



*Assessment of the level of implementation of
Integrated Water Resources Management
In
Ethiopia*

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EXECUTIVE SUMMARY

Integrated Water Resources Management (IWRM) has been accepted these days as a guiding principle for sustainable development and management of water resources. Ethiopia is no exception in this regard. Ethiopia has outlined a Water Resources management Policy in 1999. The policy bases itself on the core values of IWRM. The policy has addressed all major issues relevant to the sustainable development of water resources. It has also drawn up a water sector strategy covering technical, social, environmental and capacity building issues for the development of water supply, irrigation and hydropower.

The legislations pertaining to water resources management and regulation are currently in place. They are being applied at federal and regional level. The policy and legal frameworks pertaining to water resources development and management include Ethiopian Water Resources Management Policy, Water Sector Development Strategy, Water Management Regulation, ADLI, PRSP, PASDEP, SDPRS, Food security strategy, new coalition for food security strategy and the federal rural development policy.

The institutional framework for implementation of IWRM is in place in Ethiopia. These are MoWR, Regional Bureaus for Water Resources development, Ministry of Agriculture and Rural development, Ministry of Mines and Energy, Ministry of Health, Environmental Protection Agency, EEPCO and River Basin Organizations. The River Basin organizations bring all these stakeholders into a common forum. Abay Basin Organization is one such example.

IWRM is sufficiently streamlined in policy documents, river basin plans, legal frameworks and institutional frameworks.

Ethiopian WASH programme succeeded in bringing three Ministries to a common platform in order to fulfill its mission of providing the people with clean water and sanitation, namely, Ministry of Water Resources, Ministry of Education and Ministry of Health.

Two pilot IWRM projects are now launched in Ethiopia under the assistance of ECWP, namely, Berki and Messena. These are highly cited in many fora and IWRM plans are already developed for them.

Hence, it is concluded here in this document that Ethiopia has gone far in implementing IWRM as a means to alleviate poverty, to increase water supply coverage and extend hydropower supply. It is also actively participating in the Nile Basin Initiative (NBI) since the government commits itself to benefit sharing principle through active dialogue with the riparian countries.

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ACRONYMS AND ABBREVIATIONS

IWRM	Integrated Water Resources Management
SDO	Social Development Office
SDBS	Stakeholder Development and Benefit Sharing
NBI	Nile Basin Initiative
GWP	Global Water Partnership
ICWE	International Conference on Water and Environment
WWC	World Water Council
WSSD	World Summit on Sustainable Development
MoWR	Ministry of Water Resources
CSA	Central Statistical Office
ETC	Ethiopian Telecommunication Office
ANRS	Amhara National Regional State
ONRS	Oromia National Regional State
TNRS	Tigray National Regional State
EIA	Environmental Impact Assessment
EPA	Environmental Protection Agency (Ethiopia)
FDRE	Federal Democratic Republic of Ethiopia
EEPCO	Ethiopian Electric Power Corporation
WWCE	Water Works Construction Enterprise
WWDSE	Water Works Design and Supervision Enterprise
NMSA	National Meteorological Services Agency
WDF	Water Development Fund
RBO	River Basin Organization
WASH	Water Sanitation and Hygiene
MoE	Ministry of Education
MoH	Ministry of Health
ECWP	Ethiopian Country Water Partnership

1 INTEGRATED WATER RESOURCES MANAGEMENT AND THE NILE BASIN INITIATIVE

In the past decade, it has become obvious that water professionals, policy makers or water ministries alone can no longer resolve the water problems of a country or river basin. The problems are too complex, interconnected and multidimensional to be handled by any one institution or group of professionals. In the current century, water problems will continue to grow and become more acute and affect other development sectors like energy, agriculture, industry, environment and health. Water can no longer be viewed in isolation as a single resource, without the explicit and simultaneous consideration of other related development sectors and vice versa (Biswas, 2003). Hence, an integrated approach of the water management is necessary for ensuring maximum benefits from the utilization of the scarce water resources. Better understanding of IWRM approach and the existing water resources management challenges of a river basin are vital for achieving efficient water management along the river basin.

Water management in the Nile riparian states faces rapidly expanding pressures due to current mismanagement, mistrust and lack of cooperation among the riparians and lack of integration between different sectoral policies. The Nile basin has a water resources potential which can be harnessed for multipurpose beneficial uses through cooperation among the riparian countries in order to make optimal use of this resource and for the overall economic, social and environmental development of the region. Thus, water is linked with the overall development framework of the Nile Basin. Hence, at this moment, it is vital to analyze the interconnection among different sectors related to water management and also to deal with water in an integrated way to ensure overall socio-economic and environmental development in a sustainable manner.

In light of these facts, NBI has based its core values around the principles of IWRM. This is clearly illustrated in its institutional set up and in the fact that the NBI activities are participatory. Examples worth citing are the establishment of SDO and SDBS, employment of communication officer, IWRM specialist and so on. Moreover, it has national focal points, regional working group members, both regional and national networks of intellectuals, micro-grant programmes, capacity building programmes etc.

The domain of IWRM is a river basin. Hence, NBI has fulfilled one of the requirements since it is basin organization. Water resources development projects under NBI include irrigation, hydropower development, watershed management, rainwater harvesting, fishery and impact of these projects on the environment. Moreover, its project on efficient use of water for agriculture implies that water is taken as an economic good and a finite resource.

Hence, it can be concluded that NBI is an IWRM process and it is a means to an end which is creating an enabling environment for achieving equitable utilization of the water resources of the Nile basin.

1.1 Global developments in IWRM

The Technical Advisory Committee of the Global Water Partnership defined IWRM as “a process which promotes the coordinated development and management of water, land and water

resources in order to maximize the resultant economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems,” and emphasized that water should be managed in a basin-wide context, under the principles of good governance and public participation (GWP 2000, GWP 2003).

IWRM is not a new idea. In a number of countries, water management has been institutionalized in an advanced and integrated way over centuries. Embid (2003) writes that Spain was probably the first country to organize water management on the basis of river basins, as it adopted the system of confederations hydrographical in 1926. Over the last several decades, there have been serious attempts to implement IWRM in different global regions. In the 1940s, an early version of IWRM occurred when the Tennessee Valley Authority began to develop the water resources for that region (Barkin and King, 1986; Tortajada, 2004). A later example occurred in 1960 in Hessen, Germany, where Integrated Water Resources Management Planning was prepared on the basis of a multidisciplinary integrated approach (Berg, 1960, cited in Kaitera, 1963).

At the United Nations Conference on water in the Mar del Plata (1977), IWRM was the recommended approach to incorporate the multiple competing uses of water resources. Although in the 1980s, water disappeared, for the most part, from the political agenda, the situation changed in the 1990s, thanks to the efforts of a number of conferences and international organizations. Efforts such as the International Conference on Water and Environment (1992), Second World Water Forum (2000), International Conference on Freshwater (2001), World Summit on Sustainable Development (2002) and Third World Water Forum (2003) collectively led to breakthroughs that thrust IWRM onto the political agenda. The outcomes of the four major events are summarized hereunder.

Dublin 1992: International Conference on Water and Environment

In January 1992, International Conference on Water and Environment Issues for the 21st Century was held in Dublin, Ireland. Current thinking on the crucial issues in water resources is heavily influenced by the Dublin Principles, which are (ICWE 1992):

- i. Freshwater is a finite, vulnerable and essential resource, which should be managed in an integrated manner;
- ii. Water development and management should be based on a participatory approach involving users, planners and policy makers at all levels;
- iii. Women play a central role in the provision, management and safeguarding of water;
- iv. Water has an economic value and should be recognized as an economic good, taking into account affordability and equity criteria.

The Hague 2000: Second World Water Forum

On 17-22 March 2000, the Second World Water Forum was held in the Hague, the Netherlands. The key issues raised in the Second World Water Forum related to IWRM are (WWC 2000):

- i. *Privatization*: To achieve water security, water must be everybody’s business but on the other hand the government monopoly in water management should not be replaced by a private monopoly;
- ii. *Charging the full cost for water services*: Users should in fact be charged the full cost of the services – with appropriate subsidies made available to the poor;

- iii. *Right to access:* Water is not only considered essential for human health, it is also desperately needed by millions of poor women and men in rural areas for productive reasons: to grow the family food or generate income. Right of land and use of water are key determinates for people's potential to break down the poverty trap.
- iv. *Participation:* Water can empower people and women in particular, through a participatory process of water management. Participation implies sharing of power, democratic participation of citizens in elaborating or implementing water policies and projects, and in managing water resources.

Johannesburg 2002: The World Summit on Sustainable Development (WSSD)

In the shift of August and September 2002, The World Summit on Sustainable Development was held in Johannesburg, South Africa. The main points focusing on WSSD Plan in Implementation relating to IWRM are listed below (WSSD 2002):

- i. Developing IWRM and water efficiency plans by 2005 for all major river basins of the World;
- ii. Developing and implementing national/regional strategies, plans and programs with regard to IWRM;
- iii. Improving the efficiency of water uses;
- iv. Facilitating the establishment of public-private partnership;
- v. Developing gender sensitive policies and programmes;
- vi. Involving all concerned stakeholders in all kinds of decision-making, management and implementation processes.

The Third World Water Forum – Kyoto 2003

The forum was held in March 2003 in Kyoto, Japan. The forum suggested IWRM as a way to achieve sustainability regarding water resources. The ministerial declaration addressed the necessity of sharing benefits equitably, engaging with pro-poor and gender perspectives in water policies, facilitating stakeholder participation, ensuring good water governance and transparency, building human and institutional capacity, developing new mechanisms of public-private partnership, promoting river basin management initiatives, cooperating between riparian countries on transboundary issues, and encouraging scientific research.

According to Tarlock (2004), IWRM was endorsed in Agenda 21, the environmental action plan for the 21st century agreed to at the 1992 United Nations Rio de Janeiro Conference on Environment and Development (UNCED). It is also one of the six principles adopted at the 1992 Dublin Conference on Water and the Environment. Between UNCED in 1992 and the 2002 World Summit on Sustainable Development (WSSD) or Rio Plus 10 in Johannesburg, South Africa, IWRM was endorsed by the Commission on Sustainable Development, the General Assembly of the United Nations, and the Ministerial Declaration of the International Conference on Freshwater.

1.2 The Nile Basin Initiative process

The Nile River, the longest river in the world, traverses more than 6700 kilometers from its farthest point at the headwaters of the Kagera River in Rwanda to its delta in Egypt on the Mediterranean Sea. Ten countries share the Nile: Burundi, Democratic Republic of Congo (DRC), Egypt, Eritrea, Ethiopia, Kenya, Rwanda, Sudan, Tanzania and Uganda. The Nile River Basin covers 3 million km². It serves as home to an estimated 160 million people within the boundaries of the basin while nearly twice that number – roughly 300 million – live within the ten countries that share the Nile waters.

Despite the extraordinary natural endowments and rich cultural history of the Nile Basin, its people face considerable challenges. The Basin is today characterized by poverty, instability, rapid population growth, and environmental degradation. Half the Nile riparian countries are among the world's ten poorest. Population is expected to double within the next 25 years, placing additional strain on the scarce water and other natural resources. Yet the Nile holds significant opportunities for win-win development that could enhance energy availability, food production, transportation, industrial development, environmental conservation, and other related development activities in the region. Cooperative water resources management might also serve as a catalyst for greater regional integration, both economic and political, with benefits far exceeding those derived from the river itself.

The riparian countries came to understand that a forward movement on Nile cooperation requires a development focus, a permanent institution, and agreement on core legal principles. The Nile riparians then established a forum to facilitate a process of legal and institutional dialogue in 1997. A draft text of Cooperative framework was produced by a panel of senior experts drawn from each country in early 2000. The experts include senior government lawyers and water resources specialists.

Recognizing the need to take concrete steps to realize the development potential of the Nile, the Nile riparians took an historic step towards cooperation in the establishment of the Nile Basin Initiative.

The NBI is a regional partnership among the ten Nile Basin riparian countries. It provides a forum for cooperative development of the river's water resources, including sharing substantial economic benefits and promoting regional peace and security. The NBI was formally established in 1999 and is guided by a shared vision to achieve "*sustainable socioeconomic development through the equitable utilization of, and benefit from, the common Nile Basin water resources*". The NBI is comprised of a Council of Ministers of Water Affairs of the Nile Basin (Nile-COM), a Technical Advisory Committee (Nile-TAC), and a Secretariat (Nile-SEC) located in Entebbe, Uganda.

NBI members developed the Strategic Action Program (SAP) to translate their overall vision into tangible activities and projects. The SAP is composed of: (i) the Shared Vision Program (SVP) focusing on basin-wide projects to create an enabling environment on the ground, and (ii) a Subsidiary Action Program, focusing on sub-basin projects to deliver development projects involving two or more countries.

The basin-wide Shared Vision Program currently includes seven projects. Four of these are thematic in nature, addressing issues related to environmental management, power trade, efficient water use for agriculture, and water resources planning and management. The remaining three are facilitative supporting efforts to strengthen confidence-building and stakeholder involvement, applied training and socio-economic development and benefit-sharing.

Two SAPs have been formed. The Eastern Nile (ENSAP) currently includes Egypt, Sudan and Ethiopia while the Nile Equatorial Lakes Region (NELSAP) includes the six countries in the southern portion of the basin, as well as downstream riparians Sudan and Egypt. These subsidiary groups have identified joint investment projects which warrant further investigation and preparation.

1.3 Objectives of the study

The prime objective of the study is to assess the level of implementation of IWRM in Ethiopia. It is expected that the study assesses the streamlining of IWRM in the water policy of the country, environmental policy, related implementation strategies and water sector development programmes. The study is based on response to be obtained from key and ordinary stakeholders, conversational interview with key stakeholders, consultation of policy documents and strategy papers.

2 STATUS OF WATER RESOURCES MANAGEMENT IN ETHIOPIA

2.1 Country background report

Ethiopia is part of the East African region commonly referred to as the “Horn of Africa.” It covers an area of approximately 1.13 million km². It lies between 3⁰30¹ and 15⁰ North latitude and 33⁰ and 48⁰ East longitude. It is bordered by Somalia and Djibouti to the east, the Sudan to the West, Eritrea to the north, and Kenya to the South. Ethiopia is a land-locked country. However, Ethiopia is naturally endowed with sufficient water resources. It is believed that if sufficient financial resources are made available, the country could easily fulfill its domestic requirements for irrigation and hydropower (MoWR, 2002).

A prominent feature of Ethiopian topography is its rugged landscape, with the Great Rift Valley dividing the country into the Central Highlands, which run from north to south, and the Eastern Highlands. Ethiopia’s landscape holds mountain chains, flat-topped plateau, deep canyons, river valleys and rolling plains. Altitudes range from - 110 m.a.s.l. in the Dallol depression to more than 4600 m.a.s.l. in the Siemen Mountains. Extensive lowland areas with altitudes under 1000 m.a.s.l. abound on the western, eastern and southern margins of the country.

Despite Ethiopia’s proximity to the equator (within 15⁰), the Central and Eastern Highlands enjoy a temperate climate due to the moderating influence of high altitudes, with a mean annual temperature rarely exceeding 20⁰C. The sparsely populated lowlands, on the other hand, typically have sub-tropical and tropical climates. Rainfall generally occurs in a 5-month unimodal rainy season from May to September in the western parts of the country and averages around 1000 mm annually. The eastern and southern parts, on the other hands, have bimodal rainfall averaging annually from less than 200 mm in the semi-desert to 1000 mm in the highlands. Rainfall can sometimes be erratic, especially in the eastern half of the country and drought is a common feature.

Administrative Structure

In 1991 Ethiopia adopted a federal structure of government with 9 Regional States, the City Administration of Addis Ababa and the Dire Dawa Administrative Council. Many fiscal and administrative powers of the central government were devolved to the Regions. The Regional States are Tigray, Amhara, Beneshangul-Gumuz, Oromiya, Southern Nations, Nationalities and Peoples (SNNP), Gambela, Afar and Somalia.

Within each Region there is a three tiered structure of Government: Region, Wereda, and Rural Farmers Association (Kebele) in case of Rural areas. The area of the Farmers Association may be sub-divided into smaller areas for the administration of natural resources (e.g. grazing management).

The Ministries at the federal level are generally mirrored at the Regional level and to a lesser extent at the wereda level. Ministries at Regional and Wereda levels are referred to as "Bureaus". The most relevant ministries/bureaus for water resources management include: *Agriculture and Rural Development, Water Resources, Finance and Economic Planning, Federal Environmental Protection Authority and Regional Environmental Protection, Land Administration and Use Authorities, National Disaster Prevention and Preparedness Commission and Regional Food Security Programme Coordination Offices.*

Population

According to the 1994 census, Ethiopia had a population of 53.5 million, equally divided between male and female. The 1994 census projected Ethiopia's population to reach 83.5 million by 2010 and 106 million by 2020. Those projections imply average annual population growth rates of 2.90 per cent, 2.77 percent and 2.42 percent respectively, between two successive years of projection, starting from the actual census year.

Nearly 81 percent of Ethiopia's population lives in the three regional states of Oromiya, Amhara, and the Southern Nations nationalities and Peoples (SNNP) Region; representing 35, 26 and 20 percent of the national population, respectively. Excluding the Harari region (a city-state) and the Addis Ababa and Dire Dawa Administrative Councils (both of which are city administrations), the SNNP has the largest population density (111 people per km²), with Amhara having the second highest population density of any region (102 people per km²). Afar region has the lowest population density of any region (7 people per km²). Gambella and Beshangul-Gumuz also have low population densities, with less than 11 people per km².

Ethiopia's population is 85 percent rural and 15 percent urban. The economically active population is 49.6 percent of the total population. There are two major types of migration patterns; rural-urban and inter-urban. The former is the most dominant migration pattern by far.

Socio-economic conditions

According to CSA, in 1997/98 Ethiopia had a gross national product (GNP) of Birr 44.86 billion. That is equivalent to a per capita GNP (at market prices) of Birr 755, one of the lowest in sub-Saharan Africa. In the same year, agriculture contributed 45.7 percent of the gross domestic product (GDP). The contribution to GDP of the other sectors of the economy was: industries 11.6 percent, distribution services 14.8 percent, and other services 27.9 percent. Among the industries the share of water and electricity is a mere 1.5 percent of the GDP. Given the huge rural proportion of the population, the contribution of agriculture, a largely rural activity, to GDP is rather small. The income level and standard of living of the rural population is relatively low and the rural population is poor. In fact, 83 percent of rural households cultivated less than 2 hectares per households and 52 per cent cultivated less than 1 ha per household in 1998/99.

Additional indicators of relative poverty include a high rate of infant mortality, limited access to potable water, and a low level of dietary intake, as measured in calories. Ethiopia has one of the lowest social indicators in sub-Saharan Africa. As per the estimates forwarded by the World Development Report (1999/2000) and African Development indicators (1998/99), from 1995 to 1997, Ethiopia had an infant mortality rate of 107 per 1000 live births and a maternal mortality rate of 1400 per 100000 live births. Life expectancy at birth is 43 years, and only 26 percent of population has access to potable water.

The development of infrastructural facilities is critical to the economic development of a country. With the exception of air transport services, infrastructural facilities in Ethiopia remain grossly underdeveloped, even in comparison with other sub-Saharan African countries. With regard to roads, the road to population ratio of Ethiopia is 500 km per 1 million persons. With per capita consumption of electricity at 26 Kwh in 1996, Ethiopia appears to have one of the least-developed systems of power generation in sub-Saharan Africa. About 90 percent of the total installed electric generation is derived from hydropower. Regarding telecommunication facilities, Ethiopia had 3.3 connected telephone lines per 1000 persons by the end of 1998, according to ETC. Total number of internet connection is under 3000, one of the lowest in Sub-

Saharan Africa.

Smallholder subsistence agriculture dominates the Ethiopian Economy. It accounts for 46 percent of the GDP and 85 percent of employment. Almost all the entire sector depends on rainfall. Only 63170 ha of the total cultivated area of 8.92 million ha under small holder agriculture was under traditional irrigation in 1998/99. The major crops cultivated are cereals, pulses, permanent crops and oilseeds. Of the total area under traditional irrigation, cereals and permanent crops cover 47.7 percent and 38.8 per cent, respectively.

Ethiopia could potentially develop irrigation over 3.73 million ha of farmlands. Nevertheless, the total area under irrigation to date is estimated to about 160000 ha, including the area under traditional irrigation. Irrigated agriculture has realized only 4.3 percent of its estimated potential and in terms of output accounts for approximately 3 percent of the total food crop production.

2.2 The water resources of Ethiopia

A survey carried out under this study is compared here with the global facts given in various official documents.

The responses to the questionnaire distributed put a slightly varied assessment compared with that of the official figures. It is accepted by most of the respondents that the main sources of water in the country are rainfall, groundwater, springs, harvested water and lakes. The various uses include agricultural, domestic, industry and hydropower generation. The consumption rates are 1.5 to 2.5 l/ha/d for agriculture, 15 to 25 l/ha/d for domestic uses in the rural areas, and 50 to 150 l/ha/day in the urban areas. The potential amounts of water resources indicated in the survey do not differ from what is given officially, i.e., 122 billion m³ of surface water and 2.6 billion m³ of groundwater. The groundwater potential was estimated to be 2.9 billion m³ as per one respondent whereas another respondent argue that it is 1.6 billion m³.

With its current per-capita freshwater resources estimated at 1924 m³, Ethiopia is endowed with one of the largest surface freshwater resources in sub-Saharan Africa. However, only 2 percent of the potential is annually utilized, 86 percent of which is going to irrigation.

Ethiopia's various resource potentials have been identified and described in different master plans for integrated development of major river basins. A survey of master-plan studies and related river-basin survey shows that the aggregate annual runoff from 9 river basins amounts to 122 billion m³. The three largest river basins (Abbay, Baro-Akobo and Omo-Ghibe) contribute 76 percent of the total runoff from a catchment area comprising only 32 percent of the total area of the country. The catchment areas, annual run-off and specific discharge of the major river basins are illustrated in Table 1.

Table 1 Surface Water Resources of Major River Basins

N	River Basin	Catchment Area	Annual runoff	Specific discharge
1	Abbav	199 812	52.6	7.8
2	Awash	112 700	4.6	1.4
3	Baro-Akobo	74 100	23.6	9.7
4	Genale-Dawa	171 050	5.8	1.2
5	Mereb	5 700	0.26	3.2

6	Omo-Ghibe	78 200	17.90	6.7
7	Rift Valley	52 740	5.6	3.4
8	Tekeze	89 000	7.63	3.2
9	Wabe	200 214	3.15	0.5
10	Afar-Danakil	74 000	0.86	
11	Ogaden	77 100	0	
12	Avsha	2 200		
	Total	1 136 816	122	

With regards to groundwater resources, the true potential of the country is not yet known. However, it is estimated that Ethiopia possesses a groundwater potential of approximately 2.6 billion m³.

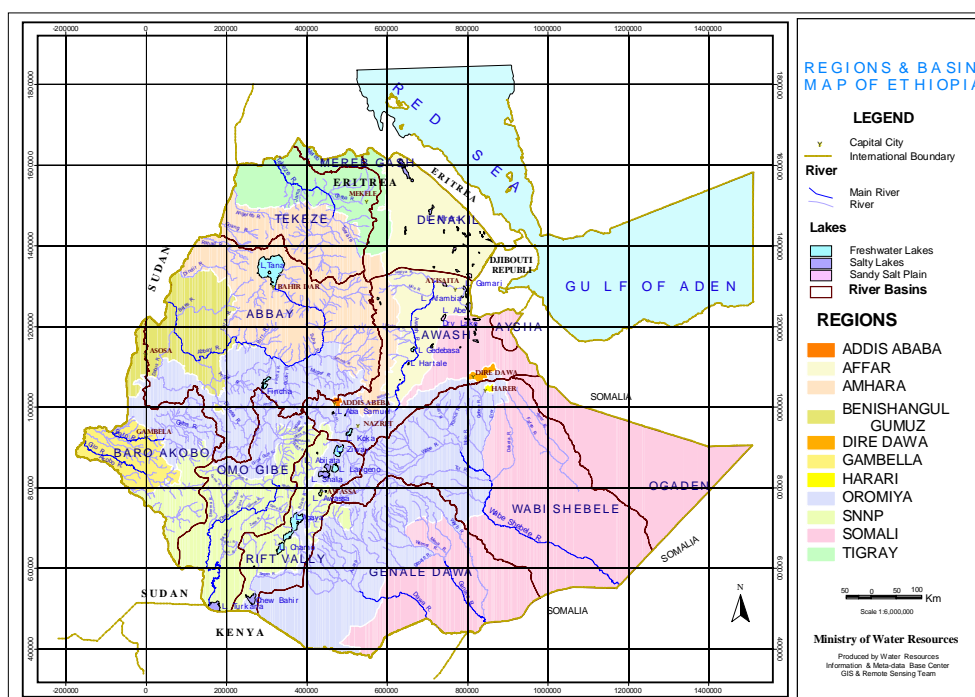


Figure 1 River Basins in Ethiopia

The gross hydropower generation potential of the country is estimated to be 650 TWh per year of which 25 percent can be exploited for power. The transportation potential of Ethiopian waterways and water bodies has not yet been fully exploited for power for economic development.

2.3 Policy and legal framework for water resources management

A substantial body of policies and policy instruments are already in place with a direct or potential bearing on water resource management and watershed management. In general, these have been adopted at the regional level as well.

The main policies and proclamations with relevance to IWRM are *Conservation Strategy of Ethiopia (CSE) (1997)*; *Agricultural Development Led Industrialisation (ADLI) (1992)*; *Ethiopian Water Resources Management Policy (1999)*; *Subscription to the Millennium Development Goals (2000)*; *Sustainable Development and Poverty Reduction Programme (SDPRP) (2002)*; *Food Security Strategy (2002)*; *New Coalition for Food Security Programme (2004)*; *Rural Development Policy and Strategies (2003)*; *Productive Safety Net Programme – Programme Implementation Manual (2004)*; *Plan for Accelerated and Sustainable Development to End Poverty (2005)*; *Water resources policies and legislation*; *Environmental Policy and legislation*; and *Rural Land Administration and Land Use Proclamations*.

Ethiopian Water Resources Management Policy (1999)

The overall goals of the national water resources management policy of Ethiopia is to enhance and promote efforts towards an efficient, equitable, and optimum utilization of the available water resources and contribute to the country's socioeconomic development on sustainable basis.

The Water Resources Management Policy includes a Water Sector Strategy, which covers certain elements of watershed management under its different components: under Water Resources Development: water harvesting ; and under Water Resource management: soil and water conservation measures to reduce soil erosion and reservoir siltation; local community participation in watershed management and water conservation measures and practices; a recognition of wetlands as a key feature in watershed management.

Water resources management laws

a The National Proclamation on Water Resources Management (2002)

The basic thrust of this proclamation is that water resources management and administration in the country should be based on the National Water Policy, the Integrated River Basin Master Plan Studies (IRBMPs) and the Water Resources Laws of the country. MoWR is clearly identified as 'supervising body' in charge of enforcing the provisions of the proclamation. It is entrusted with broad powers of 'planning, management, utilisation administration and protection of water resources'.

Among MoWR's duties are inventory of water resources, allocation of water resources, establishing standards for design and construction of waterworks, issuing guidelines and directives for the prevention of pollution of water resources as well as for water quality and health standards, establishing water users' associations, and settlement of disputes. Details of most of the provisions of the Proclamation are expected to be provided in Regulations to be issued in the future. Issues that still need to be tackled are e.g. the integrated cross-sectoral approach to water resources management including environment, agriculture, economic activities at large, health, legal and planning considerations, as well as a specific participation of water users. This is a necessary step towards 'integration' in WRM.

b Water Resources Management Regulations (2004)

A review of the draft version of the regulations shows that it mainly contains a further elaboration of the Proclamation providing in detail the main requirements for the issuance of permits for different uses of water and the conditions for the issuance, as well as the level of water charge and procedure for licensing water operators. Specific directives need to be worked out and issued by the MoWR.

c Regional water resources management policies and laws

In 2002, the Oromiya Regional State has issued a Regional water resources policy. A draft regulation for the management of water resources has also already been prepared by that Region. By and large, both the water resources policy and draft regulations for water resources management of the Oromiya Regional State are in line and similar in their content to those issued by the Federal Government.

d Environmental Laws

Environmental issues are given more and more emphasis in Ethiopia, with the recent development of a set of laws, following up on several new policies and strategies (such as the National Conservation Strategy and the SDPRP). The Ethiopian Environmental Protection Authority (EPA) has drafted three major laws regarding Environmental Pollution Control, Environmental Impact Assessment and Establishment of Environmental Protection Organs.

Although quite general, these laws, and particularly the “Environmental Pollution Control Proclamation” specifies clearly the function of law enforcement of the EPA and the Regional environmental agencies, in charge of taking administrative or legal measures against violations.

These laws are concerned mainly with pollution, and broader issues such as watershed management are not addressed yet. The need for a more integrated legal framework in line with IWRM or sustainable use of natural resources is noticeable.

According to the 2005 PASDEP document, EPA has now also developed EIA guidelines for agriculture, mining, industry, and road construction. It has assisted all regions to establish a regional EPA. ANRS, ORNS as well as TNRS are said to have developed regional environmental laws.

A key issue is how to get some action on the ground by agencies at the Wereda level using a collaborative and not a "legal enforcement" approach.

The Conservation Strategy of Ethiopia (CSE), formulated in 1995, is the basis of all environmental efforts and considerations in subsequent policies. The CSE documentation consists of five volumes: Vol. I the Natural Resource Base; Vol. II Policy and Strategy; Vol. III Institutional Framework; Vol. IV the Action Plan and Vol. V Compilation of Investment Programmes. The Environmental Policy of Ethiopia has emanated from Vol. II of the Conservation Strategy and was approved by the Council of Ministers of the Federal Democratic Republic of Ethiopia on April 2, 1997.

ADLI, i.e. using agricultural development as an engine for economic diversification and industrialization is still the government’s core policy for rural development as well as overall economic development. Implementation of this policy has focussed on provision of agricultural inputs. After initial success, the effect of ADLI seemed to stagnate, and increasingly became the

subject of debate. Questions raised are not only related to the way ADLI is implemented, but whether the theoretical basis of ADLI is correct. Central in the debate is the current strong focus on the supply side and the relative neglect of the demand side. It is now increasingly recognized in policy debates in the country that an efficient, low-cost, agricultural marketing system is required in order to close the national food security gap and increase per capita income. In addition, it is considered that there is need for structural change in the agricultural sector towards a more export market orientation that can only be achieved with reducing transport costs to world markets.

The document on a needs assessment related to the Millennium Development Goals mentions important interventions for the period 2005 - 2015 to respond to the MDG, and focuses on: integration of environmental management in the implementation of Rural Development and Food Security programmes (environmental laws, EIA) and watershed based natural resource management for sustainable development and mitigation of resource degradation (proper land use, soil conservation, water/forest resource management, irrigation, biodiversity conservation).

The Ethiopian Sustainable Development and Poverty Reduction Strategy (SDPRS) also focuses on agriculture centred rural development in order to achieve rapid overall development, liberation from dependency and promotion of a market economy. It explicitly builds on ADLI by mentioning “an overriding and intentional focus on agriculture as a potential source to generate primary surplus to fuel the growth of other sectors of the economy (industry)” as one of its main thrusts. Other broad thrusts are Strengthening private sector growth and development especially in industry as means of achieving off-farm employment and output growth (including investment in necessary infrastructure); Rapid export growth through production of high value agricultural products; Undertake major investment in education and capacity building to overcome critical constraints to implementation of development programs; Deepen and strengthen the decentralization process to shift decision-making closer to the grass root population, to improve responsiveness and service delivery; Agricultural research, water harvesting and small scale irrigation; and Focus on increased water resource utilization to ensure food security.

The Food security strategy equally underlines the importance of sustainable use and management of natural resources, mentioning more or less the same fields of attention as the SDPRS.

The New Coalition for Food Security Programme document outlines what it considered as main causes of land degradation, which are actually symptoms of improper management of natural resources: (a) cultivation of steep slopes, without conservation practices, poor, nutrient mining farming practices and (b) using crop residues and dung for household energy instead of for ameliorating soil fertility (c) biodiversity losses due to land degradation and deforestation. The document suggests participatory watershed management planning as supportive of food security interventions.

The Plan for Accelerated and Sustainable Development to End Poverty (PASDEP) represents the second phase of the PRSP process (2005-2010) that began under SDPRP. PASDEP pursues initiatives under SDPRP and ADLI but with important enhancements to capture the private initiative of farmers and support the shift to diversification and commercialization of agriculture. It is realized in PASDEP that, “parallel to this shift to commercialized agriculture, improvement of pro-poor subsistence farming still needs to take place as the main welfare improvement for several million households still depend on achieving higher yields of basic food grains. This second main orientation will be pursued through a combination of intensified extension support at the kebele level, establishment of a network of demonstration centres, increased low-level

veterinary services, support for small-scale irrigation, better use of ground water, complemented by productive safety net and off-farm income generating initiatives supported under the Food Security Program. Both approaches need to be pursued with measures to manage the natural resource base and protect the environment.”

PASDEP distinguishes between the three main economic and agro-climatic zones: the traditionally settled semi-arid/sub-humid highlands, the potentially productive semi-tropical valley areas, and the hot semi-arid lowlands. This particularly applies to agriculture but also to the private sector development agenda. Instruments are infrastructural improvement (roads, telecommunication, and electric power supply), strengthening of financial and administrative development capacity, and control of malaria and tsetse and special efforts for pastoral areas in the lowlands.

Watershed management related elements are mentioned under the sectors water management and irrigation (water harvesting) and crop production (water harvesting, soil and water conservation).

The federal Rural Development Policy promotes, among others: intensification in high rainfall areas, livestock improvement and water resource development and marketing facilities in pastoral areas, irrigation and overall development of basic facilities/infrastructure in the western lowlands, water harvesting and land conversion in drought prone areas, livestock improvement through improved breeds and technology.

2.4 Institutional framework for water resources management

Sound policies without appropriate institutional support will not be successful. On the other hand, effective institutional arrangement will remain short of its objectives without appropriate policy. Article 51 of the Constitution of FDRE outlines that the Federal Government shall determine and administer the utilization of the waters or rivers and lakes linking two or more regional states and crossing the boundaries of the national territorial jurisdiction.

The Ethiopian Water management Policy fosters the participation of user communities in water resources management by supporting the establishment of appropriate institutional framework from regional to the lowest administrative structure and promotes decentralized management. Moreover, the policy recognizes that the hydrological boundary as the fundamental planning unit and water resources management unit. The policy underlines institutional sustainability and it envisages minimizing institutional instability in order to maintain sufficiently skilled manpower. Moreover, the policy supports the enhancement of a coherent institutional framework that allows the necessary flexibility and accommodates continuity in times of change. The FDRE, therefore, intends to establish River Basin Authorities for efficient, successful and sustainable joint management of the water resources of the basin through concerted efforts of the relevant stakeholders.

The institutions for Water Resources Management in Ethiopia are characterized by institutional instability, frequent changeovers and lack of continuity. Moreover, there was absence of smooth transfer of responsibility to the subsequent institutions. Lack of clear demarcation of responsibilities between water resources management institutions was prevalent at various levels. There is and was a critical problem of capacity. There was absence of long-term vision and focus was made on short-term objectives. Coordination was weak among the various

institutions operating in the sector.

Looking from historical perspective, the water resources of the country was given due consideration under different setups. The table hereunder shows the historical process the institution has undergone:

Table 2 Historical Background of the MoWR

Year of Formation	Institution
1956	Water Resources Department under the Ministry of
1962	Awash Valley Authority
1972	National Water Resources Commission under the Ministry of Public Works and Water Resources
1975	Ethiopian Water resources Authority under the Ministry of Mines, Energy and Water
1977	Valley Agricultural Development Authority
1981	NWRC (WRDA, WSSA, EWWCE, NME)
1987	Ethiopian Valleys Development Studies Authority
1993	Ministry of Natural Resources and Environment
1995	Ministry of Water Resources

Since 1995 the Ministry of Water Resources (MoWR) oversees the general functions of Water Resources management in Ethiopia. The general functions include policy and regulation, management, development and ownership of water infrastructure and day-to-day operation and monitoring of water infrastructure including service infrastructure. There are five types of institutions responsible for these functions: government (federal, regional and local authorities), River Basin Organizations (e.g. ABWRAA), public enterprises, private sectors, NGOs, water user associations and town water boards.

The policy and regulation function is entrusted with the Ministry of water Resources at Federal Level and Bureau of Water Resources Development at Regional level concerning issues delegated by the Ministry.

The Management function is the responsibility of the MoWR at Federal Level. The management function includes water allocation and administration, coordination of stakeholder interventions, monitoring and evaluation and knowledge.

Various Institutes are responsible for development and ownership of water infrastructure like sub-sector planning, studies and construction: EEPCO for Hydropower, MoWR for large and medium scale irrigation, WWCE for large dams and irrigation, WWDSE for studies and design supervision, municipalities and water boards for water supply, regional bureaus of Water Resources development for water supply and small scale irrigation.

In summary, the table hereunder illustrates the degree of involvement of the various institutes and their major functions:

Table 3 Actors and Functions of Water Management in Ethiopia

Functions		Policy and Regulation	Management	Development and Ownership	MoM
Actors					
MoWR/ Bureau	Regional	High	Medium	less	negligible
RBO		Medium	negligible	High	Medium
Public			Medium	High	High
Private				High	High
NGOs			negligible	High	High

Ministry of Water Resources was established in 1995. MoWR drafted the Ethiopian Water Resources Management Policy in 1999. It has also drawn up Ethiopian Water Resources Management Proclamation in 2000. It has also prepared Water Sector Strategy in 2001. Master plans for eight major river basins have been finalized. Ethiopian Water Resources Management Regulation is released in 2005. Proclamations for the formation of River Basin councils and Authorities have also been released in 2007.

MoWR focuses on Water Resources Management, water supply and sanitation, irrigation and hydropower development. It spearheads negotiation on water with riparian countries. It undertakes continuous assessment of water resources. It is custodian of large data and information. It supervises river basin organizations, NMSA, EWWCE, WWDSE and WDF. It implements large number of projects and gives technical assistance to regions. Last but not least, it has established a department for Policy Assessment.

The respondents unanimously agree that the Ministry of Water Resources exclusively deal with planning, management and development of water resources. At the federal level, various Ministries including Ministry of Agriculture, Water Works Design Enterprise, Water Works Construction Enterprise, Environmental Protection Agency take responsibilities for various aspects of water resources. At a regional level, Bureau of Water Resources, Mines and Energy, Bureau of Agriculture and Natural Resources, Bureau of Health, Cooperatives, Bureau of Women's affair and Water Works Enterprise shoulder the responsibility of developing water resources. The respondents also indicated that the private sector also contributes to water resources development.

All the respondents reveal the availability of a water resources strategy in the country which indeed the case it. The strategy deals water supply, demand management, agriculture, water

pricing, irrigation, private water management and economic instruments. The Ministry of Water Resources and the regional Water Bureau developed the strategy. Both are responsible for the implementation of the strategy.

The major water programmes in the country are increasing potable water supply coverage in the rural and urban areas, expanding irrigated agriculture through building of dams and diversion structures, basin-level studies or master plan studies, implementation of IWRM at watershed level and hydropower.

2.5 Water resources management issues and challenges

The water resources management issues are broad and varied. They emanate from the water resources management policy of the country and Ethiopia's water development issues. The vision elements which are elaborated in the PRSP constitute a road map for reducing poverty and promoting development via pro-poor growth strategies, good governance, decentralisation and empowerment.

In order to achieve the stated visions in the shortest time possible, the ensuing water resources management issues are underscored: developing water resources as an integral part of national socio-economic development, ensuring that water development promotes social equity; fostering stakeholder participation and empowerment, especially of women, for sustainable use and management of water resources; promoting self-financing and cost-recovery, as much as practical, in using water resources; ensuring transparency and fairness in water resources management; while ensuring the environmental soundness of all water development activities, to attain financial viability and sustainability; ensuring sound water governance regimes at all levels of management; applying the "subsidiarity" principle to ensure that water management is conducted at the lowest, and most efficient, institutional level.

Major issues are listed hereunder (Wouters, Dukhovny, & Allan, 2004):

- a. Growing food demand as a result of population growth;
- b. Growing competition between agricultural and other sub sectors;
- c. Inadequate access to safe drinking water and sanitation;
- d. Inadequate infrastructure;
- e. Low income and declining employment opportunities;
- f. Low land and water productivity;
- g. Deterioration of quality of water and environment;
- h. Parochial interests;
- i. Management disconnection and lack of appropriate policy.

The major challenges of WRM in Ethiopia are low institutional capacity and effectiveness; shortage of financial resources, coupled with immense investment requirements, particularly in the case of large scale projects; lack of coordination among the various implementing institutions: Federal Government, Regional (State) governments, NGOs, donors and others involved; lack of appropriate technology at the level of local resources; low level of infrastructural development that would allow easy access to inputs and outputs; absence of involvement of the stakeholders in the development process; inadequate technical capacities; lack of data and information required for efficient sector planning and management; insufficient public-private partnership; and low water use efficiencies in all water consuming sectors.

Hence, change in WRM approaches is required. And that is IWRM.

3 THE IWRM CONCEPT

3.1 Current definition and guiding principles

According to IWMI, IWRM is a form of governance, financing water services under coordinated participation of all water users within the clear framework of water policy, laws, institutions and technologies and as a result optimization of social and economic water value, its use efficiency and distribution uniformity under simultaneous important ecosystems' sustainability.

The Global Water Partnership defines IWRM as a process facilitating coordinated water, land and other related resources management and development to reach the maximum economic and social level on an equitable basis without damage to vital ecosystems sustainability.

The guiding principles are based on 1977 La Plata Convention, Argentina; the 1992 Dublin Conference on Water and Environment – Dublin IWRM Principles; the 1992 UNCED – Agenda 21, Chapter 18 – Sustainable Management of freshwater resources; the 1996 GWP – working partnership among all involved in WRM; the 2000 UN Millennium Summit – MDGs; and the 2002 WSSD-Rio+10 National IWRM-WE.

The guiding principles are

- a Sustainable development and regional equities and responsibilities
- b Integrated approach
- c Subsidiarity or functional decentralization
- d Environmental integrity and water management on hydrological boundaries
- e Precautionary principles
- f User/polluter pays
- g Water Management on hydrological boundaries
- h Platform creation
- i Cost recovery
- j Public private partnerships
- k Institutional sustainability
- l Basin organizations

3.2 How the concept is understood in Ethiopia

IWRM represents a paradigm shift in WRM. It is a new approach addressing the complexity of water resources management. The understanding of IWRM is reflected in the Ethiopian water

resources management policy as shown in the subsequent paragraphs.

Based on the view of the respondents, IWRM is understood in the country. The level of understanding is rated medium in Tigray Region whereas high in Amhara Region. The four pillars of IWRM are given sufficient recognition. The fact that fresh water is a finite and vulnerable resource is appreciated very well among the community. The community also comprehends that water resources management should be participatory involving all users, planners, policy makers and all concerned parties. A good grasp of the third pillar of IWRM principle, i.e., the participation of women in management and safeguarding of water, is also attained at country level and regional level. Water is also recognized as an economic good in all regions and the rating of the understanding is high in Amhara Region whereas it is medium in Tigray Region. Gambella region has a good grasp of the IWRM principles.

The manifestation of IWRM is shown in the proclamations of the Federal Government. The Federal government drafted Ethiopian Water Resources Management Proclamation, Ethiopian Water Resources Management Regulation, River basin Councils and Authorities Proclamation, Regulation to establish Abbay Basin High Council and Authority.

The Ethiopian Water Resources management policy envisages the establishment of river basin councils and authorities as one of the instruments to implement IWRM which is actually the pillar of the policy.

Hence, IWRM is very well understood and accepted in the country.

3.3 The right emphasis focus on the means or the end?

IWRM emphasizes joint management and integration among various sectors, groups of society and applications. It provides the means to achieve social and economic development. Moreover, it brings about ecological sustainable development. To cite a few, IWRM could be applied in the following areas, namely, groundwater management, conflict resolution, poverty reduction, pollution control and in reducing health hazards. Hence, focus should be given to the means of arriving at a sustainable solution to the problem at hand,

IWRM should be viewed as a process rather than a one-shot approach. It is a long-term and forward-moving process that is iterative rather than linear in nature. IWRM has no beginnings or endings since it is a process of change which seeks to shift water development and management systems from their currently unsustainable forms.

Adopting IWRM means building on existing institutions and planning procedures to achieve a more integrated approach. A more integrated holistic approach that considers water strategically in the context of different institutional systems; different, often competing uses and the scarcity of resources lies at the heart of sustainable development.

Hence, putting IWRM up on the front in the political agenda is the right emphasis and leads to a win-win situation.

3.4 Implementation challenges

are related to policy matters and institutional matters. The challenges related to policy matters consist of low level of awareness of policies, legislations among the practicing community, weak institutional link between the Federal MoWR and the Regional Bureaus and frequent restructuring of institutions leading to institutional instability. Moreover, overlapping of roles and responsibilities of various institutes dealing with water, lack of implementation capacity and

lack of regulations regarding allocation mechanisms, conflict management and water rights are forthcoming as major challenges.

With regard to the first goal of IWRM, the major challenge faced here in Ethiopia is the conflict in water use between upstream and downstream users. The upstream users usually do not accept the fact that water shall be equitably used even though it enshrined in the Water Policy.

The major challenge with respect to the second goal of IWRM is the excessive withdrawal of water from rivers and lakes encountered in the country. It has left the water bodies without sufficient water to maintain their ecological diversity. The flow regime of the rivers is also disturbed leading to undesired bed erosion which causes failure of structures built in there.

Third goal of IWRM which cares for water being used with economic efficiency is far from being implemented in Ethiopia. There is a poor efficiency in water use especially in case of irrigation where the irrigation method is stilling a flooding type. Moreover, the crops grown are not high value cash crops.

The outstanding challenges concerning participation in the formulation of water policy and objectives are less integration among different sectoral institutions and programs, lack of clear integration of water and land resources management, limiting decentralization to establishment of local level institutions but not on management of resources by communities, lack of holistic approach of project studies, inadequate integration of the sectoral institutions.

3.5 Recommendations for the improvement of the concept

The concept of IWRM is clear. It can be adapted to various sustainable development scenarios. Many countries are incorporating it to their legislative framework. Hence, the consultants do not see any suggestions for improvement of the concept for the time being.

4 IMPLEMENTATION STATUS OF IWRM

The country follows a comprehensive water policy. It has already formulated a water resources strategy. It is currently implementing a comprehensive water strategy.

As is summarized in Chapter 2.3, the country has drafted and implemented a number of policy documents and legal framework creating a conducive environment for water resources management. These documents emphasize the importance of IWRM to various degrees. The following sections highlight the linkages of IWRM to these policies in brief.

4.1 General level of recognition of linkages between IWRM and poverty reduction

Chapter 7.5 of the PASDEP has addressed the water resources of the country. It states that the country possesses substantial untapped water resources that could play significant role in reducing poverty and accelerating growth. It is outlined in the PASDEP document that various efforts have been made to develop the water resources so that its contribution to the national economy will be increased. Hence, a greater effort is required to enhance the management of the sector and its contribution to socio-economic development.

Assessment of water resources has been fully implemented and is being carried out. Basin studies for long-term development and management of water resources is in full swing. Eight river basin master plan studies have been completed to date. Rainwater harvesting schemes have also been partially executed as part of a plan to alleviate poverty.

PASDEP reports the water use in all sectors especially for irrigation and water supply. The coverage of water supply has been improving in the last successive years. Arable land under irrigation is expanding and hence more of the surface water is being utilized for irrigation. Programs and policies are drafted for managing agricultural water use, municipal water use and industrial water use. Water demand surveys in different water using sectors are also carried out and being reported in the annual progress report of poverty reduction plan.

Programs and policies for watershed management have been fully implemented. Guidelines for efficient allocation of water resources among competing uses are in place. Norms and guidelines to evaluate environmental impacts of water projects are employed.

The linkage of IWRM to poverty reduction plan is manifested in the fact that the first phase of the Poverty Reduction Plan was formulated and implemented within the frameworks of the national Water Resources Management Policy, Water Sector Strategy and Water Sector Development Program (WSDP). These documents promote as their core value the principles of IWRM. During the early periods of implementing the poverty reduction plan, significant steps have been taken towards improving overall water resources management, including conclusion of the Nile Basin Initiative.

The poverty reduction plan recognizes that the water resources management refers not only to water for all purposes but also the need for substantial collaboration across agencies. Hence, the poverty reduction plan implicitly promotes IWRM indicating a strong linkage to IWRM. It is cited here that the Nile Basin Initiative is a good model in which considerable movement is expected in terms of implementation of a watershed development program, implementation of irrigation and drainage projects etc.

Functional hydrological and hydro-meteorological monitoring networks are in place and being expanded. Standardized procedures for data compilation, processing and analysis are under consideration. Moreover, programs for information exchange and knowledge sharing about good practices are partially implemented.

4.2 General level of recognition of the importance of IWRM as a tool for water resources development and management planning

The Ethiopian Water Sector Strategy drafted in November 2001 clearly states that an integrated approach rather than a fragmented approach shall be followed in water resources development. It recommends that during water resources planning and development, preliminary investigations shall be conducted of the whole river basin leading to a broader idea of what kind of basin development programme seems plausible or possible. Moreover, the strategy emphasizes that water allocation plans will be developed taking into consideration basin, sub-basin and other hydrological boundaries. Hence, a proper recognition of IWRM is given in the strategy.

Ethiopia has so far prepared master plans for eight of its river basins. These master plans pave the way for water resources planning, development and management. The master plans underscore that the river basin be employed as the unit of water resources planning. This conforms to IWRM guiding principle.

The strategy puts enough emphasis to the enabling environment for water resources planning and development. These constitute decentralized management, full participation of user communities, mapping relevant stakeholders, capacity building, forming RBOs and the like.

Establishment of RBOs is being undertaken. Proclamation No. 534/2007 on River Basin Councils and authorities Proclamation is worth citing at this juncture. The Proclamation maintains that the establishment of river basin councils and authorities will have significant contributions in creating efficient and stable mechanisms for the implementation of the Ethiopian Water resources management policy through river basin plans and effective and sustainable joint management by relevant stakeholders of the water resources of the basin.

The objective of the river basin high councils and authorities is to promote and monitor the integrated water resources management process in river basins with a view to using of the basin's water resources for the socio-economic welfare of the people in an equitable and participatory manner, and without compromising the sustainability of the aquatic ecosystems. The Powers and duties Basin High Councils are stated in the Proclamation. One of the duties attributed the Council is the directing the preparation of the river basin master plan. It should also ensure high level of coordination among stakeholders for the implementation of IWRM in the basin. It examines and decides on water allocation rules in both normal times and during water shortage. The Council can adopt its own rules of procedure.

The Basin Authority shall give permits relating to water use and water works. The issuance of permits relating to water use or water works shall take into consideration the basin's future perspective in line with IWRM process.

Basin Authorities develop and use management oriented basin information system, in order to guide and support the basin water resources strategic planning and water management functions. The information system encompasses the quantity and quality of water resources of the basin, the aquatic ecosystem of the basin, the level of water demand, the existing and planned major

water infrastructures, major interventions or projects that may have impact on the water resources, the existing water resources and stakeholders of the basin.

River basin plans are also well defined and their contents specified in the proclamation, Proclamation No. 534/2007.

Pursuant to this Proclamation, the Abay basin High Council and Authority has been established under the regulation, regulation No. 151/2008. The Abay basin Authority undertakes activities necessary for the implementation of IWRM in the Abay basin.

4.3 Level of mainstreaming of IWRM principles in national policies and plans

The core values of IWRM are manifested in the Ethiopian Water Resources management policy. The Ethiopian Water Resources Management Policy complies with the basic principles of IWRM. This could be illustrated as follows:

- a The Ethiopian Water Resources Management Policy recognizes the fact that water is a scarce and vital socio-economic resource and to manage water resources on strategic planning basis with long-term visions and sustainable objectives;
- b The Policy promotes the participation of all stakeholders , user communities; particularly women’s participation in the relevant aspects of water resources management;
- c The policy underlines that women play a central part in the provision and safeguarding of water;
- d The policy recognizes water both an economic good and a social good in order to significantly contribute to development.

Hence, the IWRM principles are well streamlined in the policy of the country.

4.4 Level of mainstreaming of IWRM considerations in the framework

IWRM is reflected in poverty reduction plans, water efficiency plans, national development and investment plans, regional and sub regional water resource management plans, transboundary water plans to a high extent.

The Policy complies well with the operational principles of IWRM. The policy creates conducive environment for the enhancement of linkages and partnerships between the Federal and Regional states on the basis of the constitution for the realization of efficient, sustainable and equitable water resources management.

The policy also ensures that water resources management is compatible and integrated with other natural resources as well as river basin development plans and with the goals of other sectoral development plans in health, mines, energy, agriculture etc.

The policy fosters the participation of user communities in water resources management by supporting the establishment of appropriate institutional framework from regional to the lowest administrative structure and promotes decentralized management.

The policy incorporates environment conservation and protection requirements as integral parts of water resources management. It creates appropriate mechanisms to protect the water resources of the country from pollution and depletion to maintain sustainable development and utilization of water resources.

The policy recognizes water as a natural resource with an economic value and ensures that fees are paid for services rendered. The policy promotes the “User Pays” principle for urban supply and sanitation services.

The Ethiopian water resources management proclamation, Proclamation No. 197/2000, is the basis for the legal framework regarding a water resources management, protection and utilization. The Proclamation is required to put the water resources of Ethiopia to the highest social and economic benefit for its people through appropriate protection and due management. It states that the integrated master plan studies and water resources legislative framework shall serve as a point of reference. Moreover, it asserts that the management of water resources of Ethiopia shall be in accordance with a permit system. The Proclamation affirms that domestic use shall have priority over and above any water uses.

The Ethiopian Water Resources Management Regulation was issued in 2005. It sets the legal framework for water use. A supervising body is set in order to oversee water exploitation. Water resources utilization requires an application for water permit. Duties of the supervising body, MoWR, are clearly set in the regulation, Council of Ministers Regulation No. 115/2005. Water charges are needed to be paid for water use. Discharging of water after use entails cost. The wastewater needs to be treated before release into a receiving body.

Fees and charges are paid for use of water, for discharge of treated wastes into water resources and for the use of water from government projects. Charges for use of water are determined by the Council of Ministers. Charges are billed once a year. If water is abstracted from a government water works project, the charges payable to such water shall be based on the principles of cost recovery.

Dispute of settlement is well laid and cases are filed at the premises of the supervising body. Arbitration is also another mechanism of dispute settlement.

4.5 Level of mainstreaming of IWRM considerations in the institutional framework and implementation/enforcement mechanisms

The policy complies with other principles of IWRM such as public private partnerships, institutional sustainability, basin organizations. The policy recognizes and adopts the hydrologic boundary or basin as the fundamental planning unit and water resources management domain. This has led to the formation Abay Basin Authority and others are to follow. The Proclamations cited earlier in this report affirm the mainstreaming of IWRM in institutional framework.

The policy envisages creating for discussions and consultations amongst the various stakeholders. Moreover, institutes for water resources management should align themselves on the principle of cost recovery for water supply and irrigation schemes.

Water management institutes should promote the involvement and meaningful participation of the private sector in water resources development and planning. Institutional sustainability shall

be made better through IWRM.

However, enforcement mechanisms are not yet in place or are just beginning in Ethiopia.

4.6 Challenges related to implementation of IWRM in Ethiopia

The main challenge to the implementation of IWRM is financing. Water resources planning, development and management involve huge amounts of investment. The water sector investment plans are mostly prohibitively huge. Strategies pursued to mobilize financial resources might be tiresome and frustrating. Most of the schemes might not be financially sustainable.

5 CASE STUDIES OF IWRM INITIATIONS IN ETHIOPIA

5.1 Introduction

Ethiopia has formulated a water policy strategy and a 15-year development program based on the principles of Integrated Water Resource Management (IWRM). Three case studies are considered to illustrate the level of implementation of IWRM in Ethiopia. The first two case studies are efforts made by the Ethiopian Country Water Partnership whereas the third one is the endeavor by the Ministry of Water Resources to formulate and establish River Basin Councils.

The Ethiopia Country Water Partnership (ECWP) is testing the national plan by implementing IWRM on the ground. To promote and implement IWRM in Ethiopia, ECWP is testing IWRM principles and approaches at two pilot catchments for extrapolation to other watersheds across the country. The two pilot sites selected are Berki catchment in Tigray region and Messena IWRM area in Amhara Region.

5.2 Case study 1: Berki catchment in Tigray Region

The Berki catchment in Tigray region is selected to serve as a pilot IWRM learning site. The Berki Integrated Water Resources Management (IWRM) is being proposed as poverty reduction initiative which is financially supported by Water Aid, with the framework of the current country strategic opportunities. A brief summary of the IWRM planning process at Berki is presented below.

Background

Berki watershed is found in Tigray region, in the Northern part of Ethiopia. It is surrounded in the North by Woreda Saesie Tsaeda Emba, to the south Mekelle city and Afar regional state, to the east Afar regional state and to the west Wukro town. Geographically, it is located between 13° 32' 44" N and 39° 33' 39" E to 13° 45' 00" N and 39° 47' 40" E. The total area of the watershed is 410.02 km². The total size of the population in the watershed is about 90,000.

The Berki River flows to join the Giba River, a tributary of river Tekeze, which itself is a tributary of the Blue Nile. The Berki Watershed encompasses three Woredas: Kilte Awlalelo, Enderta and Atsbi-Wemberta. Atsbi-wonberta woreda and Enderta Woredas are located in the upper catchment and the Kilte-awlalelo forms the lower catchment. The watershed is characterized by mountainous terrain in the upper portion and flood plain and low hills in the lower portion. The location map of the watershed is shown in Figure below.

There are three diversion structures (Chuhot, Berki and Laelay agulae) on Berki River and three Dams (Era, Adishu and Adazabe) constructed on the upper catchment and there are also a number of privately owned and communal wells for irrigation.

The Berki Watershed is classified as dry Dega (highland) and dry Woyandega agro ecological zone. The altitude varies between 1800 and 2846 m.a.s.l. The mean minimum temperature is 11°C and the mean maximum temperature is 24.3°C. The mean annual rainfall is about 483.2 mm. The watershed has uni-modal rainfall pattern with peak in July and August.

The land use pattern study shows that there are about 21,565 ha of agricultural land (52.5%), 10,777ha forest (26.3%), 6750 ha grazing (16.5%) and the rest homestead and miscellaneous land. The potential land suitable for irrigation is 9808 ha, and currently the area under irrigation is estimated to be 600ha.

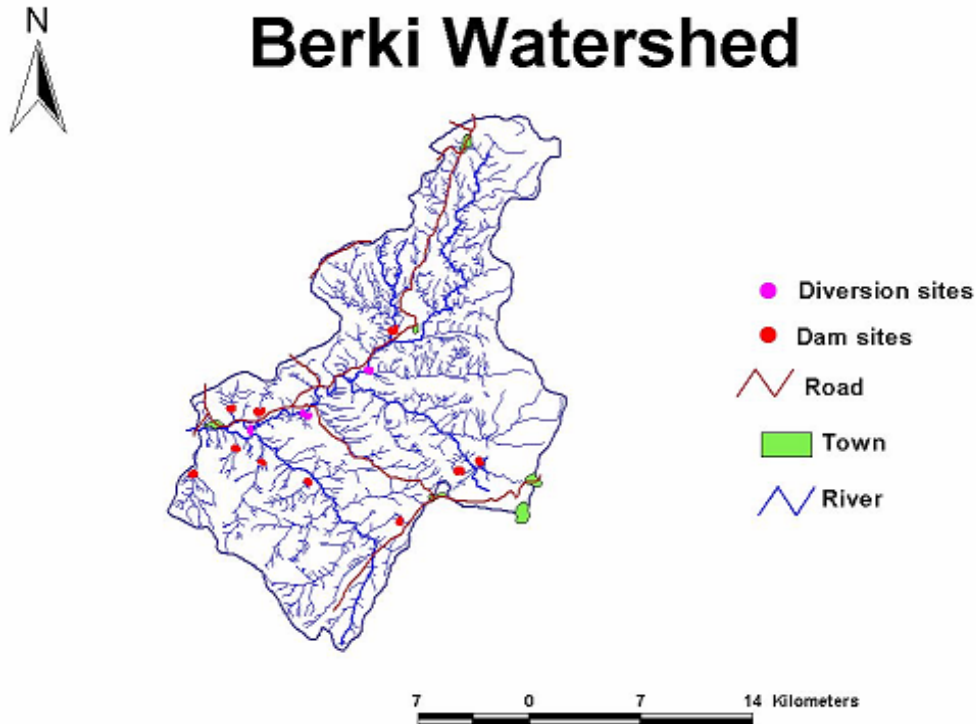


Figure 2 Berki Watershed

IWRM: Issues in Berki

- a. The backbone and the main stay of the watershed areas is agriculture. It has been practiced for ages. But still the pace of production of agriculture is at the infant stage. There is gap between the food requirement of the people and the existing crop production. At present farming is below subsistence level of production and the population in the catchment are unable to meet their annual needs of food.
- b. In recent years, most part of the watershed has suffered from drought. The rainfall is erratic, variable, and seasonal and of short duration, which is insufficient for proper growth and maturity of crops. In most parts of the areas, the farmers are suffering from shortage of water not only because of its unavailability, but mainly because of the lack of skills to make it available at the time and place required.
- c. There have been a number of conflicts in the watershed in utilization of the water of the Berki River.

- i. Communities living in downstream area are said to suffer from dry season, unavailability of irrigation water from Berki River due to effects of diversion made in the upstream locations.
 - ii. The study area is frequently affected by drought; as a result a large number of the upstream and the downstream farmers introduced pumps to exploit water from the Berki stream. Inefficient utilization of irrigation water and water withdrawal by pumps in upstream areas causes a serious water shortage on the already diversions users in the downstream. Many water users are unable to get enough water for their produces. This creates a disagreement among the users in respecting of the water user associations' rules and regulations.
 - iii. The spring near Berki diversion is being used by the church for spiritual purposes. The church taps the spring with the fear that it may be developed by government to supply water for Agulae town. There is potential conflict between the church and the Bureau of water resource mines and energy.
- d. Lack of integration and coordination among various stakeholders.
 - e. Extensive utilization of forestlands mainly for construction and sources of energy with out any replacement can lead to decrease in the vegetation coverage of the area and finally may lead to the depletion of the available natural resources. In most areas, the main source of firewood is the existing forest. Deforestation may lead towards soil erosion and shortage of moisture and these in turn will affect the agricultural productivity of crops.
 - f. The watershed is characterized by high fertility rate, on average the population is growing by 2.9%. High population growth rate accompanied with low off – farm income sources, small land holding and high environmental degradation make life difficult for the majority of the population.
 - g. Basically land is state owned and precious natural resource. Currently there is high pressure on the existing land resource both from the rural community and from the local and regional government for expansion of infrastructure and investment. The average land holding in the watershed is 0.5 ha per household.

It is expected that water will be scarce resource and the quality of water and environment will be degraded. Competition for a finite resource will be high as demands are outstripping of supplies. Furthermore, lack of coordination among sectoral bureaus will aggravate the water shortage problem on the whole part of the Berki catchment.

The Berki Integrated Water Resource Management is expected to solve the above aforementioned problems in the catchment by promoting coordinated development and management of water, land and related resources, to maximize the economic and social welfare in an equitable manner with out compromising the sustainability of the ecosystem.

The baseline study (Situational analysis)

The purpose of the baseline study is to help characterize the present situation and to use the information to predict future adjustments necessary for the IWRM approach. The main objective of this analysis is to assess the natural resources, and identify the potential and the constraints in

utilizing the resources in the catchment.

The situational analysis of Berki catchment was made to identify outstanding issues of IWRM, problems and their solutions of the study area. Prioritizing problems, issues and solutions in terms of social, economic, environmental and political priorities was an important aspect of the situational analysis. It is especially important to view the situation from the perspective of those directly affected.

The study is based on the broad division of water resources, agricultural crop production, watershed management and environment, land capability of the area, and social and economic development. The study includes among others the following:

- i. assess the quantity and quality of surface and groundwater
- ii. identify the pertinent parameters of the hydrological cycle, and evaluate the water requirement of different development alternatives
- iii. pinpoint the major water resources issues, risks and hazards such as flood and drought
- iv. assess the agricultural crop production condition and problems
- v. assess the extent of land degradation , deforestation and erosion problems
- vi. population size and characteristics;
- vii. education and health situations;
- viii. land holdings use and management;
- ix. status of natural resource;
- x. livestock resources and livestock production;
- xi. local services and infrastructure;
- xii. institutional and Legal establishments and framework;
- xiii. Gender consideration in social and economic development; etc.

The baseline study (situation analysis) has been conducted by a study team of expert consisting of hydrologist, hydro-geologist, watershed expert, agronomy and soil expert, livestock expert, socio-economist, environmental impact assessment expert together with the Woreda technical team members.

A number of methodological approaches are used to conduct the study: field and desk works, review of available document on the watershed, data collection and verifications, dividing the watershed into sub-watersheds, field survey and observation, laboratory analysis for soil and water samples, stakeholder's analysis, consultations and interviews and group discussions with the community. During the study a number of sectoral and cross-sectoral problems are identified and solutions are forwarded accordingly. The details are presented in the volumes containing the sectoral reports which are compiled in five volumes; Socio-economic assessment, agricultural crop production, water resources assessment, and watershed management and environment of the area.

The IWRM planning process

The goal of Integrated Water Resource Management in Berki catchment is to improve livelihood of the communities through sustainable development and management of water and other natural resources. The specific objectives in preparing the IWRM plan were:

- i to determine water development activities in the watershed
- ii to determine water and other natural resources management activities
- iii to manage conflicts related to water and other natural resources use and management

- iv to develop appropriate regulatory and institutional framework for managing water resources

The planning process is the continuation of the baseline study of Berki Catchment in which scenarios have developed that can improve livelihood of the communities. The objective of the process is to develop an integrated development and management plan for the area based on selected scenario.

The planning process involves a number of awareness and sensitization meetings and workshops in the Region on IWRM. Various key stakeholders brought together from Regional and Woreda government offices, non-government organizations, the private sector and other stakeholders, to discuss, share knowledge and experiences and launch regional framework for promoting IWRM. The plan will provide possible strategies and scenarios which will improve the livelihood of farmers in the watershed.

Steering committee and regional and woreda level technical committee were set up which includes all stakeholders involved in water works and management to lay the framework for developing and implementing the IWRM plan for Berki Catchment. Community and woreda level watershed planning teams were formed to work together with the study team of experts. The proposed plans have been discussed by the community and the watershed planning team incorporated the comments and the draft plan is prepared.

The problems of the Berki catchment are identified, analyzed and prioritized and all possible solutions are forwarded by stakeholders. These solutions, irrespective of their feasibility, are considered in the scenario identification process.

A draft plan is prepared following the steps set in the Community Based Participatory Watershed Development Guideline Prepared by the Federal Ministry of Agriculture and Rural Development. The preparation of the management plan was participatory and has brought on board major stakeholders of Berki catchments particularly the community.

Proposed intervention

Watershed management and erosion control measures, constructing water harvesting structures in the middle and lower catchments, improving crop production and productivity and institutional strengthening and capacity building are found to be key intervention areas to solve the problems and to attain the objectives of IWRM in the catchment . In fact, along with these there are a number of cross sectional issues that are crucial to meet IWRM goal in the area. These include, improving social services and infrastructure, conflict management, improving legal and regulatory framework, improving institutional setup, community participation, strengthening cooperation and partnership and others.

The way ahead

In Berki catchment, there is a severe water shortage problem compared to the existing demand for different uses; including irrigation, livestock watering, and domestic uses. There are already conflicts over the use of water resources among individual households and different social institutions. Besides, the watershed is degraded that is aggravated by higher deforestation and overgrazing rates. To minimize and to solve these problems, promoting and testing the IWRM

approach is very important.

The Berki IWRM draft plan is prepared and it should continue to come up with implementation plan for the proposed interventions. Care should be taken to bring the sustainability of the project in view of the apparent inadequacy of the institutional arrangement for water user groups. Tigray Regional Water Resource, Mines and Energy Bureau should monitor and evaluate the coordinated effort of all relevant stakeholders to enhance the effectiveness of the implementation of the plan.

The IWRM Planning process has taken a long time. In the process, sectoral integration and coordination was difficult and to bring the different interests of the stakeholders towards common objective was a challenge. The final IWRM plan will be finalized soon. Though there is a commitment from the Regional Bureau to implement the plan, the availability of fund for implementation may be a limiting factor.

5.3 Case study 2: Messena Catchment IWRM Plan

The general objective of the IWRM study is to develop possible scenarios which improve livelihood of communities of Messena IWRM area through application of Integrated Water Resource Management principles. The specific objectives consist of assessment of water resources of the catchment, assessment of the socio-economic setting, state of agricultural production in the area, appraisal of the watershed situation, scrutinizing the existing problems, pinpoint prevailing constraints and opportunities for development and identifying scenarios of development.

Messena micro-watershed is found in Amhara Region, Oromiya Zone, Dawa Chefa Woreda in Gerbi Mesena peasant association and in northern part of Kemise town which is the zonal capital of Oromiya zone. Geographically it is located at 10⁰42'53.23" N, 39⁰49'52.35"E and 10⁰44'53.43" N, 39⁰51'15.32"E. The total area of the catchment is 546.22 ha.

The IWRM area does not fulfill the ideal definition of a watershed. Rather it is a combination of two watersheds (northern and southern Messena) and a flat land beneath the two which is part of the large Borkena plane.

A situation analysis has been accomplished initially. The analysis has covered the assessment of water resources, agricultural crop production, land capability of the area, and state of social and economic development. The assessments include among others the

- a the quantity and quality of surface and groundwater
- b identifying the pertinent parameters of the hydrological cycle, and evaluate the water requirement of different development alternatives
- c pinpoint the major water resources issues, risks and hazards such as flood and drought
- d assess the agricultural crop production condition and problems
- e Population size and characteristics;
- f Education and health situations;
- g Institutional and Legal establishments and framework;
- h Land holdings use and management;
- i Status of Natural resource (bush and uphill trees);
- j Livestock Resources; Livestock production;
- k Local services and infrastructure related;
- l Economy and livelihoods related;
- m gender consideration both in social and economic development issues; etc.

Of Interest here in the appraisal are the institutional framework and the stakeholder analysis.

Institutional framework

A number of government institutions and community organizations are engaged in the development of the IWRM in Messena. The institutions at Regional level appear in the framework which decentralize to Woreda and Kebele level. These include, the Wereda Politico-Administrative of Messena ; Kebele Politico-Administrative of Messena ;and Community-based organizations. The Wereda Politico-Administrative of Messena is the most nearer and standby institution for the overall undertakings and responsibilities of the area. The group of sectors which include the Dawa Chefa Wereda (and now the Kemmisie Zuria Wereda) Administrative office, Office of Agriculture and Rural Development, Office of Health, Office of Education, Office of Justice, Office of Women's Affairs.

The leading and most responsible sector which holds the responsibility of IWRM [the cases of water resources, crop production, livestock production, energy and mines, inputs supply, natural resources management, cooperatives, and food security and disaster prevention] is the Office of the Woreda Agriculture and Rural development. The Woreda OoARD is organized into 5 main technical departments (which they call it Desk) the agricultural extension desk, inputs desk, cooperatives desk, water desk, and food security and disaster management desk.

The capacity and efficiency of the administrative and political structures to undertake development programs, conservation of resources, good fiscal management and service delivery systems at kebele level is based on the kebele Administration system as a head and other sectoral nominees at kebele level as a development facilitator which is adopted from wereda decentralized way of administration. Inhabited people in the Messena have community organizations which were formed to assist the management of natural resources like the surrounding bush and the water supply, which by name are Water user Committee; Forest conservation task force and Land Administration committee.

Legal establishment and framework

The legal system like other development sectors is to aware the community not to go to illegal acts ,resource abuse, and beyond that if there are any on the action of abuse ,to take legal measurements in away it can teach the community, and the person in charge. The legal establishments and framework for Messena emanates from the rules, regulation and bylaws of the active sectors like the OoARD, and the actual civil and criminal codes of the Region. The leading sector i.e. the Woreda OoARD has got rules, regulation and bylaws which helps for better use and conservation of resources including water. Some acknowledged are related to the land management, trees management, uphill areas management, and livestock management. Some specific ones include

- a. No one can sale buy, or transfer the land;
- b. In planting the eucalyptus trees it should first consult the DA, the
- c. forest task force and should get authorized from them;
- d. Any one can not construct his house as near as 6 meters to the gullies;

Stakeholder analysis

The importance of application of IWRM in Messena is of prime importance to the Messena

community, Ministry of Water resources, Bureau of Water resources Development Country water partnership, Bureau of Agriculture and Rural development, Woreda Office of Agriculture and Rural development, Kebele Agricultural Development offices, Environment and Land uses Authority, ANRS Bureau of Health, Woreda Office of health, and NGOs (World Vision Ethiopia). At the same time these sectors are highly important for the application of IWRM.

In terms of power and influence, the Messena community is both the owner and leading actor for the IWRM; hence they have got the highest influence and power for the success. In addition the stated sectors above again are with high influence both in terms of financial and technical assistances, and then should be approached well.

Conversely the application of IWRM will have least importance to external stake holders like the transiting pastoral Afars, and the local investors. In this case they have got very high influences on the IWRM and they will be sources of risk for IWRM failure.

Problem analysis and identification

During the study a number of sectoral and cross-sectoral problems are identified and solutions are forwarded accordingly. The problems are categorized into four. These are problems related water and environment; water agriculture and food security; water, sanitation and hygiene; institutional and regulatory mechanisms.

The first problem identified was flood hazard as a result of deforestation and overgrazing. Possible suggested solutions are gully control and rehabilitation, hillside conservation and development, establishing flood early warning system, community awareness creation and capacity building, resettle highly susceptible villages, and enhance collaboration of actors.

The second problem relates to water logging of farmlands due to overflow from Borkena River and runoff from uphill catchments. Due to overgrazing, the productivity of the livestock has decreased which endangers the food security situation. To mitigate the situation, the prescribed solutions constitute intensifying and improving irrigation system, promoting alternative income generating schemes and improving the agricultural practice.

The third problem is inadequate provision of potable water and poor sanitation. These affect the health of the residents adversely. To make the situation better, the following measures are suggested: sustaining drinking water sources linked with groundwater system through artificial groundwater recharging; improving Water use and management especially through improving water use efficiency during fetching; provision of additional water supply bore holes; improve health services for a healthy community for sustainable resources use and management; and make the community aware on effects of population pressure on resources, and family planning

The fourth problem relates to competing and conflicting use of natural resources. This results from a high demand for water and grazing land as compared to the availability of the same. Hence, lack of regulatory mechanism in case of arising conflicts exacerbates the situation. Hence, to alleviate these circumstances, awareness creation and sound natural resources management and enhancing cooperation and participation are suggested as possible solutions.

Four possible IWRM scenarios were developed at the end of this study.

5.4 Case study 3: Ethiopian WASH

The WASH movement is presented here as the third case study of successful IWRM implementation. Ethiopia WASH programme has the goal of reducing morbidity and mortality caused by lack of safe and adequate water, poor sanitation and hygiene conditions. The objectives are to promote improved water, sanitation and hygiene practices and gain the political and social commitment and endorsement required to make a real difference in the country's water, sanitation and hygiene situation.

Ethiopia WASH is a multi-stakeholder coalition. The movement has been exceptionally successful in spreading the WASH message and in facilitating change. Among others the WASH Movement contributed to a MoU signed among three ministries – Ministry of Water, Ministry of Health and Ministry of Education. This was followed by the development of a National Hygiene and Sanitation Strategy and Protocol.

The cause of the success of the WASH movement is attributed to advocacy and social mobilization, monitoring and coalition building. WASH Ethiopia Movement Member Organizations include

- Government Organizations
- International Organizations
- Civil Society
- Private sector
- Faith based organizations.

5.5 Lessons learnt from IWRM initiatives in Ethiopia

IWRM initiatives are being promoted through Ethiopian Country Water Partnership Programme. The launching of the Messena and Berki IWRM programmes will have a lasting impact on other regions in terms of conflict resolution as a result of scarce land and water resources. Moreover, stakeholder participation has been pivotal in implementing the IWRM projects. As it is discerned from the IWRM reports of both projects, the stakeholder mapping has been inclusive and brought the blessing of the politicians.

Moreover, the success of Ethiopia WASH programme in bringing the three Ministries to work together has resulted in increased coverage of water supply and sanitation to the needy in Ethiopia. Even though a lot of campaign was essential to reach this stage, IWRM principles played a crucial role in the success of the project.

Since water related problems like drought, flood, degradation are all related, IWRM principles have been successfully applied in both Messsea and Berki cases to address the problems. Moreover, the creation of the awareness of programme helped in formulating lasting solution to the pertinent problems of overgrazing and poor sanitation.

6 CONCLUSIONS ON THE LEVEL OF IMPLEMENTATION OF IWRM

6.1 Conclusions on the level of implementation of IWRM

Ethiopia has definitely implemented IWRM into its policies and plans. The Ethiopian Water management policy has clearly incorporated the core values of IWRM. Gender mainstreaming, participatory approach in policy and strategy formulation, issuing water use permits and implementing cost recovery schemes lay at the heart of the policy.

It has already issued proclamations and regulations in the areas of Water Resources Management, establishment of River Basin Councils and Authorities, Water Sector strategy and Water Sector development plan. All these documents reflect the core values of IWRM.

Three cases of IWRM implementation come out loud and clear and have been reported in the media. Hence, this brings one to conclude that Ethiopia is implementing IWRM principles.

6.2 Recommendations for improving IWRM implementation

In order to improve the implementation of IWRM, huge financing is required. Finance from both internal sources and external sources should be brought together to extend the pilot implementation of IWRM projects in all regions.

Capacity building at all levels should be vigorously pursued so that stakeholder participation in IWRM could be enhanced or promoted. The efforts of ATP-NBI, ECWP, and USAID should be complemented to reach every corner of the society and preach the values of IWRM.

Last but not least, the recently established Ministry of Science and Technology should bring all pertinent stakeholders to one forum and form a National Water Research Center for promoting both research and training in the area of IWRM.

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