Great and Little Kinyasungwe draining the dry upper catchments in Dodoma.

Consequently, the number and spatial distribution of flow gauging stations is related to the size of the drainage areas. The inventory of available information on river gauging observations network indicate that there have been 32 primary and secondary flow gauging stations in the sub-basin, two of which are locally managed (WRBWO 2007b).

The stations were established in various periods since the 1950s through to 1970s and have been operational in various periods between the early 1950s and 2007. Spatially, there have been a few (usually one) gauging stations in small catchments or tributaries such as Miyombo, Tami and Lumuma and several gauging stations in large catchments of large and long rivers such as Rivers Kinyasungwe, Mkondoa and Wami. The existing dense network has significantly declined since the early days due to several factors including necessary closure from unfavorable site conditions, poor maintenance and replacement of measuring equipment, etc. Currently, only a few (14) gauging stations are still operational with some receiving major rehabilitation in 2006 (WRBWO 2007b). Table 4.3 summarizes the current networks available for data collection in the Basin.

Table 4.2 Current Data collection and monitoring networks in the sub-basin

Type of the network	Total No of stations	No of stations working
Hydrometric stations	14	14
Rainfall stations		
Weather stations	4	1
Water Quality Stations	7	7

4.9.2 Current status of data collection and monitoring networks

Information from WRBWO indicates that there have been improvements in rehabilitation and construction of new stations for data collection and monitoring for compliance. Table 15 has details of the current networks for data collection and monitoring in the Wami sub-basin. These stations are those which are operated by WRBWO. In terms of hydrology, an important concern is the quantity and quality of data available for rivers of the Wami Sub-Basin. Although there are 26 different gauging sites in the sub-basin, the datasets from these gauges vary in their period of record. A few gauge sites date back from the 1950s, but most flow records span only the period of the 1970s-1980s. Very little discharge data are available from the mid 1980s through 2005 (WRBWO 2007b).

In 2006 a noteworthy attempt was made by the Wami/Ruvu Basin Water Office to rehabilitate many of the gauging sites, and hydrologic data, at least water levels, are being collected from 12 sites as of late 2007 (WRBWO 2007b). However, the rating curves of most of these stations still need verification or revision in order to ensure accurate estimation of discharge from observed water level measurements (Ndomba 2007). Data quality issues were therefore of concern for the Wami IEFA team, and it was necessary for the hydrologist and hydraulic engineer to assess the suitability of data from gauges and make modifications where necessary (WRBWO 2007b). Table 4.4 shows the status of the streamflow gauges in the Basin.

Table 4.3 Status of streamflow gauges in the Wami/Ruvu sub-basin ***4.10***

SNo	Station Code	River	Location	Gauge Range	Last Data Received	Status
1	1G1	Wami	Dakawa	0-10m	December 2006	Operational – rehab in Sep 2006
2	1G11	Chogoali	Difulu Village	0-3m		Non-operational
3	1G2	Wami	Mandera	0-5m	August 2003	Operational – rehab in Dec 2006
4	1G5A	Tami	Msowero	0-5m	July 2007	Operational – rehab in Oct 2006
5	1G6	Kisangata	Mvumi	0-6m	March 2007	Operational – rehab in Oct 2006
6	1G6	Wami	Rudewa		August 1969	Non-operational
7	1GA1A	Lukiguru	Kimamba Rd. Br	0-5m	May 1987	Operational – rehab in Sep 2006
8	1GA2	Mziha	Mziha (Kimamba)	0-4m	July 2007	Operational – rehab in Sep 2006
9	1GB1A	Diwale	Ngomeni		July 2007	Operational – rehab in Oct 2006
10	1GB2	Mkindu	Mkindu		August 1969	Non-operational
11	1GD32	Mkondoa	Railway Brg.	0-4m	April 1991	Non-operational
12	1GD35	Myombo	Kivungu	0-6m	April 1963	Operational – rehab in Oct 2006
13	1GD14	Kinyansungwe	Gulwe		June 1977	Non-operational
14	1GD16	Kinyansungwe	Kongwa/ Dodoma	0-5m	July 2003	Operational
15	1GD17	Kinyansungwe	Godegode		April 1984	Non-operational
16	1GD2	Mkondoa	Kilosa	0-6m	March 1991	Operational – rehab in Oct 2006
17	1GD21	Kinyansungwe	Itiso		June 1992	Operational
18	1GD29	Mkondoa	Mbarahwe	0-5m	August 1980	Non-operational
19	1GD30	Lumuma	Kilimalulu	0-4m	March 1989	Non-operational
20	1GD31	Mdukwo	Mdukwe	0-4m	June 2003	Non-operational
21	1GD33	Masena	Ibumia		June 1976	Non-operational
22	1GD34	Kinyansungwe	Mayamaya		March 1983	Non-operational
23	1GD36	Mkata	Mkata	0-6m	June 2007	Operational – rehab in Oct 2006
24	1GD37	Kinyansungwe	Ikombo	0-4m	March 1990	Operational – rehab in Sep 2006
25	Local	Kinyansungwe	Ipala	0-4m	June 1985	Non-operational
26	Local	Kinyansungwe	Chihanga	0-4m		Operational – rehab in Sep 2006

4.11 Summary of key points – Water Resource Management

The basin operates with IWRM guidelines, whereby management of water resources is conducted at the basin level and within the bounds of the NAWAPO of 2002 and the new law known as The Water Resources Management Act, No. 11 of 2009. It is an Act to provide for institutional and legal framework for sustainable management and development of water resources; to outline principles of for water resources management; to provide for the prevention and control of water pollution; to provide for participation of stakeholders and general public in implementation of the National Water Policy

Most water users have been reluctant to pay water user fees. Currently, only the major users such as MORUWASA and DAWASCO pay for water. More effort is required to create awareness among users to fulfill their roles. Industries have been the main offenders on the discharging effluents. Efforts are still continuing with the support of NEMC to promote good water quality for humans and biodiversity.

The major source of funding has been the government whose allocations have decreased over time. Various strategies have been put forward, including conducting a study of how to achieve sustainable self-financing for the basin. The current water tariff will be reviewed regularly and adjusted accordingly. District Councils are better situated to manage water at local levels. Although women are active on many village water committees, they still need to be empowered to effectively participate in decision making. Village Water Use Committees still require capacity building to effectively manage resources and finances. Data collection—particularly monitoring of abstraction—is still weak due to inadequate financial resources within the basin.

5 Opportunities and Constraints in the Wami sub-basin

The previous sections have presented an evaluation of the existing natural resource base and related threats, socio economic activities and their impacts on the water and natural resources as well as the water management regimes in the sector.

5.1 Challenges and issues of the sub-basin

Based on interviews conducted for the purposes of this Situation Analysis and a stakeholder workshop held in Morogoro 15–16 December 2008, this section of the report compiles information to assemble the perspectives of various stakeholders in the Wami sub-basin. The main problems and issues can be broadly be categorized into natural resources management, conflict issues and water resources management issues. On the basis of these issues, the concluding section lays out a number of priority areas for action.

5.1.1 Water resources

Encroachment of water sources

Threats to the Ukaguru Mountain forest include encroachment from farmers and workers from the plantation forest, fuel-wood collection and fires spreading from lowland areas. Degradation of this catchment forest has multiple impacts on water resources. First, removal of forest areas is believed to impact the level of rainfall in the region. It does directly affect the level of water storage in catchment forests. Without adequate forest protection, water run-off increases and flows become more variable. Removal of forest cover for charcoal production and development of agricultural land increases erosion, which also impacts the flows in rivers due to siltation. Other impacts include a loss of biodiversity and natural forest products to support local communities.

Protection of river-banks is needed to protect water sources. Environmental committees do exist in some communities and aid in raising awareness regarding the protection of water sources. Pastoralists that need to access the river to water their livestock contribute to river-bank erosion. They are willing to use and even contribute to the construction of cattle troughs but often they do not exist or are insufficient in number. There is sometimes cultivation along the river-bank and agricultural expansion in watersheds in places such as Chalinze, Wami Mbiki and Nguru, which also contributes to erosion and siltation in the rivers.

Water scarcity and increasing water demand

With population growth, there is more pressure on available resources. The challenge is how to cope with an increasing demand coupled with increasing water scarcity. The Wami Sub-basin is among the basins with a high potential for irrigated agriculture and the government is investing in the area to improve existing irrigation schemes and possibly build new ones. Extraction of water by these schemes needs to be carefully monitored as there may be significant impact on water flows especially during the dry season. Furthermore, irrigation infrastructure is often inefficient and leads to excessive water losses which drain away water resources through evapotranspiration large amounts of water are wasted. Also the impacts of upstream agriculture can increase sedimentation and contaminated run-off resulting in siltation and pollution of reservoirs such as Hombolo. This in turn affects the ability of farmers to access water of adequate quality and quantity for irrigation.

Upstream abstractions

There is some concern about upstream abstractions, and how they might affect downstream water allocation. For example, at the Mtibwa Sugar Estate water levels are very low during the dry season and they cannot abstract their full water allocation. SEKAB wants the WRBWO to ensure efficient water management and prevent illegal abstractions. In addition, there is a need for greater water storage to buffer low flows during the dry season. On top of all this, it is vital to maintain environmental flows going downstream that reflect the seasonality of flow in the river, in order to maintain a healthy environment that continues to provide natural resources to support people's livelihoods.

Ground water abstraction and pollution

Ground water overpumping and contamination in the Wami sub-basin is a concern. For example, in Dodoma there are problems with individuals that drill private boreholes in town, as the ground water is shallow and can be impacted by latrines. If businesses mix this potentially contaminated water with DUWASA supplied water then it can be difficult to identify the source of the disease. In other areas such as Kongwa, ground water is naturally saline which can limit its use for domestic purposes.

Protection of the Makutopora well field, which supplies Dodoma, is relatively successful but there is still some livestock activity in the area. There is also a problem of bush fires which damages trees in the catchment area of the well field. These fires may or may not be due to sabotage; rather people may be trying to protect their cattle by setting fires.

Pollution

Downstream communities in the basin are often affected by upstream pollution. Downstream impacts include sedimentation from erosion as a result of deforestation and agricultural practices and contaminated water. This reduces access to safe drinking water and water for livestock and agriculture, and investment must be made in other water resources such as ground water. However, people often use contaminated water as there is no other alternative and, without boiling it, run the risk of water-borne diseases such as cholera. If the water is boiled for safe consumption this puts added pressure on forest as they are exploited for fuel.

The source of pollution is often difficult to determine. Possible polluters tend to blame each other; contamination can come from industry, agriculture, fishers that use poison to catch fish and domestic sewage. Even if monitoring is carried out it does not always allow the WRBWO to pinpoint the source of pollution.

5.1.2 Socio-economics and politics

The WSDP addresses a priority for many communities, access to water supply for domestic use, but often construction of the water supply networks are delayed due to problems with contractors. For example, Ngerengere has raised the required 5% of the cost for a water supply scheme and two boreholes have been drilled. However, the village is waiting for the contractor to fix the distribution network, a problem that has existed for two years

Section 3.9 outlined various types of conflict in the basin. There are conflicts between upstream and downstream users, usually in regards to water quality. For example, Mtibwa

Sugar Estate has been identified as a source of pollution when their effluent ponds fail resulting in contamination of the river and impact on the Wami Mbiki WMA and Sadaani National Park. At the same time, poor agricultural practices result in increased siltation, and illegal fishing using harmful chemicals can have devastating impacts on the riverine ecosystem. There are also significant increasing conflicts between pastoralists and farmers over access to land and water, especially in the Kilosa district. Finally, there are conflicts over financial resources between village governments and water committees. Funds obtained from water fees are seen as a possible source of income for other activities in the community rather than investing in developing and maintaining the water supply infrastructure.

5.1.3 Policy and law enforcement

Protection of water sources

Protection of water resources is often inadequate, not because of the lack of laws and regulation, but due to limited enforcement. This is compounded by a lack of awareness on the need to protect water sources within communities. Furthermore, there is inadequate monitoring of surface water abstractions, pollution and the location of boreholes. Illegal drilling of boreholes and the over-pumping of ground water are main concerns ground-water, especially along the coast where these activities have resulted in saline intrusion and subsidence.

The law does not provide adequate power to ensure that people pay for their water rights and therefore the WRBWO reported that no organizations have been prosecuted for infringements. If results are above acceptable standards then the WRBWO writes to the offending organization to explain their breach. They are then given some time to amend the situation before follow-up checks are carried out. If the Basin Office cannot take action, then people will not pay in the future. The Office needs to be able to use the law to prosecute although they employ social means such as dialogue and awareness raising to prevent breaches.

Water permits and payments

The WRBWO reports low payment rates for water user fees. It is often difficult to get users to register for water rights, especially if a community has been historically extracting water from the river without previously paying. In many cases there is a lack of awareness on the need to apply for water permit in order to legally abstract water from a source including both surface and ground water.

The Water Resources Management Act, No. 11 of 2009 provides a legal framework for sustainable management and development of water resources, and importantly, enforcement support. The Act outlines principles for water resources management, provides for the prevention and control of water pollution and provides for participation of stakeholders and the general public in implementation of the National Water Policy.

5.1.4 Management and administration

Weak stakeholder linkages

The WRBWO is not well known and its role is not clear to all stakeholders. Those who are aware of the basin want to see tangible outputs from the office beyond issuing permits and collecting water fees. This includes protecting water resources, providing technical support, disseminating data and building capacity.

Stakeholder involvement in the management of water resources in the sub-basin is weak and would benefit from a stakeholder forum to discuss common issues impacting their activities as well as promote the sharing of information between institutions. Such a dialogue could diffuse potential conflicts and mistrust among stakeholders. However, currently the linkages between the Water Basin Office and Local Government Authority are not strong throughout the basin. Local government (district, wards, and communities) provides a conduit to reach water users and are essential in the formation of catchment forums and water user associations.

Information gathering and coordination

Making decisions on how much water could be abstracted requires up to date information on the status of the resources. Information is dispersed between institutions and collaboration is weak. Communication between departments at district, regional and national level is often limited. Not only is communication between sectors inadequate but also between levels of bureaucracy. For example, there is a gap between the district and basin office, and it is difficult to get information on data such as discharge rates. Consequently, databases need updating to ensure there is adequate and accurate information on information such as discharge rates and water users in the basin.

Decisions made at national level are not always useful in communities. There is also a lack of harmonization of policies at the national level resulting in poor multi-sectoral coordination. For example, the demarcation zone around water bodies has historically varied between Ministries and creates confusion when trying to relocate people. This communication deficit also applies to broader issues such as the impacts of climate change on water resources. This is a concern for DDCA and there does not appear to have been any active collaboration with academic institutions. Students do approach the DDCA for information but DDCA is not actively communicating with academic institutions about their research needs. The same issue needs to be addressed with the WRBWO.

Weak capacity

A challenge faced by many of the institutions in the Wami sub-basin is a lack of capacity. For example, the Regional Catchment Office, which protects the catchment forests, does not have enough staff or vehicles to patrol the catchment area. Plus people do not understand the need for forest conservation and simply take timber to supplement their incomes.

Another example of capacity challenges is within the WRBWO. The Office has the mandate to issues water permits, but it is apparent that the office does not have the capacity to monitor compliance of approved levels. Similarly the office does not have the capacity to monitor regularly effluent levels which creates conflicts with downstream users. There may also not be sufficient experts to carry out the mandate of the Office.

5.2 Priority areas for Action

WRBWO is still a developing basin office with limited financial and human resources so it is critical that they choose priorities wisely in order for the limited investment to bear fruit for further development and for the office to ensure that there is a reliable sustainable water resource in the basin.

a) WRBWO has already developed a business plan derived from a SWOT analysis (strength, weakness, opportunity threat).that highlights the following areas of focus: basin level water resources management

b) preparation of integrated river basin management and development plans
c) development of priority WRM infrastructure and studies at the basin level

The WRBWO has suggested that future investment in the basin include:

- water user association formulation and capacity building essential to managing the water resources
- sufficient equipment for the collection of data so that the office can manage allocations of water resources
- secure water sources for most of the district towns in the basin to ensure water supply
- awareness raising on the existence and function of the office and the value of water
- a borehole inventory in Dar es Salaam
- autonomy of the basin that includes a reliable source of funding to run all activities
- investment to construct more storage facilities (reservoirs, ground-water storage)
- human resource development

This situation analysis and workshop determined a number of priority areas that are described in detail in the sections below.

5.2.1 Result 1: Strengthened stakeholder capacity & participation

Identification of stakeholders and their roles and responsibilities

The WRBWO needs to understand its stakeholders—from industrial to irrigation to domestic users—perhaps through stakeholder mapping or analysis. This could be coupled with improving communication between the basin office and key stakeholders such as the districts.

The WRBWO must market itself to communicate its role to water users and they should define roles and responsibilities for their stakeholders and identify areas for delegation. For example, information on water permits applications can be provided at the district level rather than just at the basin office.

Improving communication

There clearly is a need for increased communication and awareness from the WRBWO on their activities, and how it contributes to water resource management. The majority of stakeholders stated that they want to see where funds are being spent and demonstration of tangible outputs. For example, DUWASA wants improved protection of the Makutopora well field by demarcating the whole related sub-catchment. This can be achieved by increased transparency by the Basin Office by making annual reports widely available and communicating their outputs to stakeholders. In addition, a Basin communication strategy can be a clear guide on how to improve information sharing.

Communication with the Basin Office should improve through sharing data and information on sources, as well as monitoring of source capacity. For example, there is reduced flow at Sagara spring in Kongwa and the district cannot figure out why. Technical expertise from the Basin Water Office is needed to solve this problem as the technical capacity is not always available at the district level.

Building stakeholder capacity

There needs to be improved awareness and education on water rights so that water users are aware of when they need to get a water permit and what process needs to be followed. In addition, there is also an immediate need to clarify the future water management set up, which includes information on the Basin officer and their roles as well as how to create water user associations and register the associations. At the same time, information on the necessity to protect water sources and prevent pollution must be communicated to water users. For example, the WRBWO can provide assistance in catchment protection such as helping the district determine what needs to be done (i.e. planting trees, protecting river-banks. They can also train farmers and other stakeholders including agriculture departments on water resource management.

To reduce the information and capacity gap between the Basin and districts there needs to be further integration of district plans in the Basin plans and vice versa. This requires communication and knowledge sharing between WRBWO with Districts. This has been started through the establishment of District Facilitation Teams that are intended to put integrated water resource management into practice. These facilitation teams can be used to raise awareness and carry out training on a variety of issues including IWRM. More specifically the teams can discuss the impact of poison from illegal fishing, importance of preventing vandalism to data collection networks, why relocation is sometimes necessary, where best to drill boreholes, and the understanding of land use (where is best to farm).

Prior to carrying out training and awareness raising, a needs assessment may be useful to decide where is best to invest time and resources. Training and awareness should be considered for different audiences ranging from Basin staff to local government to communities. Finally, measures need to be considered to effectively incorporate environmental education in schools which includes information on managing and protecting water sources.

Improving stakeholder linkages and collaboration

IWRM calls for stakeholder participation in the management of water resources through catchment forums, as defined in the water policy, but they need to be put into practice, possibly with input from the district offices. Catchment stakeholder forums can assist in delegation of basin office roles, sharing of information and conflict resolution.

Through stakeholder platforms, districts can assist in the formation of WUAs. The survey showed that there are several water committees in the Wami sub-basin and such potential groups could be facilitated to form WUAs.

The same platform can contribute towards conflict resolution using District Councils that have mandates over natural resource use in their districts. In the same vein, the stakeholders will also facilitate marketing and awareness raising in the districts and elsewhere on the WRBO and its roles and responsibilities. It should be noted that delegating responsibilities to the districts to create WUA and catchment forums requires financial and human capacity investment. .

There also needs to be more inter-sectoral co-ordination in areas such as managing pollution within the basin. The Basin Office has a large number of potential partners, including District Councils, Zonal Irrigation offices, Irrigators, Water Supply Agents, NGOs and private investors that can be coordinated to implement these actions. Some of these partners are willing to work with the Basin office in areas such as awareness creation on water permits and processing the applications at the district level. Therefore the basin should delegate some of its responsibilities to lower levels. . For example, improved management of water schemes can be partially achieved by building the capacity of the water department at the district level.

Finally, industries should be sensitized on the impacts of their effluents to downstream users. The Basin can work with industries to find solutions and minimize impacts by convening regular meetings to discuss and plan the implementation of restorative measures.

5.2.2 Result 2: Reliable information to support planning & management

Strengthening of Database management (ICT)

The data collected by the WRBWO and partners provide information on the available water resources in the Basin. Thus it needs to be stored and processed for use in decision-making. There needs to be investment in the Basin Office's capacity for not only data collection, but also data management, including computer hardware and software and staff training for data entering and analysis.

Specifically, there is a need for a database describing water resources—particularly on ground-water resources in semi-arid areas. There should also be an inventory of private ground-water drillers in urban areas and where they are drilling. Information on the location of wells and guidelines for drilling can be a step forward in controlling *ad hoc* well development.

Strengthening of monitoring of the quantity and quality of available water resources

The WRBO must ensure adequate instrumentation for both surface and ground-water resources in the basin. Abstraction rates and water quality must be measured regularly, for surface and ground-water resources, particularly in the Dar es Salaam area. A specific concern is the need for regular monitoring of effluent discharges to rivers that affect ecosystem health and downstream users. A databank of how water is used and how much is lost would also be useful for improving efficiency.

WRBWO needs to enhance co-operation and sharing of the collection and monitoring of ecosystems data on hydrology. For example, there are indicators of water flow and quality for monitoring that arisen from studies carried out by CARE. A systematic arrangement between the office and such initiatives would enrich the office database. In addition, some Districts Councils are undertaking various projects that will add value to water resources management in the basin. Another example is DDCA, which is a strategic partner since it deals with most clients requiring drilling services. They could provide WRBWO with information on the water infrastructure being developed such as boreholes and inform their clients on the need to obtain a water right. . In addition, best practices in collection of data should be shared in order to continue learning and update monitoring methods. Regular sharing of this information is critical

Communities can be trained and encouraged to co-operate in collecting monitoring information. For example, there are often persons that are responsible for collecting data from monitoring stations which includes water levels and sometimes flow rates. This can improve ownership of the monitoring station and possible reduce the incidence of vandalism.

5.2.3 Result 3: Resources efficiently planned and managed

Effective planning

IWRM planning is essential at all levels from the basin to sub-catchment to streams. They need to understand how multiple users will access, use and manage the resource. This could mean designing structures for different users, such as livestock keepers and farmers, promoting conservation farming and exchanging information on how to resolve conflicts. Obstacles to implementing such plans in place require that opportunities first be defined and studied. If livelihoods are affected then planning may include setting up alternative incomes to charcoal and mining, through the introduction of other industries such as tourism, bee keeping, fishing and hunting. Simple but effective monitoring and evaluation plans that can detect changes—including quantity and quality and allow for adaptive management of water resources—could be implemented.

In order to have effective IWRM planning it is necessary to have water assessments of both ground and surface water so the availability of the resource is known. A water balance is needed and the water demand also needs to be assessed which includes demand by the environment to a level of health decided by stakeholders. This can be determined by undertaking an environmental flows assessment (one has been carried out already in the Wami sub-basin).

IWRM should also take into account other sectoral plans especially land use planning which also includes multiple stakeholders. Involvement of industry is also important and should include co-operative action plans to ensure water allocation that accounts for availability of the resource and prevention of pollution that will impact downstream users.

Improving water use efficiency

Improving water use efficiency can include a range of activities such as improving existing infrastructure by, for example, lining irrigation canals to reduce leakage. Other possibilities include creating awareness on efficient technologies and conservation strategies such as harvesting rainwater. Larger-scale solutions can also be explored, including the introduction of water storage facilities and modifications to existing resources to minimize water losses in irrigation and domestic use.

Water abstraction and pollution control

Support for implementation of the new Water Resource Management Act, 2009 is crucial. However, continued weak monitoring of polluters means that is difficult to enforce regulations and for the WRBWO to be seen as a legitimate entity to manage water. Collaboration with other government agencies such as NEMC can improve monitoring of pollution source and enforcement of regulations. In addition, it is imperative to raise awareness of the impacts on water source from upstream activities including mining, and farmers using manure and fertilizer. This can be achieved through NGOs or another sector.

The WRBWO needs to have the resources to monitor compliance on the quantity of abstractions approved to have a better idea of the available water resources in the basin. This is essential for determining future allocations. WRBWO also need to frequently monitor effluent quality from industries to safe guard downstream users

It has been suggested by some stakeholders in the basin that water permits should indicate seasonal abstraction amounts rather than a constant value. This reflects the seasonality of flows in the river and ensures that there is sufficient water for the environment during rainy and dry seasons.

Catchment protection

Catchment protection is a vital component of managing water resources, and this should include clear demarcation and planting of trees. Improved protection of well fields can also be achieved by demarcating as well as zoning the sub-catchment so that polluting activities are limited. There is also a need to protect future potential water sources from pollution, such as the Hombolo sub-catchment and the Bubu River. This will save the cost of relocating people in the future

Protection of the forests is vital for water management and can be achieved through adequate monitoring and patrolling. This means a greater level of capacity in the Catchment Forest Project, as well as building firelines and having access to fire fighting services. Other priorities include village tree planting, income generating activities (such as beekeeping, aquaculture, livestock keeping), and awareness raising. WRBO should participate and invest with other lead partners CARE, Eastern Arc Mountains Conservation Endowment Fund, Regional Catchment Project, LVIA, MAMADO and the Living Project so that village environmental committees play a great role in forest catchment protection.

5.2.4 Result 4: Strengthened regulation and compliance

Harmonizing laws

There are cases of conflicting legislation, such as is the case of the distance allowed to build a structure from water source, so. there is a need for harmonization and enforcement of all laws that improve catchment protection. At the same time, there needs to be awareness on what laws apply where and how. Finally, local by-laws should be linked to national laws and at the same time such by-laws can inform laws at various levels.

Strengthening interagency co-operation and enforcement

Existing laws are not fully effective to control polluters and illegal abstraction. Stronger legislation has been drafted (in the Water Resource Management Act, 2009) to control polluters and illegal abstraction but support for implementation is crucial. Stronger legislation is being drafted but support for implementation is crucial. The continual inadequate monitoring of polluters means that is difficult to enforce regulations and that the WRBWO in not widely acknowledges as a legitimate entity to manage water. Collaboration with other government agencies such as NEMC can improve monitoring and enforcement of regulations.

The WRBWO requires resources to monitor compliance on the quantity of approved abstractions and to comprehend the available water resources in the basin. This is essential for determining future allocations. WRBWO also needs to collaborate with other institutions to monitor effluent quality from industries in order to safeguard downstream users

5.2.5 Result 5: Sustainable financing ensured

WRBWO has reported that revenues collected from water permits provide 40% of the finances needed for operation. Therefore 60% of funding comes from the government. The basin office should undertake research on the current water tariff and its rationale, which could be a way forward to determine how to strengthen the revenue base. Furthermore, it could consult with SADC and neighboring countries on how financial sustainability can be achieved.

5.3 Opportunities to implement priority action areas

Comprehensive water resources management in the basin is critical to all basin stakeholders including urban municipalities, districts, irrigation schemes and industries. Furthermore, wise management is crucial for maintaining a healthy ecosystem with biodiversity. Currently the government is implementing the WSDP aimed at addressing challenges affecting the management of river basins in Tanzania. The new Water Resource Management Act will strengthen compliance by providing legal strength to pollution control regulations.

It is against this background, that the government is committed through its long-term programme (WSDP) to see that the above is achieved. The WRBWO has undertaken the development of a business plan and situation analysis that will provide focused areas for action and hence a marketable output.

Available supporting partners may include but is not limited to IUCN, JICA and SNV. Future joint ventures should be explored with district councils, water supply agents, major irrigators, NGOs and future partners.

Annex 3 provides some possibilities and examples of how the priority areas of action could be implemented.

6 Conclusions

6.1 Synthesis of findings

The synthesis of findings is summarized in the logical framework shown in Figure 6.1. The goal of the sub-basin is that its water resources are sustainably managed for the socio-economic and environmental needs, interests and priorities of the sub-basin population.

Five main results areas were identified:

1. Strengthened stakeholder capacity & participation.
2. Reliable information to support planning & management
3. Resources efficiently planned and managed
4. Strengthened regulation and compliance
5. Sustainable financing ensured

A logical frameworks for the two sub-basins combined was also developed so as to provide focus to the WRBWO (Figure 6.2).

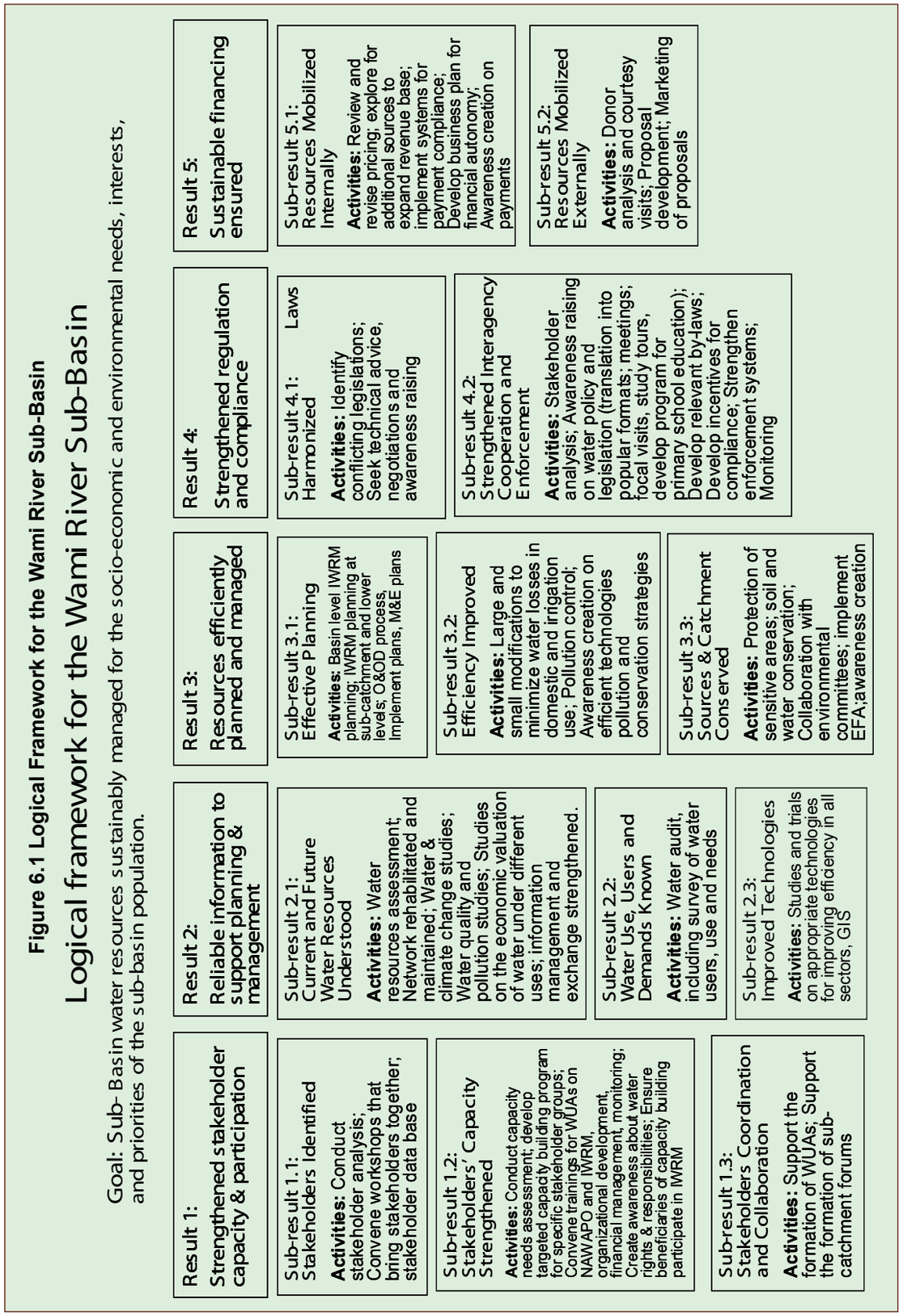
Using this logical framework the WRBWO can put together a plan of action. The aim is to efficiently use available resources to invest in successful projects that will achieve the Water Sector Development Programme.

6.2 Gaps in information

The database on sub-basin water resources is still inadequate due to financial limitations within the WRBWO. The database on water abstraction is decent but the main problem is lack of compliance on approved permits.

Information on the expanding livestock population and its impact on the land use and water resources are not well known. Records are needed on the increase in livestock in the sub-basin and analysis of perceived impacts.

Other missing information is the impact of climate change and the effect of these impacts on water resources. This is important in view of the increasing water needs, expanding population and global climate changes impacting on soil moisture availability.



WSDP Framework for the Wami-Ruvu River Basin

Example Goal: Healthy Wami and Ruvu River Basins that supply water of adequate quality and quantity to the people and environment of the Basins

Result 1: Strengthened stakeholder capacity & participation

- **Sub-result 1.1:** Stakeholders Identified
  Activities: Conduct stakeholder analysis; Convene workshops that bring stakeholders together; stakeholder data base
- **Sub-result 1.2:** Stakeholders' Capacity Strengthened
  Activities: Conduct capacity needs assessment; develop targeted capacity building program for specific stakeholder groups; Convene trainings for WUAs on NAWAPO and IWRM, organizational development, financial management, monitoring; Create awareness about water rights & responsibilities; Ensure beneficiaries of capacity building participate in IWRM; Targeted conflict resolution activities
- **Sub-result 1.3:** Coordination & Collaboration
  Activities: Support the formation of WUAs; Support the formation of sub-catchment forums

Result 2: Reliable information to support planning & management

- **Sub-result 2.1:** Current and Future Water Resources Understood
  Activities: Water resources assessment; Network rehabilitated and maintained; Water & climate risk and vulnerability studies; Water quality and pollution studies; Studies on the economic valuation of water under different uses; Environmental Flow Assessment; information management and exchange strengthened; Monitoring
- **Sub-result 2.2:** Water Use, Users and Demands Known
  Activities: Water audit, including survey of water users, use and needs
- **Sub-result 2.3:** Improved Technologies
  Activities: Studies and trials on appropriate technologies for improving efficiency in all sectors; GIS systems

Result 3: Resources efficiently planned and managed

- **Sub-result 3.1:** Effective Planning
  Activities: Basin level IWRM planning; IWRM planning at sub-catchment and lower levels; O&OD surveys; Implement plans
- **Sub-result 3.2:** Efficiency Improved
  Activities: Large and small modifications to minimize water losses in domestic and irrigation use; Awareness creation on efficient technologies, rainwater harvesting, pollution and conservation strategies
- **Sub-result 3.3:** Sources & Catchment Conserved
  Activities: Protection of sensitive areas; soil and water conservation; Pollution control; Collaboration with environmental committees; implement EFA;awareness creation

Result 4: Strengthened regulation and compliance

- **Sub-result 4.1:** Policy Documents Harmonized
  Activities: Mapping regulations; identify policy conflicts; technical advice, stakeholder input; negotiations and awareness raising
- **Sub-result 4.2:** Strengthened Interagency Cooperation and Enforcement
  Activities: Stakeholder analysis; Awareness raising on water policy and legislation (translation into popular formats; meetings; focal visits, study tours, develop program for primary school education); Develop relevant by-laws; Strengthen links to district councils; Develop incentives for compliance; Strengthen enforcement systems; Develop allocation guidelines; Monitoring

Result 5: Sustainable financing ensured

- **Sub-result 5.1:** Resources Mobilized Internally
  Activities: Review and revise pricing; explore for additional sources to expand revenue base; implement systems for payment compliance; Develop business plan for financial autonomy; Awareness creation
- **Sub-result 5.2:** Resources Mobilized Externally
  Activities: Donor analysis and courtesy visits; Proposal development; Marketing of proposals

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Annex 1

List of institutions and interviewees in Wami sub-basin

Mtibwa Sugar Estate

1.Bernard Kihula – Assistant General Manager

2. Edward Adul – Irrigation engineer &(Wami/Ruvu Water Board Member)

Wami Mbiki Society

1. Furaha Patson- Capacity Building Office
2. Arafa Mbutulage-Cashier
3. Abubakary Msonde-Capacity Building Officer

Chalinze Water Supply Project

Semka Hashim , Laboratory Technician, Administrator

Saadani National Park

Datomax Selanyika ,Park Waden Tourism

LIVING Project, Mtibwa

Masejo N Songo – Gender Equity, Monitoring and Evaluation Manager

Mafanikio Group – Dihombo Village

1. Andreas Venance ,Village Executive Officer
2. Beata Daniel ,Chairperson Mafanikio Group
3. Ignas Kigadu –Ag. Village Chairperson
4. Elias J Mponda – Vice Chairperson Mafanikio Group

Chanzuru Irrigation Scheme

Mohamed Hamad Member -Village Council

Mzee Maganga Sahuritanga - Member Village Council

Zaina Kibona – Ward Agriculture Extension Officer

Teresia Bruno - Ward Livestock Extension Officer

Kilosa District Council

1. Bakunda Faustin Ag. District Executive Director
2. L F Macha – Ag. DALDO
3. Charles Mogella – Irrigation Technician
4. Mahamoud Libembembe – Agriculture Extension Officer
5. Willie Girbert Chisengo - Irrigation Technician

Kongwa District Council
1. Eng R A Mulungu ,District Water Engineer
2. Shaban Jellan – Water Technician

Mpwapwa District Council
1. Eng Mafuru – District Water Engineer
2.Kapinga – Kilosa Urban Water Supply

LVIA Kongwa
1. Paulo Runko
2. Andrea Lubianco, Agriculture Sector Coordinator

Dodoma Urban Water Supply and Sewerage Authority (DUWASA)
David Pallanjo – Technical Manager

Maji na Maendeleo Dodoma (MAMADO)
1.Mathew Halla , Managing Director (WRB Board Member)
2. Augustin Rukeha , Project Officer
3. Clare Ollerenshaw, Project Management Adviser
4.Fanuel Mzuzu , Accountant

Maji na Maendeleo Dodoma (MAMADO)
1.Mathew Halla , Managing Director (WRB Board Member)
2. Augustin Rukeha , Project Officer
3. Clare Ollerenshaw, Project Management Adviser
4.Fanuel Mzuzu , Accountant

GTZ Tanzania
Ernst Doering ,Head of Programme Support to the Development of the Water Sector
Tony Richards – Consultant

JICA
RUWASA-CAD
Mikiko Azuma
Community Water Supply Facility Planning/Operation and Maintenance

Villagers in Hombolo village
Ms. Eudia Mwaluko
Ms. Mariam Bakari

Annex 2

Questions for Stakeholders

1. Do you know about the Wami/Ruvu Basin Water Office (WRBWO)?
2. What are your linkages to the WRBWO?
3. What are your activities in the Wami/Ruvu Basin?
4. What activities are you undertaking that are related to water resource management?
5. Have you been involved with water user groups or associations/ environmental committees ? How?
6. How do pastoralist, irrigation, and/or agricultural activities impact on water resources ?
7. Do you know about water rights? Do people in your project/district pay for water rights?
8. How do you fund your activities?
9. Are there problems with water quality? What are you doing to mitigate this?
10. What strategies do you undertake to ensure gender equality?
11. Are there any conflicts over water or other natural resources? How are they resolved ?
12. Who are your partners? What is your relationship with the government?
13. What should be the priority areas of investment in your area in the future?
14. Do you share your information with WRBO ?
15. Whom do you think is the critical stakeholder in the basin ?

Annex 3

Implementation of priority action areas

Below are tables that were constructed during the stakeholder workshop which outline how the priority action areas could potentially be implemented.

Result Area 1: Strengthened Stakeholder Participation

Sub results	**Capacity building stakeholder i.e. WUA, Ministries, Basin Office, NGO, LGA.**	**Stakeholder Analysis**	**Capacity needs and assessment** ***- part of capacity building***	**Awareness creation among water users** ***- part of capacity building***
Activities:	Capacity Development needs assessment. To develop capacity building programme. Resolve conflict among water users	Identification of key stakeholders in the basin Organize stakeholder workshops Create stakeholder data base Linkage between stakeholders		Awareness off water rights, water efficiency, responsibilities Training of WUA in - Financial management - Policy, - Water law - IWRM - Organization Management - Monitoring system

Comments:
It was noted that the first step needs to be stakeholder analysis, followed by capacity needs and assessment and awareness creation. These latter two sub-results come under the sub-result of overall capacity building.

Result Area 1: Strengthened stakeholder participation

Sub results:
1. Stakeholder analysis
2. Capacity building of stakeholders (includes capacity needs and assessment, and awareness creation)

Activity	**Who is responsible?**	**Partners who is involved?**	**Resources Materials Financial**
Create awareness of water rights.	WRBWO	District, villages, NGOs, Ministry	Communication material - pamphlets radio
Identification of key stakeholders	WRBWO	NGO, DVT Partners, District Council	Transport Fund Guideline Manual
Organize key stakeholders workshop	WRBWO	NGO, DVT Partners, District Council	Fund WSDP WUA Fee
Create stakeholders data base	WRBWO	MOWI District	Expertise Equipment (IT) Funds
Linkage between key stakeholders (communication strategy)	WRBWO	Stakeholders	Manuals Communication Facilities
Capacity development needs assessment	WRBWO	District councils NGOs SNV Consultants MoWI	- Funds - Expertise - Guideline to facilitate implementation of the capacity development framework.
To develop capacity building programme	WRBWO	WRBWO MOWI Consultant	Fund Expertise
Mechanism for stakeholder participation and dialogue (some type of forum perhaps in addition to catchment committees)			

Result Area 2: Reliable Research and Data to Support Planning and Management

Sub results	Information on water demand and use	Information on current and future water resources (monitoring network)	Pollution assessment and risk analysis
Activities:	Conduct water use survey Assess water demand	Exchange visits to learn best practices. Rehabilitate/construction of infrastructure for data collection Data collection and analysis Water resources assessment (include climate change) Data/information management (sharing/ disseminating publication)	Water Quality survey Water quality analysis Identification of sources of pollution. Design and construct water monitoring network. Data collection and analysis. Water quality data management.

Result Area 2: Reliable Research and Data to Support Planning and Management

Activity	Who is responsible?	Partners who is involved?	Resources Materials Financial
Sub-results: Information on water demand and use			
Conduct water use survey	WRBWO	LGAs NGO Users	Funds Manpower
Assess Water Demand	WRBWO	LGAs NGO Users	Funds Manpower
Sub-result **Information on current and future water resources (monitoring network)**			
Exchange visit to learn best practices.	WRBWO	Other Basins and Institutions	Funds
Rehabilitate Construction of Infrastructure for Data Collection	WRBWO	LGAs NGO Users Dev. Partners	Funds Equipments
Date Collection and Analyses	WRBWO	LGAs TMA Users	Funds
Water Resources Assessment (climate change)	WRBWO	LGAs Users	Funds
Data Information management (shearing/ dissemination/publication)	WRBWO	TMA Dev. Partners NGO LGAs Users	Funds
Sub-result: Pollution assessment and risk analysis			
Water Quality Survey Water Quality Analysis Identification of Sources of pollution.	WRBWO	LGAs NGO USERS Dev. Partners	Funds

Comments:

- need an activity to prepare local government authorities to be involved in activities before research and surveys begin
- Up until now the LGA mandate has not been towards water resource management. The district engineer tends to deal with water supply
- Training on resource management is needed

Result Area 3: Strengthening Regulation & Improved Compliance

Activity	Who is responsible?	Partners Who is involved?	Resources Materials Financial
Public awareness through the use of media	WRBWO	Ministry of Broadcasting & information Broadcasters, Journalist	Communication professional i.e. write press releases Lots of TZSs.
Sub-result: Interagency co-operation and enforcement			
Identify key actors *This includes:* Identify target groups + regulation that applies to them - industries - livestock keepers - farmers - fishers - communities concerned - policy makers - representative from different agencies	WRBWO	1. Target groups - industries - agriculture and livestock - water authorities 2. Enforcers - NEMC, MOWI, Ministry of Nat. Resources, Ministry of Agricultural - Ministry of Livestock & Fisheries - PMO POLG.	Human Policies & Regulations, acts + by – laws TZSs.
Translation of policies - Popular version	MOWI	- WRBWO - NEMC - Ministry of Nat. Res. - Vice President Office, - MOWI - Research Institution. - Local Govt. Authorities	-Translators Feedback process TZSs.
Communicate with key actors (meetings, seminars) *This includes:* Meeting with stakeholders (such as industries) to explain regulation need for compliance Invite people with influence to participate to ensure compliance with regulations (bring together people w/low influence and high interest and high influence with low interest) Identify focal point for co-operation between agencies on each issue	WRBWO	- Target groups & enforcers	Facilitator TZSs.

Activity	Who is responsible?	Partners Who is involved?	Resources Materials Financial
Engage with parliamentarians e.g. study tour, communication.	WRBWO & Ministry of Water	Parliamentarians - Regional Commissioners - District Commissioners & Chairman	Facilitator Organiser Funds
Integrate policies and regulations into syllabus in schools	Ministry of Education	Schools Appropriate ministries	Training of teachers. Trainers and funds
Support development of by-laws for consistency between districts	Local Government Authority WRBWO as an advisor	LGA, District, Wards, Villages	Information on by-laws Technical committees for advice
Technical advice on how to comply	WRBWO	Target groups	Working group to advise
Monitoring and evaluation of impacts of enforcement Follow-up meeting (i.e. annual basis) that become institutionalized	WRBWO	Enforcing agencies	M&E specialists within WRBWO Database Staff and funds

Result Area 3: Strengthening Regulation & Improved Compliance

Sub Result: Harmonizing policy documents			
Mapping/Identifying specific regulation	WRBWO	Regulators	Govt. website with Policies & Regulations Staff and funds
Compare regulations & find conflicts Regularly check whether policies are relevant in practice	WRBWO	Regulators Universities	Researchers to do comparative study Funds
Include input from technical people i.e. where exactly is the edge of the river-bank	MOWI, WRBWO	Regulator Local Govt. Authorities	Map of regulations & conflicts between them. Lots of TZSs
Meetings between policy maker to discuss conflicts and come to an agreement. Proposal for changes on policy/ regulation	MOWI → submit draft proposal to parliament → cabinet for approval	Regulators i.e. NEMC Ministry of Land Ministry of Natural Resources WRBWO	Someone to write proposal – Lawyer Funds

Result Area 4: Environmental Resources Efficiently Planned & Managed

Sub results	Catchment Conservation	Land use + water resources planning	Adaptation Strategies for climate change Ex. Storage facilities	Improve water efficiency
Activities:	**A** Demarcation of catchment area. Awareness creation to stakeholders on catchment conservation Formation of steering committee Promote alternative income generation activities Develop and enforce by-laws. Monitoring & evaluation.	**B** Conduct O&OD to identify village resources base. Develop village land use plan. Develop and enforce by-laws. Water resources Assessment. Water use Assessment Water use planning for different uses Monitoring and evaluation of water resources.	**C** Promote Rainwater harvesting technologies. Promote soil water conservation practices Afforestation	**D** Assessment of water utilization by different sectors. Awareness creation on proper water use Control & minimization of water losses in domestic & irrigation use Research for alternative technology options

Result Area 4. Environmental Resources Efficiently Planned & Managed

Sub- result (activities are in previous table)	Who is responsible?	Partners who is involved?	Resources Materials Financial
A - Catchment Conservation	WRBWO	LGA, NGOS, Donors Villages and Private Sector	Funds Experts
B - Land use and water resources planning	WRBWO	LGA, Village government, NGOS Donors and Private Sector	Funds Experts
C - Adaptation strategies climate change e.g. storage facilities	WRBWO	LGA, Village government, Zonal irrigation office, Donors and Private sector	Funds Experts
D- Improve Water Efficiency	WRBWO	LGA, Village government, Zonal irrigation office, Urban water authorities Donors and Private Sector	Funds Experts

Comments:
Alternative income generation is important.
MoWI needs to be included

Result Area 5: Ensure Sustainable Financing

Activity	Who is responsible?	Partners who is involved?	Resources Materials Financial
Sub result: Mobilisation of external financial resources			
Analysis and donor visits	WRBWO	Development Partners (IUCN, SNV, JICA) Basin Water Office	Consultancy?
Projects proposal development	WRBWO	Development Partner (IAQEA, IUCN, SNV, JICA, WB etc	Consultancy?
Developing communication products for marketing the proposals.	WRBWO	Consultancy and BWO (Basin Water Office)	Travel budget staffs, Consultant
Travels to market proposals	WRBWO	Development Partners (IUCN, JICA, WB, SNV etc)	Travel Budget
Sub result: Mobilisation of internal financial resources			
Water user survey to identify big users and small users	Basin Water Office	Consultancy, Basin Water Office, LGA (Local Gov. Authority)	Travel budget, staff and consultant
Study on economic value of water - liaise with TLC	Basin Water Office	Basin Water Office	Travel budget, staff from Basin Office
Review pricing and water with incentives for saving water.	Ministry of Water & Irrigation Basin Water Office, Consultant	Consultant	Travel budget, Consultant
Raise awareness on value of water and pricing. Draw lessons from other basins	Basin Water Office	Consultant	Travel budget, staff and consultant
Broaden funding sources by looking additional water sources.	Basin Water Office	Basin Water Office Development Partners (IUCN, SNV, WB etc)	Travel budget, staff and consultant
Develop system on compliance and law enforcement.	Ministry of Water & Irrigation Basin Water Office	Ministry of Water & Irrigation and Basin Office	Consultation Budget
Business plan for Basin to be autonomy by 2015.	Basin Water Office	Development Partners (IUCN, SNV, WB)	Budget for staff

Comments:
- The basin office can be seen as an investment centre
- Work within legal structures to ensure people pay
- Learn financial lessons from within country (Rufiji Basin) and outside
- Need for separate document on fundraising and strategy à this can be derived from the business plan

* Water holes are storage ponds dug in a flat terrain and they are normally referred to in their Spanish name “Charco dams”. In India they are called ‘tanks’. They are normally used to store runoff generated from hillside catchments with sheet or rill flow. The system requires methods for controlling siltation especially if the area is prone to soil erosion, evaporation, and seepage losses especially if the subsoil is sandy.

Rainwater harvesting technologies for agricultural production: A case for Dodoma, Tanzania

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The IUCN Water and Nature Initiative is an action programme to demonstrate that ecosystem- based management and stakeholder participation will help to solve the water dilemma of today – bringing rivers back to life and maintaining the resource base for many.

Wami/Ruvu Basin Water Office

The Wami/Ruvu Basin Water Office (WRBWO) and Wami/Ruvu Basin Water Board (WRBWB) were established in July 2002, with the vision of to ensure that basin water resources are sustainably managed for the socio-economic and environmental needs, interests and priorities of the basin population.

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