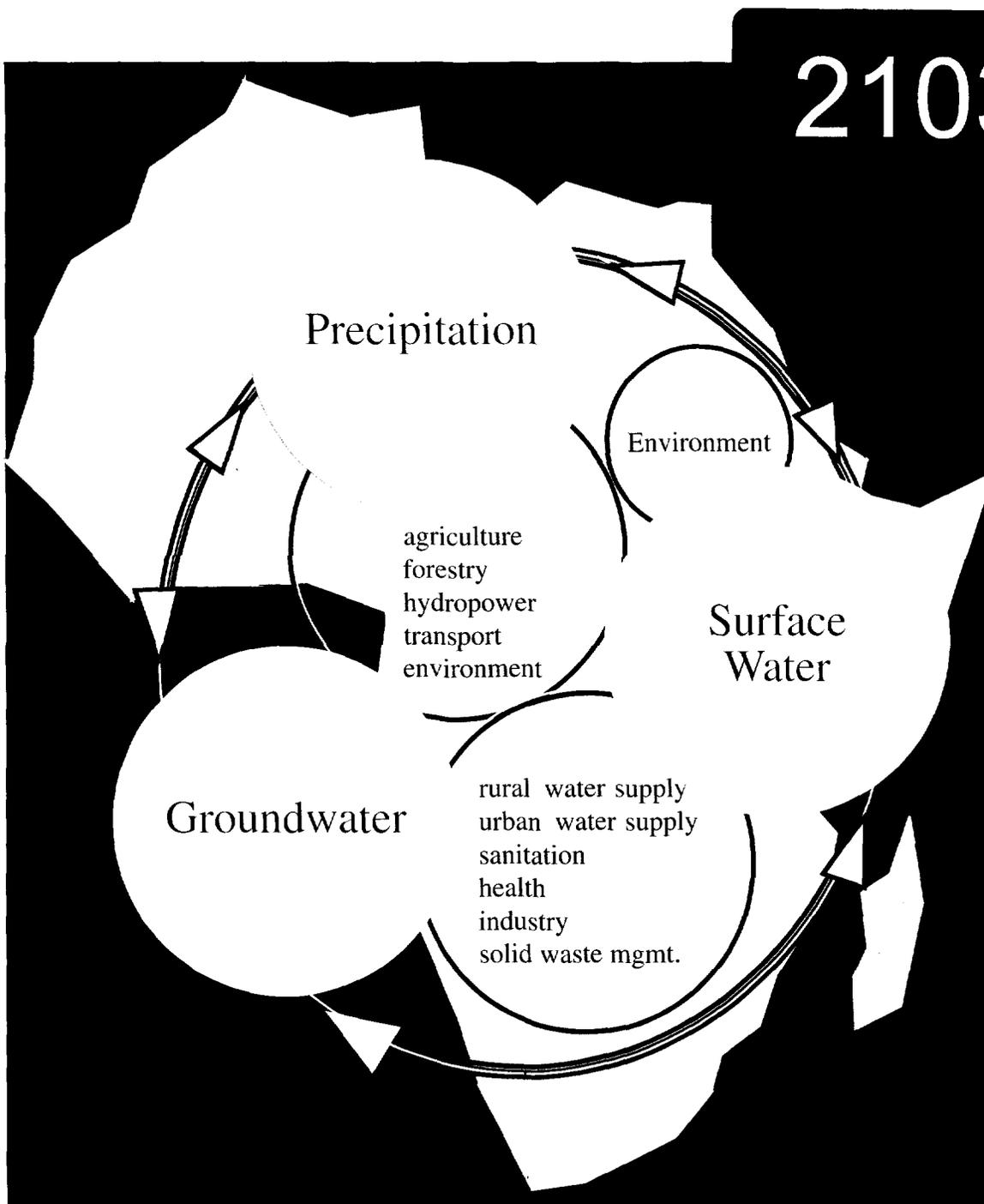


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Proceedings of the World Bank Sub-Saharan Africa Water Resources Technical Workshop

21032



Nairobi, Kenya

February 12–15, 1996

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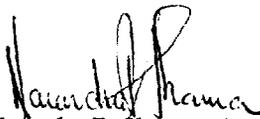
FOREWORD

Water is becoming an increasingly scarce resource in Sub-Saharan Africa, and with rapidly increasing demands, the countries of the region must make the transition to efficient and equitable management of their water resources. Any delay will hinder attempts at economic growth and poverty alleviation and could lead to unprecedented conflicts between user groups within countries or between countries sharing international rivers.

African countries must take the lead in integrated, multi-sectoral approaches in the development and implementation of national water strategies that involve all stakeholders. When designed by African countries themselves, such strategies can make optimum use of African capabilities, resources, and experiences. Additionally, partnership is needed between donors, between African countries, and between these two groups. Experience shows that donors working together, and following an African lead within countries, is the best path for success.

This document is the result of one event designed to help promote such partnership: the Sub-Saharan Africa Water Resources Technical Workshop held in Nairobi, Kenya, from February 12 - 15, 1996. The workshop was jointly sponsored by the World Bank and the United Nations Environment Program. This workshop provided an opportunity for senior level representatives of Eastern and Southern African governments, UN agencies, bilateral donors, NGOs, and the World Bank to discuss how to best achieve the goal of sustainable water resources management. The papers compiled in this document are an account of the lively and insightful discussions which followed. In addition, the main point of debate, *African Water Resources: Challenges and Opportunities for Sustainable Development*, has been revised to reflect workshop discussions.

One important outcome of the Nairobi workshop and the follow-up workshop held in Dakar is the determination that the African Advisory Group, formed for the preparation of the Draft water strategy paper, should take the lead in the promotion and development of a Pan-African Partnership. This Partnership will foster inter-country dialogue, facilitate the sharing of knowledge, experience, and best practices, and develop consensus on key issues and actions. The goal now is to maintain the momentum from these workshops, furthering cooperation and an African-led development process.



Narendra P. Sharma, Agricultural Advisor
Environmentally Sustainable Development Division
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The World Bank

PREAMBLE

Theme: *African Water Resources: Challenges and Opportunities for Sustainable Management*

Focus: *Partnership and Consultation: Develop consensus and a Broad Coalition for promoting more efficient and equitable use of water resources in Sub-Saharan Africa*

The Nairobi Workshop was the first of two sponsored by the World Bank to enable ministers and experts on water resources management in Africa to discuss and draw conclusions on key issues. Hosted by the UN Environment Programme (UNEP), it was attended by 119 participants, including water sector ministers and senior government officials from 21 countries of eastern and southern Africa together with representatives from UN agencies, bilateral donors, non-governmental organizations (NGOs), and the private sector (a list of participants is included as Annex 2 of these proceedings). A second similar workshop was held a week later in Dakar, Senegal, covering the countries of western and west central Africa.

In advance of the workshop, participants received copies of a draft World Bank Strategy Paper - *African Water Resources: Challenges and Opportunities for Sustainable Development* (the workshop theme) and were invited to review and comment on the draft both during the workshop sessions and in writing to the staff of the World Bank's Africa Technical Department who attended the workshop. The prime aim of the workshop was not, however, to finalize the Strategy Document; it was to use the analyses and action-oriented recommendations in the paper as a starting point from which to develop consensus on national and regional policies and programs for improving water resources management on the continent.

In an opening address presented on behalf of the UNEP Executive Director Elizabeth Dowdeswell, Assistant Executive Director Jorge Illueca linked the workshop theme to *Agenda 21*, and in particular to Chapter 18 (the freshwater chapter), which calls for *Integrated Water Resources Development and Management* with the overall objective "to satisfy the freshwater needs of all countries for their sustainable development" and priority to "the satisfaction of basic needs and the safeguarding of ecosystems". He related it too to the UN Secretary-General's *Special Initiative for Africa* which emphasizes a "Fair Share" approach with "water equity" at three levels: (i) across major water uses and users; (ii) in national economic development plans; and (iii) between countries using shared water resources. The Fair Share theme was amplified later in the workshop in a plenary presentation by UNEP Deputy Director, Water, Walter Rast.

The process for reaching consensus at the workshop began with plenary presentations and discussions of issues and challenges and a review of individual country experiences for which the participants divided into two concurrent sessions which then reported back to a plenary discussion. These presentations and plenary discussions occupied the first two days of the workshop. Their conclusions were consolidated into action-oriented recommendations on the third day in five concurrent sessions each dealing with an individual theme. The thematic working groups reported back on the fourth day, and their recommendations were refined in a plenary discussion and summarized in a Wrap-up presentation.

These Proceedings are divided into six sections. Following this Preamble, the sections are:

Section 2: The Continent in Transition

A summary of the Keynote Address, presented by Kevin Cleaver, Director of the World Bank's Africa Region Technical Department.

Section 3: The African Perspective

The text of a presentation by His Excellency, Roberto Costely-White, Minister of Public Works and Housing of Mozambique and a series of key questions presented by Professor Mark Mujwahuzi of the Institute of Resource Assessment at the University of Dar-es-Salaam, Tanzania.

Section 4: Country Perspectives: Achievements and Opportunities

Full texts of the individual country presentations.

Section 5: Thematic Presentations

Introductory presentations made to the five thematic working groups:

Group A: Strategies and investment options

Group B: Capacity utilization, building, and retention

Group C: Information and knowledge base

Group D: International water resources

Group E: Donor collaboration

Summaries of the individual working group reports are included as Annex 1.

Section 6: Summary Workshop Report

Summarized conclusions and recommendations, based on the Wrap-up presentation by the Workshop Coordinator, Narendra Sharma of the World Bank's Africa Region.

OPENING ADDRESS

**Dr. Jorge Illueca, Assistant Executive Director/Managing Director
Program, UNEP**

1. INTRODUCTION

In June 1992, the Earth Summit of world leaders adopted Agenda 21, a pioneering plan on national and international action needed for moving toward development that was economically, socially, and environmentally sustainable. All of the countries represented here have approved Agenda 21.

The first paragraph in the Preamble to Agenda 21 states as follows:

"Humanity stands at a defining moment in history. We are confronted with a perpetuation of disparities between and within nations, a worsening of poverty, hunger, ill health and illiteracy, and the continuing deterioration of the ecosystems on which we depend for our well-being. However, integration of environment and development concerns and greater attention to them will lead to the fulfillment of basic needs, improved living standards for all, better protected and managed ecosystems and a safer, more prosperous future. No nation can achieve this on its own; but together we can - in a global partnership for sustainable development."

There can be no serious disagreement with the statements that socio-economic development, and the resultant betterment of human lives and living conditions, is a priority goal. At the same time, socio-economic development is not possible without some environmental impact. Unfortunately, this impact often is negative. The key, therefore, is to find the right balance between satisfying the needs and desires of humanity for the rewards of socio-economic development, while at the same time conserving and protecting the very environment that makes it possible.

Some have dismissed Agenda 21 as an "environmental wish list". However, Agenda 21 also recognizes that if we do not use our natural resources, water included, in a sustainable manner, the likely results will include: (i) socio-economic development that is critically restricted over the long term, (ii) socio-economic and socio-political conflict as an inevitability, and (iii) pervasive hunger and misery, particularly in those areas with the least capabilities for addressing them. And yet, donor agencies and institutions still often fail to take the goals of Agenda 21 into account as a prerequisite for future development. UNEP's position on this matter is perfectly clear – the sustainable use of natural resources is a prerequisite for development of sustainable strategies for the water and other relevant sectors over the long term. The environment is not an externality. Rather, it is at the core of sustainable development – it supplies the fundamental resources and accepts the wastes and byproducts of our development activities.

Let's consider some realities relative to the role of water in socio-economic development in Africa:

- (1) **In Africa as elsewhere on our planet freshwater is the key natural (and growth limiting) resource. An adequate supply of clean water is fundamental for sustaining human life, for maintaining ecological systems that support all life, and for achieving sustainable development;**

- (2) **Throughout Africa water is unevenly distributed by nature and unevenly allocated by humans.** Many African countries already experience water-stress or scarcity conditions. By the year 2010, it is estimated that more than 400 million Africans in at least 17 water-scarce countries will face severe constraints on food production, ecosystems protection, and economic development, directly as a result of their inadequate water resources. The poor majority of people will likely continue to pay the highest price for this scarcity. They already spend too much of their limited income, calories, and time to get inadequate amounts of water;
- (3) **Over half the population of Africa today still lacks reasonable access to safe water. Even more lack adequate sanitation.** After many decades of development, and countless billions of dollars spent, this reality is neither acceptable nor defensible. As it involves the poor majority of people in Africa, it also is unsustainable in economic, social, environmental, and even political terms.

Our forum over these next few days on "Challenges and Opportunities for Sustainable Management of African Water Resources" brings together an impressive number of African Ministers, senior officials, and experts. **But a major concern also must be those who are not here.**

For every issue in our agenda, and every discussion in which we engage over the next few days, we must strive to keep our focus on the compelling water needs of the poor majority of people. **Our overriding challenge is to expand their opportunities for better living conditions, sustainable livelihoods, and longer lives. All three depend on reasonable access to adequate and affordable supplies of clean water.**

2. AGENDA 21 AND WATER FOR SUSTAINABLE DEVELOPMENT

As the basis for action in regard to water, Chapter 18 of Agenda 21 reads in part:

"The extent to which water resources development contributes to economic productivity and social well-being is not usually appreciated although all social and economic activities rely heavily on the supply and quality of freshwater".

Indeed, many countries are reaching conditions of water scarcity or facing limits to economic development, as their population and economic activities grow. The overall goal, therefore, is to "satisfy the freshwater needs of all countries for their sustainable development".

The recommended approach in Agenda 21 for addressing this situation is *Integrated Water Resources Development and Management*, with the overall objective being "to satisfy the freshwater needs of all countries for their sustainable development" with priority to "the satisfaction of basic needs and the safeguarding of ecosystems".

It would be interesting if we, the so-called experts, could ask our fellow citizens if they agreed with integrated water resources management and its objectives. I suspect many, if not most, people would likely not know how to reply. Primarily to please us, many people likely would be polite and agree with our definition. However, I also believe that privately, in their real hearts and minds, many would have serious reservations. **Why? Because they don't measure progress**

by what is written or promised in our national or global plans and strategies, they measure success by the quantity and quality of water coming out of their taps or village wells.

That is, if they have a tap or well or access to either nearby. This is the key point and challenge to all of us at this meeting: the majority of people in Africa still do not have reasonable access to safe, clean water.

The majority of Africans are poor. Lack of reasonable access to safe water is one of the factors that keeps them poor. Moreover, as water gets scarcer they will become even poorer. As one example, in the Mathare Valley slum, only three kilometers from this meeting room, several hundred thousand poor people there already pay four to five times more for water than the rates paid for this UN complex. Further, during periodic, almost regular, water shortages, the poor suffer first and most, as they get even less water but pay as much as ten times more.

When asked to rank food, shelter, and water in order of priority, it will come as no surprise to you, the "experts", that over half the people in a recent sample survey in the Mathare slums gave top priority to the issue of water. **Their top priority must become our top priority. When we discuss water pricing, charges, and cost recovery at this meeting, we must constantly remind ourselves that the poor majority of African people already pay the highest prices for water. And that price is not only measured in terms of money. The poor majority also pay the highest price in terms of time lost and calories expended to obtain water. They pay an even higher price in terms of poor health and lost lives, because of too little water or water that is unsafe. We are still a long way from supplying clean water to the poor majority at a reasonable price.**

3. EQUITY-LED GROWTH FOR SUSTAINABLE DEVELOPMENT

So, how can we get there? First and foremost, we need to reassess our development policies and strategies.

- (1) **To begin with, in Africa we need to build on, but move beyond, Agenda 21: We must focus on actions that support sustainable development for everyone, including the poor majority. As our SADC colleagues rightly pointed out in their report to the 1992 Earth Summit, we "need a new basis for a new deal for the poor majority of people and countries." We must now put, and keep, the poor majority of Africans at the front and center of all our national and international development policies. Equity is an issue requiring our attention.**
- (2) **The need for economic growth itself is not at issue: A renewed, invigorated economic growth is imperative throughout Africa. Without such growth, additional resources will not be generated to tackle the huge backlog of environmental degradation and pollution.**

We do, however, need to change the kind and content of this growth. Growth in our national and world economies must (i) become less polluting, (ii) less energy consumptive, and (iii) less resource intensive. Without this environmental sustainability, economic growth is not possible over the long-term. Further, without greater equity, future growth will not be socially or politically sustainable.

To sum up, throughout Africa we need economic growth which is equity-led and focused on, supported by, and directly beneficial for the poor majority of people.

- (3) **We need to keep our focus on these three main, inter-linked goals of economic, social, and environmental sustainability, to ensure future development.** This focus will help (i) accelerate economic growth with greater equity and self-reliance, (ii) improve the health, living conditions, and livelihoods of the poor majority, and (iii) ensure equitable and sustainable use of the environment and natural resources for the benefit of present and future generations.

The first question our finance Ministers will ask is "How much will it cost?" In fact, **the main challenge is political not financial.** For example, we are using increasingly large quantities of money just to fix the adverse social and environmental consequences of economic and sectoral policies which are too narrowly focused on short-term growth in the first place. Therefore, we need policy changes as well, which also require Government commitment and persistence. This is often harder to achieve than obtaining funds.

Examples of the types of policy changes needed for renewed growth, greater equity, and sustainable development include:

- (1) **Assigning greater priority in economic development policies to enterprises in the informal sector.** These enterprises already are main sources of income and affordable goods and services for a majority of people. In accelerating their transition into the formal sector, a main source of new revenue needed to reduce aid dependence will result;
- (2) **Modernizing land tenure laws and policies to include the rights of women to inherit and own land;**
- (3) **Ensuring the larger part of expenditures in public health budgets and policies is for primary health care, which is both accessible and affordable for the poor majority, rather than for specialized medical services and facilities;**
- (4) **Assigning top priority in settlements and public works policies to the serious water and sanitation problems in poor urban and rural settlements;**
- (5) **Changing international lending policies to ensure they have a positive net impact for the poor majority and the environment over the short- and long-term; and**
- (6) **Recognizing that high rates of population growth undermine development, but also that the lack of development is a major driving force of population growth.**

Policy changes also are needed in environmental management. Basic regulatory measures are needed to protect human health, life-supporting ecosystems, endangered habitats and species. Additional economic incentives and disincentives also are needed to supplement regulatory approaches (e.g., duty free import and accelerated depreciation allowances for environmentally-sound technologies, deposit/refund schemes). These policy changes do not require significant new expenditures by Governments.

Another facet of this picture is integrating what we call "EIA³" in all public policies and decisions. Economic, social, and environmental sustainability needs to be anchored and reinforced by incorporating simultaneous impact assessments as an integral part of policies and decision-making in at least three respects. These assessments comprise (i) the likely environmental impacts of economic policies and activities; (ii) the likely economic impacts of environmental policies and measures; and (iii) the likely equity impacts of both economic and environmental policies.

EIA³ will increasingly compel decision-makers to assess and defend their decisions, in terms of their economic, social, and environmental sustainability. To this end, at least one public policy seems prudent for Africa – if major public policies and programs do not lead to at least some improvement in the lives and livelihoods of the poor majority, then we must strive to find alternatives that do. This will not make for easier decision-making; however, it will make for better decisions for present and future generations.

Fortunately, we do see some glimmerings of commitment to equity-led growth by Governments and agencies. As an example, the Council of Ministers for the twelve SADC countries are considering a new regional policy and strategy on equity-led growth for sustainable development, calling for application of EIA³ in their policies and decision-making. Further, in late October of last year, a UNEP-sponsored meeting of top African water experts suggested a dominant challenge for policy-makers and planners for the next decade is equity in ensuring that everyone gets reasonable access and a fair share of safe water. They also agreed that the top priority for water resources management in Africa must continue to be the provision of drinking water and sanitation for the poor majority of people.

4. THE SECRETARY-GENERAL'S SPECIAL INITIATIVE FOR AFRICA

The Secretary-General of the United Nations also has taken Africa's challenges to heart, with the development of a UN System-Wide Initiative on Africa. This evolving initiative, which includes all UN agencies, has a "Fair Share" Approach as a priority, with "water equity" (i) across major water uses and users, (ii) in national economic development plans, and (iii) between countries using shared water resources. As chair of the Water Working Group for this initiative, UNEP is committed to providing a practical, working demonstration of the feasibility of this innovative approach during its 1996-97 Biennium in cooperation with other key organizations and agencies in Africa.

This evolving proposal to apply the Fair Share Approach has five key components:

- (1) Assessing all future national and international water policies, plans, and programs in terms of their economic viability, environmental sustainability, and equity impacts;
- (2) Assisting governments to incorporate the "Fair Share" Approach in their national and international water development policies and programs;
- (3) Assisting governments to disseminate practical and affordable techniques for helping the poor majority get access to clean water in the shortest possible time;
- (4) Accelerating existing projects to emphasize and demonstrate the "Fair Share" Approach;
- (5) Assisting governments to set up more effective water basin agreements and institutions for avoiding or resolving disputes over equitable access and use of shared water resources.

In conclusion, I want to congratulate the organizers of this meeting for bringing together this impressive array of Ministers and top experts on water resource management in Africa. I also express my appreciation to all the participants, for taking the time from your important national responsibilities to attend this meeting.

For our countries, our economies, and our people, water is the key natural resource. I ask you to work to ensure that the needs of the poor majority of people get more than a fair share of attention in your discussions and concluding recommendations. I look forward with interest to the results of your discussions and deliberations.

KEYNOTE ADDRESS

Summary

THE CONTINENT IN TRANSITION

***Kevin Cleaver, Director, Technical Department, Africa Region,
World Bank***

Analysis of political changes in African countries in recent years indicates progressive liberalization. The increasing pluralism, including greater stakeholder participation in development planning, is a significant positive sign when the World Bank and donor agencies are considering program support.

There is an enormous variation in economic performance in Africa, with a few countries having high growth rates but many with declining GDP. The World Bank's approach (recognized to be controversial) is that countries whose economic growth is already strong have a greater chance of success with new water resources management strategies. Others may need to focus first on economic reforms, to create a more favorable environment for investments in WRM programs.

In favoring commercialization of water activities, the World Bank also recognizes the need to strengthen the core functions of government - regulation and sector management - through capacity building and employment incentives (to retain top notch people). It is a topic for debate whether adoption of a more commercialized approach necessarily means privatization. The key is good management. It is also important to have effective regulation to safeguard environmental uses of water.

Water development will necessarily be delayed in countries with continuing conflicts but is an important element in the transition from war to peace. Countries emerging from civil war need substantial investments in rehabilitation and may receive priority for such programs from the World Bank and other donors, though not at the cost of reduced support for countries which have maintained peace and stability.

With a huge legitimate agenda for sector investment, but limited available resources, African countries face difficult decisions on choices and trade-offs involving water, agriculture, industry, education, transport, and other development goals. Support and guidance are needed on the analysis of trade-offs.

Pricing is the key to effective water conservation and environmental protection but needs to account for poverty through use of affordable technology and well-directed cross-subsidies (which will be reduced as community management spreads).

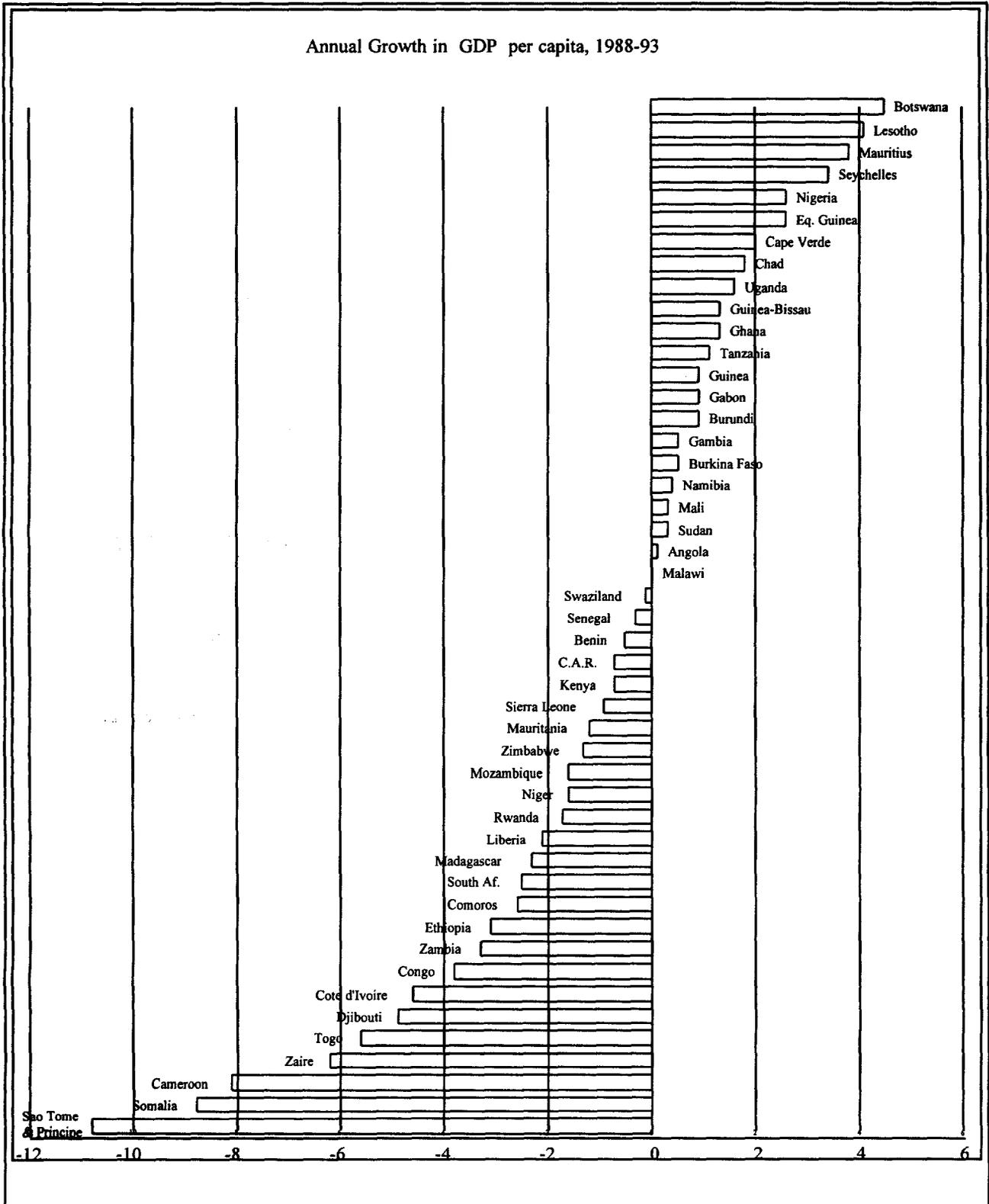
Combating poverty remains a priority aim of the World Bank, and approximately 50% of African people live in poverty. There are clear links between economic progress and success in water sector investments, with lack of water access seen as an indicator of poverty.

Agriculture accounts for 75% of Africa's GDP and 70% of employment in the continent. Some 70% of the poor live in rural areas. Agricultural growth and economic progress are closely linked. The bulk of agricultural production comes from small private farmers, which is a positive indicator from the World Bank's point of view. With good agricultural services to support them, small-scale irrigation programs which help private smallholders to produce more can be a

powerful route to economic progress. Governments have a key role to play in mobilizing resources for expansion of sustainable irrigation services.

Macroeconomic Performance

Annual Growth in GDP per capita, 1988-93



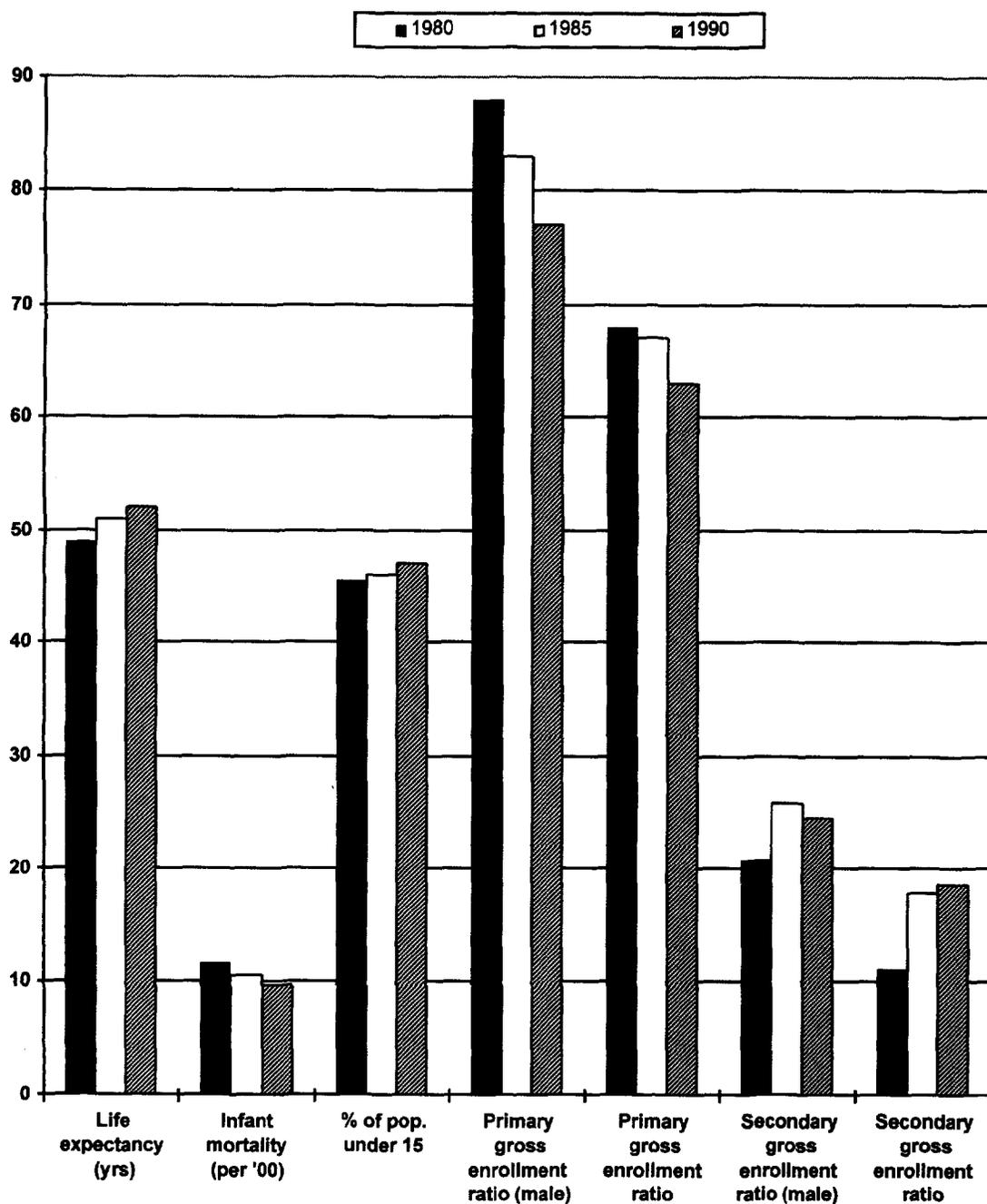
What is Policy Reform?

It is the response to:

- fiscal imbalance
- uncompetitive exchange rates
- high trade barriers
- administered price controls
- large, inefficient state enterprises
- large, inefficient civil service
- public expenditure going to white elephants
- poor capacity

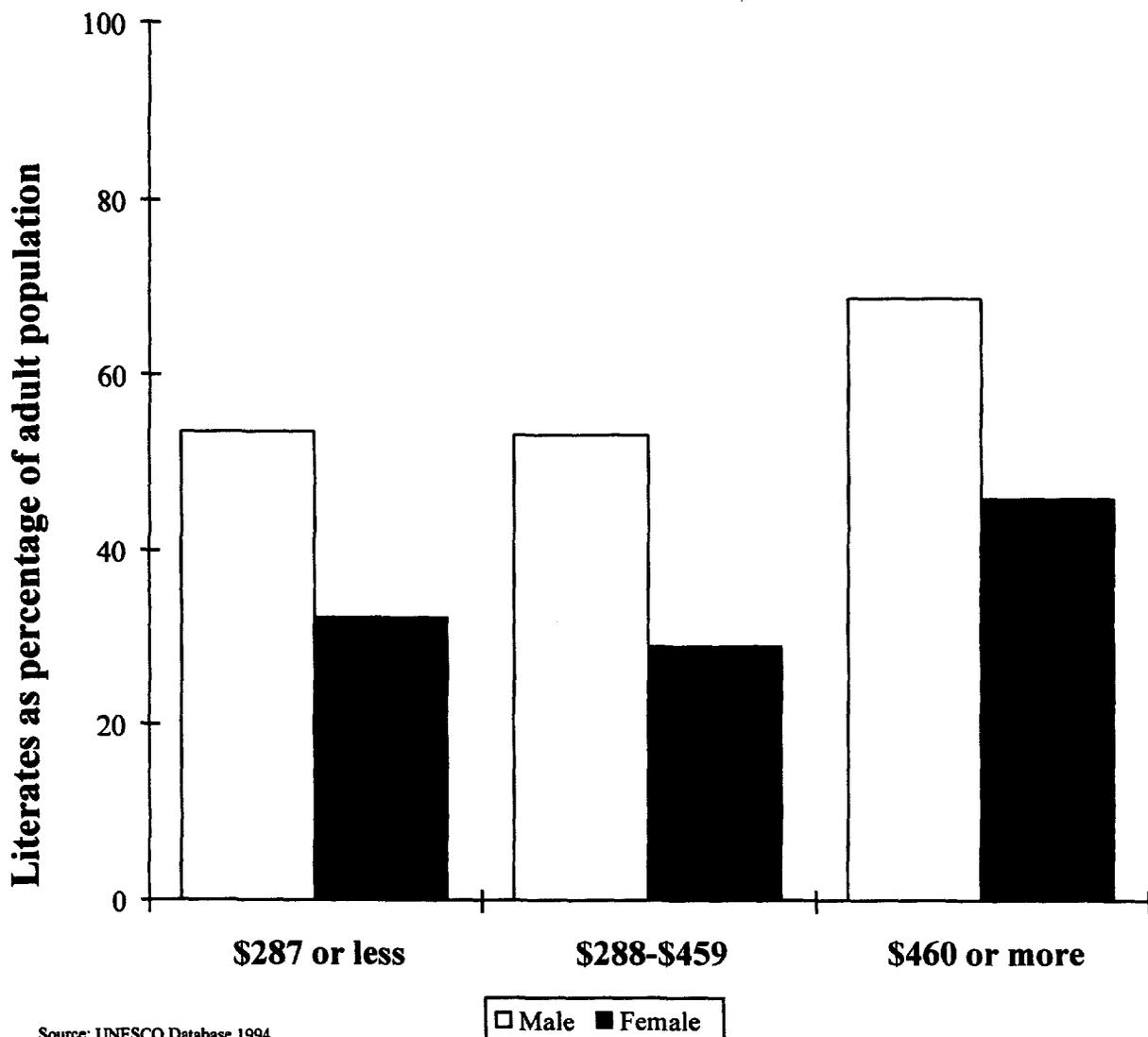
INSTITUTIONAL AND HUMAN DEVELOPMENT PROGRESS

Evolution of social indicators from 1980 to 1992



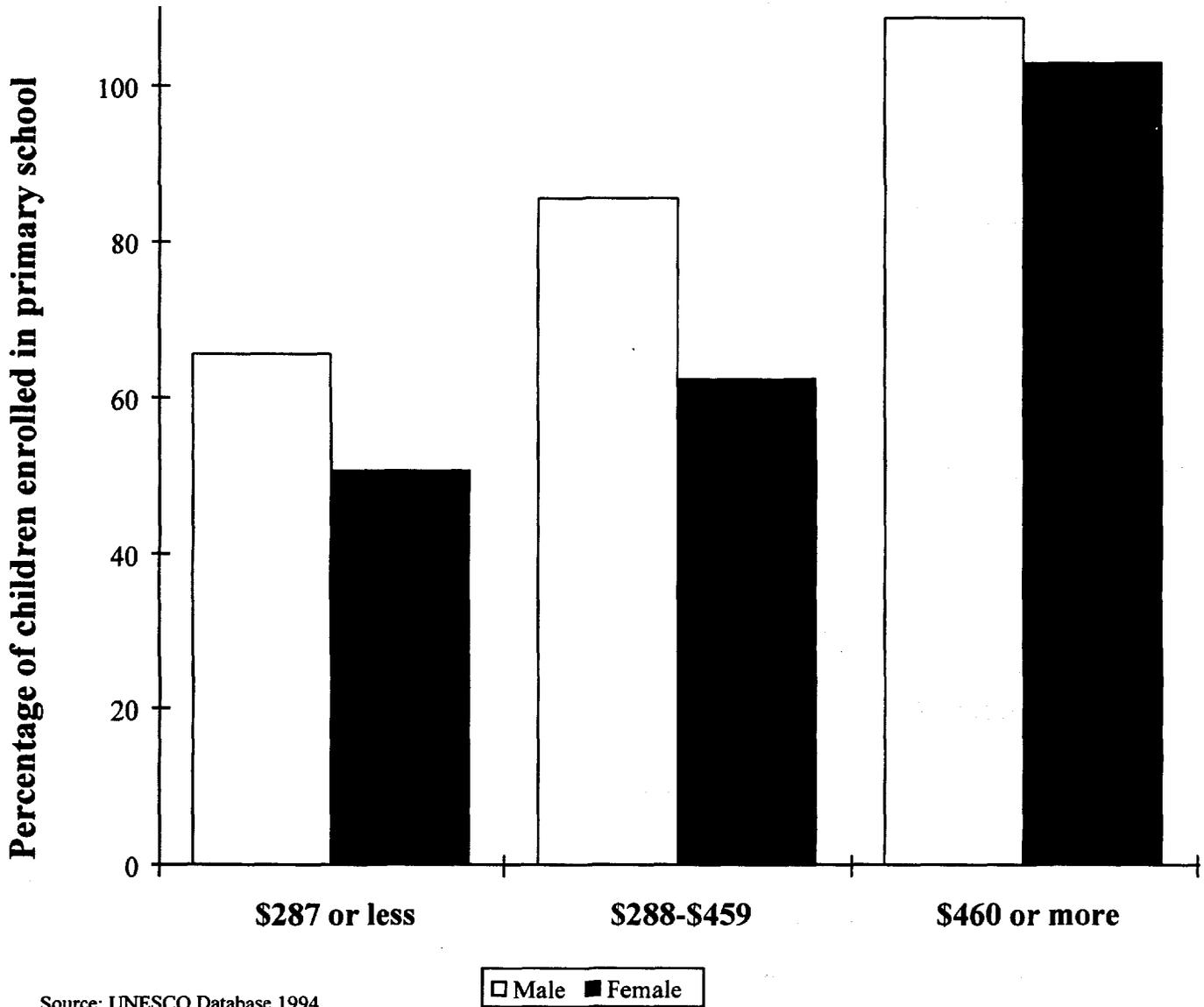
INSTITUTIONAL AND HUMAN DEVELOPMENT PROGRESS

Adult Literacy Rate by Gender by GNP per Capita Groups (1990)



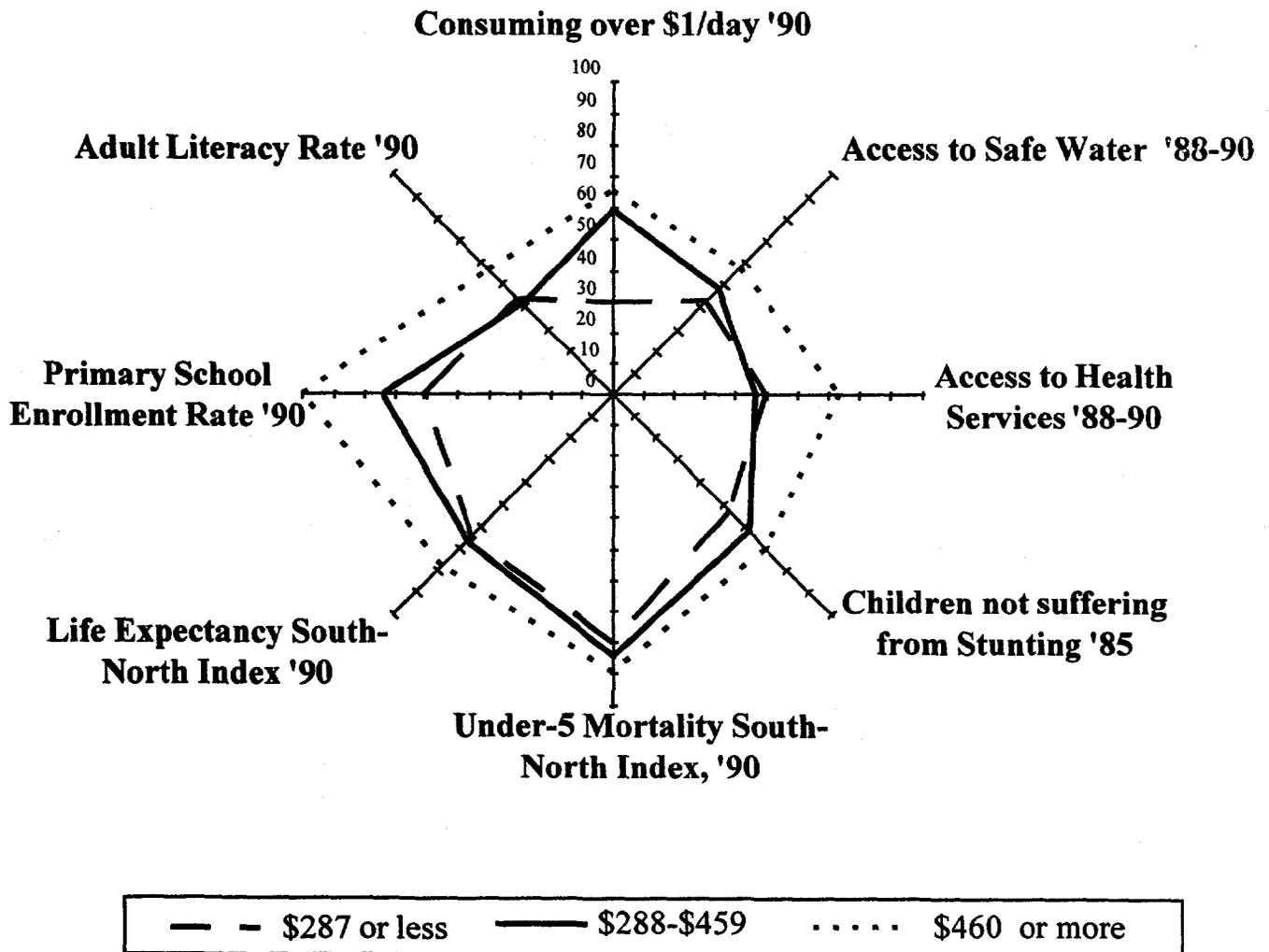
INSTITUTIONAL AND HUMAN DEVELOPMENT PROGRESS

Gross Primary Enrollment Rate by Gender by GNP per Capita Groups (1990)



INSTITUTIONAL AND HUMAN DEVELOPMENT PROGRESS

Priority Poverty Indicators for Sub-Saharan Africa

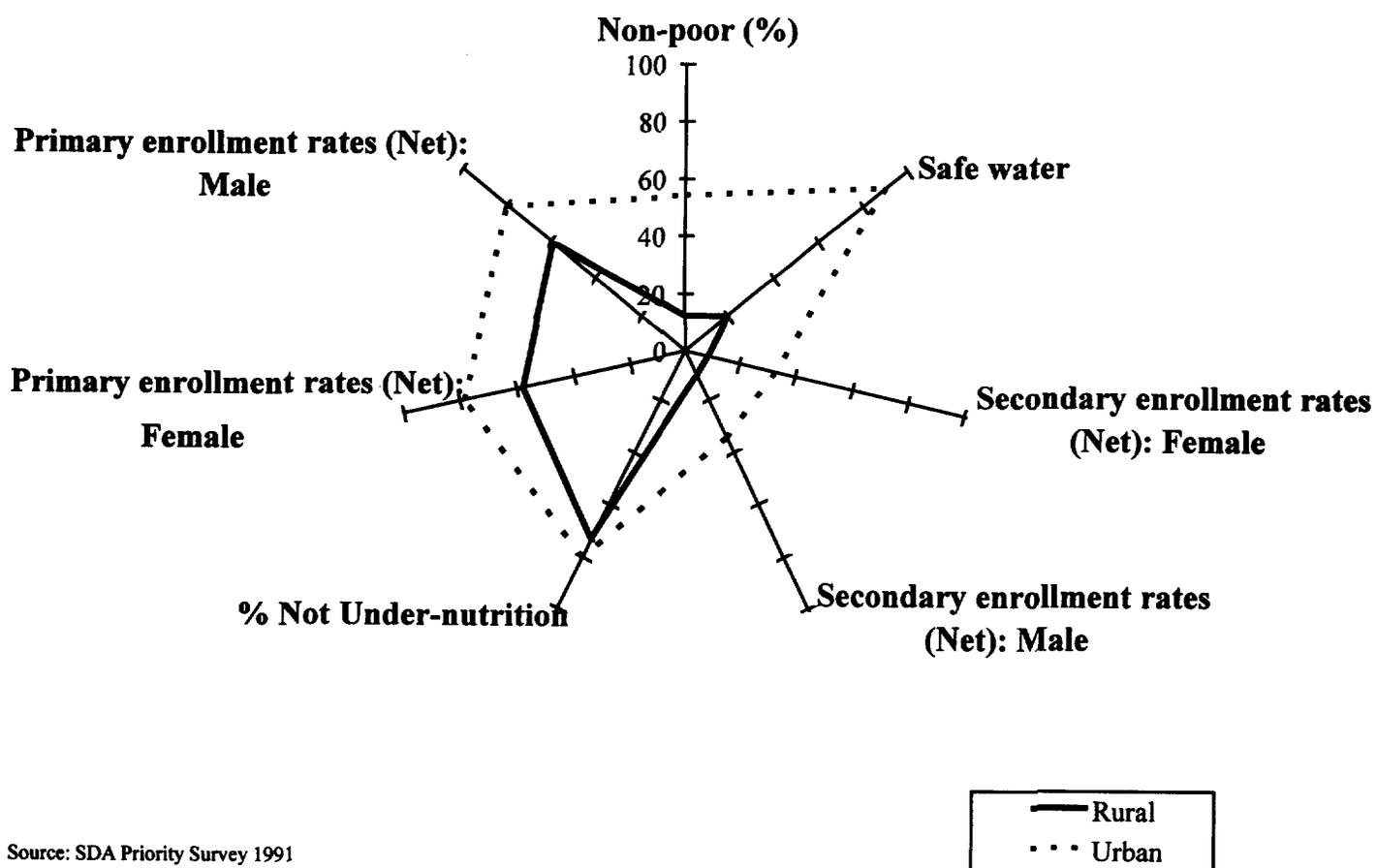


Source: World Bank and UNDP; (*) North =100; GNP per capita 1990-92 (in 1987 US\$)

INSTITUTIONAL AND HUMAN DEVELOPMENT PROGRESS

Zambia

Population: Rural 54%
Urban 46%



Source: SDA Priority Survey 1991

Countries doing well on policy and at least one indicator

Agriculture Growth Rates

Country	1981-87 (% p.a.)	1988-92 (% p.a.)
Benin	6.1	4.9
Botswana	-4.6	2.2
Burkina Faso	2.6	0.8
Ghana	0.8	1.6
Guinea	N/A.	3.3
Kenya	2.5	1.6
Malawi	3.0	-1.8
Mali	0.0	2.6
Mauritius	3.4	9.0
Niger	2.2	N/A
Nigeria	3.8	4.2
Rwanda	-0.6	1.8
Tanzania	4.3	5.0
Togo	6.8	2.0
Uganda	0.2	3.3
Weighted Average	2.61	3.20

PARTNERSHIP BETWEEN GOVERNMENT, NGOs, AND PRIVATE SECTOR

Countries doing well on either policy alone, or two indicators

Agricultural Growth Rates

Country	1981-87 (% p.a.)	1988-92 (% p.a.)
Burundi	3.1	2.5
CAR	3.4	-0.6
Congo	2.3	-0.4
Côte d'Ivoire	-5.7	2.3
Gabon	1.7	-1.2
Madagascar	2.6	2.0
Mozambique	-0.4	0.6
Zimbabwe	1.9	-2.1
Weighted Average	-1.74	0.91

PARTNERSHIP BETWEEN GOVERNMENT, NGOs, AND PRIVATE SECTOR

Countries doing well on at most one indicator other than policy

Agricultural Growth Rates

Country	1981-87 (% p.a.)	1988-92 (% p.a.)
Cameroon	0.5	-5.8
Chad	2.2	5.6
Ethiopia	-2.2	1.0
Guinea-Bissau	4.2	-2.1
Mauritania	0.9	0.1
Senegal	2.8	-0.2
Sierra Leone	2.7	-2.9
Sudan	1.3	-0.5
Zambia	8.0	-10.4
<hr/>		
Weighted Average	0.91	-1.89
<hr/> <hr/>		

THE CHALLENGES OF WATER MANAGEMENT IN MOZAMBIQUE

H.E. Roberto Costley-White

Minister Of Public Works And Housing Of Mozambique

1. INTRODUCTION

Mozambique is located in the eastern coast of Southern Africa, sharing borders with Tanzania, Malawi, Zambia, Zimbabwe, South Africa, and Swaziland. With an area of about 800,000 km², the country's total population is currently estimated 16 million inhabitants, with a growth rate of 2.7% per annum. The population of Mozambique is predominantly rural. However, during the last years of the war, a significant part of this population was forced to migrate into urban areas seeking safety. It is estimated that over 3.2 million people do now live in the urban areas, where the population growth rate is estimated 5% per annum.

Mozambique is a country with abundant natural and hydro-energetic resources. These include, for instance, more than 30 million hectares of arable land, an hydroelectric potential of about 12,500 MWh (around 9,000 MWh from the Zambezi River Basin alone), about 2,600 Km of coastline with abundant potential for tourism and fisheries.

Through its railway and ports infrastructure (i.e. the ports of Beira, Nacala, and Maputo), Mozambique provides an easy gateway of access to the sea for the economies of the Southern African landlocked countries, such as Zimbabwe, Malawi, Zambia, Swaziland, and the north-eastern part of South Africa. Agriculture is the main economic activity in the country, currently accounting for 42% of the GDP and 80% of the total employment.

The successive wars that the country had to face until recent years did not only inhibit the development of these resources but also caused extensive damage/destruction of the economic and social infrastructure, including that of the water sector. This situation resulted in an accelerated decline of the country's economic performance, particularly after 1981. The per capita GDP fell dramatically, throwing Mozambique into the group of the poorest countries of the world, with an average GDP of US\$90 per capita.

With the advent of peace in 1992 and the first multi-party elections in 1994, the country's stability was restored, and with it the basic conditions for the reactivation of the economic and social activities were established. Besides, the new atmosphere of stability and democracy that characterizes Southern Africa today allows us to say that, for the first time in the country's history, the necessary environment for re-launching the economy has been created.

2. WATER RESOURCES

A country-wide reconnaissance assessment of the ground water resources of Mozambique has shown that they are very limited. Whereas in the northern part of the country the crystalline complex geology limits the occurrence of significant aquifers, ground water salinity and insufficient recharge are the main constraints in the South. With average yields in the order of 15

m³/hr, these resources are mainly used for small applications and constitute the main source for the rural water supply programs.

The most important water resource of Mozambique is surface water. From historical flow data, these resources have been estimated at around 216,000 mm³ per annum. However, it must be stressed that only 46% of this quantity is generated inside the country, and 54% results from cross-border flows in the international rivers (3/4 of which in the Zambezi River alone).

The distribution of both precipitation and river-flows is very uneven in time and space. The country's interior is dry, and the precipitation is concentrated along the coastal strip, in the northern mountainous areas, and western borders. The bulk of the river-flows also occurs during three months of the year. In the northern region, the main rivers have regular flows and are perennial, while those of the central and southern regions are torrential and irregular, drying up for long periods of the year.

3. THE PROBLEMS AND CHALLENGES OF WATER MANAGEMENT

After living all these years in a permanent emergency situation, today, thanks to peace, we are gradually coming out of it and moving towards a development stage. This new situation brings with it problems and challenges for the water sector, namely:

- increase of drinking water supply coverage;
- need for water for food production;
- international rivers and river basins management;
- investments and their sustainability.

3.1 INCREASE OF THE DRINKING WATER SUPPLY COVERAGE

In 1980, only 13% of the population lived in the urban areas. Little more than 10 years later, this percentage has risen to 20%, and in absolute terms this means a doubling of the number of inhabitants living in the cities.

The government was not able to provide the appropriate investments required to cope with the pressures of this situation on the water supply systems. Consequently, the level of coverage fell from 48% in 1980 to 35% in the early nineties. In the rural areas, however, despite the war and lack of safety, coverage has improved dramatically, rising from 6% in 1980 to about 30% in the early nineties. These figures show, however, that Mozambique still is a country with one of the lowest coverage rates in Africa.

The government has indeed to make an effort to rapidly increase the water supply coverage level, and this implies, to start with, two challenges; firstly, the mobilization of the necessary financial resources and, secondly, the choice of investment options between the countryside and the cities.

While for obvious reasons, it is necessary to improve urban water supply coverage, the required investments per capita are far greater than those for rural areas, where the systems are simpler, less costly, and cover a larger population.

Our strategy is based on the recognition that even though the government's budget is not sufficient, on its own, to provide for the improvement of coverage rates, an important component of the investment funds should be allocated to that end. The credit funds and donations mobilized by the government play a crucial role in this effort. The investment priority is rural water supply, so as to encourage a rapid re-settlement of the populations displaced by the war, the re-launching of family agricultural production, improvement in sanitation, and reduction in child mortality.

The intended coverage level by the year 2000 is 40%, which implies the rehabilitation of 200 small systems and the construction of 6000 new sources to serve a population of 3 million inhabitants across the country. This program is evaluated at US\$100 million and will make use of the successful experiences of the rural water supply program implemented during the war period.

In the urban water supply sector, the objective is to reverse the actual tendency and achieve coverage levels between 50 and 80% by the year 2002 (this high amplitude reflects the great differences in coverage levels between cities in Mozambique). Investments in the physical infrastructure will concentrate on the reduction of water losses in the distribution network, currently estimated at about 50%, and the improvement of sources. This will also allow us to expand the water supply network to the peri-urban areas where most of the lower income population live who will be served through public water points. Clearly, considerable investments (estimated in US\$30-35 million per year) are required for the rehabilitation and expansion of these systems.

3.2 WATER IN FOOD PRODUCTION

Mozambique is essentially an agricultural country. The agro-pecuary sector contributes to over 40% of the GDP, and the family sector is the most representative in terms of food production. The private, cooperative, and parastatal sectors are essentially dedicated to export cash-crops, such as cotton, cashew, sugar, and tea.

In spite of its great agricultural potential, Mozambique still depends upon external food-aid. This dependence has been progressively reduced since family production has increased as the population resettles due to the end of the war. Even though this kind of production tends to increase, it is extremely vulnerable as it depends upon the occurrence of regular rains. More reliable and sustainable options are therefore required.

In the short term, the solution is to rehabilitate the nearly 600 small dams that existed prior to the war to support irrigation and which, for lack of maintenance during the war, are not operational or are partly destroyed. The operation and maintenance of these structures are within the reach of local businessman or even small farmers cooperatives.

The potentially irrigable land in Mozambique exceeds 3 million hectares, of which 2 million occur in the Zambezi Valley. The southern region also has a considerable irrigation potential, and contrary to the situation in the central and northern parts of the country, large investments have been made on large storage facilities in this area. However, from the 98,000 ha developed in this area, only about 50,000 are currently being used.

The government's strategy here is to progressively rehabilitate the irrigation schemes abandoned during the war or those where operation is now deficient. Only after that will new schemes' construction be promoted. The operation of these schemes will be left in the hands of experienced private sector companies, while the government will concentrate on the investments and maintenance of the public infrastructures required for the regularization of the river flows.

The necessary investments are high and greater than the government's financial capacity, so the main challenge consists of mobilizing the necessary investments in an area where international financial institutions and donors are reluctant, but which also represents our only way to autosufficiency and sustainability.

3.3 INTERNATIONAL RIVERS AND RIVER BASIN MANAGEMENT

Mozambique shares most of its main rivers with other countries of Southern Africa, namely the Rovuma, the Zambezi, the Pungwe, the Buzi, the Save, the Limpopo, the Incomati, the Umbeluzi, and the Maputo River Basins. In fact, Mozambique is the only country that shares one or more international river basins with every single country of SADC, with the exceptions of Lesotho and of course Mauritius.

It should be stressed that with the exception of the Rovuma River Basin, which constitutes the natural border between Mozambique and Tanzania, Mozambique is the lowest riparian in all of these river basins.

Moreover, a large part of Mozambique is situated on plains. Consequently, in case of floods, our territory functions as a flood-plain, a situation that often results in considerable damage to agricultural and pecuary production, loss of property, and even human lives. In the dry periods, and as a consequence of reduced or non-existing flows, sea water encroachments through the river channels occur up to several tenths of a kilometer inland, causing salinization of the soils and imposing severe limitations on agricultural activities.

In the southern part of country where up to 90% of the natural river flows are generated in the upper riparians, where significant water developments have been recently implemented, the situation has become critical. In the dry periods, rivers that were always perennial run dry at the border, with devastating socio-economic and environmental consequences for Mozambique.

This situation has lead many of our fellow citizens to think that Mozambique emerges from the war not just with its social and economic infrastructure damaged or destroyed, but also with much less water available for its own development. This thought has been particularly exacerbated by the drought recently experienced by the SADC region. However, it is also true that this thought is based on the conviction that the extensive developments for water use by more developed upstream-countries put Mozambique's socioeconomic development perspectives at serious risk.

In face of this situation and conscious of the need and importance of an integrated approach to the management of water resources, the Government of Mozambique is making efforts to, jointly with the other member states of SADC, establish or re-activate existing mechanisms to promote coordinated and harmonized development of such resources for the common benefit.

We considered the advent of the SADC Protocol on shared river systems an important step in the right direction. Therefore, despite the strong reserves Mozambique has with regard to it, we decided to subscribe to it as a sign of good will. We are convinced that in its present form the protocol does not yet provide the basis for a fair sharing of the available water resources. Furthermore, the philosophy of the aforementioned protocol is far from the global philosophy of the SADC, which advocates the sub-regional economic integration of Southern Africa and the balanced development of its member states.

With regard to the SADC Protocol on shared water systems, it is our position that:

- i) planning and management of water resources should be made on the basis of entire river basins up to their terminus in the sea or inland lake;
- ii) planning and management of the water resources of a particular river basin are a matter of the exclusive concern its riparian states;
- iii) inter-basin transfers must be previously agreed upon by all riparian states concerned;
- iv) we should rapidly move towards solutions whereby the planning and operational management of the basins are common, harmonizing the potentialities and the development prospects of each state.

The Zambezi River Basin deserves a special mention in this regard. The Zambezi River is, by far, the largest and most important water resource of Mozambique. One of the greatest hydroelectric potentials in the SADC region, in excess of 9,000 MWh, is concentrated in Mozambique's part of the immense basin. This represents 70% of the national hydroelectric potential. Two out of the three million ha of irrigable land of Mozambique are in this area. In this basin are Mozambique's largest reserves of coal. These reserves occur near the surface, and there are also large quantities of iron minerals, titanium, manganese, and fluorides. This enormous potential makes the Zambezi River Basin an area of priority for investments which can assure the rapid growth of the country's economy, as well as those of the neighboring countries. However, this purpose can only be achieved in a sustainable manner if the water resources which are crucial to secure investment can be guaranteed in the future. Therefore, we do assume ourselves an active part in the efforts currently underway for the establishment of the necessary mechanisms for the coordination and harmonization of the use of the Zambezi River water resources.

3.4 INVESTMENTS AND THEIR SUSTAINABILITY

Our strategy with regard to investments aims at recovering the immense infrastructure destroyed by the wars, in order to realize their potential as a factor for economic growth, poverty alleviation, and public health improvement.

The investments required just to bring Mozambique in line with the average African standards are very high. Together with the weak state of the national economy at the moment, which makes the country unable to commit substantial funds, this puts Mozambique in a very special position in relation to other African countries.

Even though we agree with many of the principles defended by international donors with regard to the need for cost recovery, the mechanic application of this principle for countries such as ours can only worsen the social conditions of the population.

With regard to rural water supply, the challenge is an intelligent combination of important investments to improve coverage and communities' participation in the operation and maintenance of the sources provided. For the most deprived communities, the maintenance costs will continue to be subsidized during the time required for their economic stabilization, while at the same time investments should be made in the training of community members capable of assuring repairs as well as in the establishment of a reliable network for the local (commercial) distribution of spare parts.

Large investments are required in the urban water supply systems in order to stop infrastructure degradation, improve the level of service rendered to the communities, and expand the peri-urban water supply coverage in the medium-term.

On the other hand, great efforts are also necessary to improve managerial services. A first step towards achieving this is the gradual adjustment of tariffs, so that operation and maintenance costs can be recovered in the short term. A rapid decentralization of services will follow, as well as a gradual reduction of government intervention through measures leading to the complete autonomy of water supply operators. To this end, the involvement of the private sector in management of water supply services is an option under strong consideration.

Water resources management implies high investments in storage works and flow control. Due to financial constraints, the government is not considering, in the short term, the construction of large scale water storage works. The investments will focus on the reposition of installed capacity through rehabilitation to completion of existing dams which are vital for relaunching irrigated agricultural production. Another area of priority in terms of investment is the reposition of the hydro-meteorologic data collection network.

Because of the specific geographic configuration of the country, we opted for a decentralized model of operational management of water resources. Regional Water Administrations (ARAs) were therefore created.

These autonomous organisms shall be responsible for, among other things, the operation of storage facilities and the collection and processing of hydro-meteorologic data at the basin level. Each ARA may encompass one or more river basin. It is intended that, in the future, these organizations shall be financially sustained by water tariffs paid by users to cover infrastructure, operation, and maintenance costs.

The problem of international rivers needs to be faced urgently. Funds are currently being mobilized to reinforce countries' investigation and planning capacity, in order to strengthen the process of negotiating water sharing with other riparian states of international river basins.

4. CONCLUSIONS

Water supply coverage level is clearly too low, and much work needs to be done to bring it to an acceptable standard. The government's efforts to improve water supply coverage and the quality of services rendered to the community, with the objective of raising the extremely low quality of life of the majority of the population, will require substantial support from the international donor community.

In this context, we would like to emphasize here that, for countries such as Mozambique, emerging from war situations with extensive damage to their infrastructure and economy, special policies with regard to financial assistance and arrangements are required to enable them to come out of the emergency situation, rehabilitate infrastructure, and get back on the path of development.

It is well known that no country can develop without the availability of suitable water resources. The extreme dependence of Mozambique on the cross-border flows of international rivers jeopardizes our country's development prospects, placing it in an unacceptable situation considering the framework of principles that guides the SADC. This fact impels us to defend an integrated approach to planning, development, and management of water resources in the region.

We believe that the future of the African economy depends upon integrated management of the scarce water resources of the continent. We think that the efforts of the technicians, managers, and politicians can lead us to win this challenge.

THE POLITICAL ECONOMY OF WATER RESOURCES MANAGEMENT IN AFRICA: CHOICES AND TRADEOFFS

Narendra P. Sharma
Africa Region, The World Bank

Ladies and Gentlemen:

“When the well’s dry, we know the wrath of water.”

These words uttered by Benjamin Franklin, a famous scientist and statesman, ring true today, more than two hundred years after they were spoken. While Franklin spoke of the importance of water in the newly formed United States, these words remain fresh today and bear relevance for Sub-Saharan Africa, where many areas teeter on the brink of water scarcity.

Today, I will discuss the subject of managing Africa’s water resources in terms of four questions:

- Why is it important to address water management in Africa?
- What are the problems?
- What are the causes of the problems?
- How can these problems be tackled?

After examining these questions, I will briefly discuss the role of the World Bank in assisting African countries to accelerate their transition to sustainable and equitable management of water resources.

WHY IS IT IMPORTANT TO ADDRESS WATER MANAGEMENT IN AFRICA?

In Sub-Saharan Africa (SSA), as in the rest of the world, human survival depends on water. Yet many people in urban and rural areas throughout the Region have no access to safe drinking water and sanitation services. I want to focus on the poor, many of whom live in rural areas and have limited or unreliable access to water for even subsistence farming. The poor, who often pay the most for water services, suffer the most in terms of health and economic opportunity. The overall access to water by the poor is closely associated with poverty. It is the poor who are most affected by intensifying water degradation and scarcity. In addition, rising contamination and pollution of freshwater are adversely affecting human health and natural systems.

In this context, water has become a commodity of strategic importance in most African countries, because of increasing demands and rising costs, coupled with diminishing supplies of water. Developing sound water resource management programs will be crucial to the region's poverty reduction, economic growth, food security, and environmental protection. Thus, it becomes even more urgent to secure efficient, equitable, and sustainable use of water resources for present and future generations.

The current situation in SSA calls for renewed commitment and new approaches and partnerships built on African achievements and local experiences. Also needed are implementable actions, economic and social efficiency, and regional cooperation to accelerate the transition to more efficient and equitable use and management of water resources. The African

countries must develop their own solutions based on a participatory approach, good governance, and environmental stewardship.

WHAT ARE THE PROBLEMS?

SSA is a vast continent with diverse physical and socio-political characteristics. In its physical configuration, the region sees too little water or too much, in the wrong place or at the wrong time, and often of poor quality. There are too many demands placed on limited water resources and too many people, agencies, or institutions attempting to manage the resources. There are often disincentives for water resources conservation and not enough knowledge or capacity to manage it effectively. SSA suffers because water and hydrological systems are integrated resources, but the human response – in Africa and in its development efforts – is not integrated. Also, diverse concerns and interests at the local, national, regional, and international levels require reconciliation, cooperation, and management.

Water Stress and Access. I want to point out that the evidence of water stress and access problems is seen on the ground in many local areas throughout the Region. By 2000, about 300 million Africans will risk living in a water scarce environment. Moreover, the imbalance of demand and supply will place as many as 18 countries in a situation of water stress. Currently, about 65 percent of the rural population and 25 percent of the urban population are without adequate water. Similarly, about 73 percent of the rural and 43 percent of the urban populations are without proper sanitation.

Poverty, Health, and Food Security. Water availability for household consumption and for productive use is closely associated with poverty reduction and food security. By the turn of the century, poverty will affect an estimated 600 million people in SSA. The majority of the poor have limited access to clean water and sanitation for domestic use as well as for crop production.

Water-borne and water-related diseases are common in the region: the diarrhea death rate of 17/1000 is the highest in the world. In urban areas, water contamination is widespread due to industrial pollution, poor sanitation practices, and discharge of untreated wastewater into surface and ground waters. With rapid urbanization, industrialization, and expansion of agriculture, point- and non-point source pollution risks will grow rapidly.

Competing Demands for Water. Two features of African water resources are critical to effective management. First, precipitation across much of the region is exceptionally variable – both in time and in space – and unpredictable. Second, runoff is extraordinarily low. The consequence of these two features is endemic drought. Also, some areas of the region, especially the Sahelian countries, have limited supply of freshwater and more variable rainfall, while other areas, particularly the humid tropical zone in Central and West Africa, have abundant water. Even within countries, the availability of water varies considerably because of physical features and rainfall patterns. Water management becomes more difficult as every continental SSA country shares one or more rivers with its neighbors and many countries see most of their surface waters flowing from or to other countries.

The demand for water (by industry, agriculture, energy, municipalities) throughout SSA will increase significantly, as population is growing at a rate of 3 percent annually. Agriculture and irrigation will require more water if countries are to achieve food security; hydropower production – which is far below potential – will increase with development. River and lake navigation will be more important in the future, and water will need to be conserved to maintain vital ecosystem functions. Finally, infrastructure services which often do not even meet current demand will be more expensive to provide in the future.

An estimated 320 million hectares of vegetated lands have been degraded over the past several decades in SSA leading to flooding, reduced ground water recharge, and reduced stream baseflow. Poor cultivation, deforestation, and overgrazing have had similar effects, negatively impacting aquatic ecosystems in the region, including water quantity and quality.

Infrastructure and Costs. As easily accessible surface and ground water resources have already been exploited throughout SSA, the costs of exploiting new water supplies are rising sharply. Also, the investment needed for new infrastructure (irrigation systems, water supply systems for domestic use, and hydropower) will be enormous. For instance, the capital requirement to provide clean water and sanitation services to all households in SSA countries over the next ten years will amount to about US\$47 billion. In addition, if the African countries add another 6 million hectares to irrigation over the next 10 to 15 years, the capital cost will amount to nearly US\$30 billion.

Dependency and Subsidy. Presently, African countries are highly dependent on external financing. In SSA, external financing amounted to over 80 percent. Throughout SSA, water use is highly subsidized as water tariffs are set below the supply costs and often below the operation and maintenance costs. Consequently, cost recovery remains low, increasing the financial burden on the central government to provide capital for maintaining existing systems and developing new infrastructure.

WHAT ARE THE CAUSES OF THE PROBLEMS?

As in many other parts of the world, water resources in SSA are generally regarded as a public good and there are incentives to misuse and waste water. These incentives are influenced by economic, social, and political forces in a broader context of political economy. These forces manifest themselves through market and policy failures, low capacity for effective management, lack of awareness, and insufficient information. However, as is widely true across the world, special interest groups and political considerations often influence decisions on water utilization. In SSA, particularly in those countries where water is becoming scarce, these underlying causes (which are not unique to the Region) can have serious effects on water supply and use due to the Region's socioeconomic and hydrological conditions.

Awareness, Capacity, and Management. Throughout SSA the state of water resources in terms of supply and demand, quantity, scarcity, and ecological values is often unknown. People often are unaware that water is a finite resource with supply constraints, that it has a scarcity value, and that there is a cost of using it. There is also a lack of understanding of the consequences of deforestation and land degradation on the quantity and quality of water. In many countries, water management is highly centralized and the public sector plays a dominant role in management. Management of water resources is highly fragmented among sectors and institutions, and there is excessive reliance on the public sector for services.

Policies, Regulations, and the Enabling Environment. Few countries have adequate national water policy statements, strategies, national water plans, legislative and regulatory frameworks, or mechanisms for intersectoral coordination and conflict resolution. Even if countries have been involved in water policy reforms, the long-term sustainability of these reforms has often been undermined by financial constraints, lack of public service capacity, and political instabilities. The regulatory framework in many of the region's countries is inadequate and often weakly enforced due to overlapping institutional responsibilities, governance problems, insufficient funds, technical capacity, and political interference.

We need to accept that water, both for domestic consumption and irrigation, is underpriced because of inadequate pricing policies. Pricing decisions are generally influenced by political considerations, preferred priority users, and equity reasons. This not only leads to misallocation of water resources and inefficient use, but also benefits the better off consumers and commercial farmers. In addition, macroeconomic and other sectoral policies affect, directly or indirectly, water demand as well as investments in water-related activities.

Data and Information. Data and information systems (physical, technical, socioeconomic, etc.) relating to water resources in terms of quantity, quality, accessibility, dissemination, and use are generally inadequate throughout the region. Surface and ground water quality networks are not well developed in SSA due to budgetary constraints, lack of equipment, logistical limitations, as well as a lack of appreciation of the importance of water monitoring. Often, development of African data and information systems are supply driven, with no cost recovery from some large users. Sharing of information among stakeholders is also limited.

Framework for Addressing Transboundary Water Resources. All of the countries in continental SSA share one or more international river basins. There are at least 54 rivers or water bodies that cross or form international boundaries in the region. Few of the transboundary river basins in the region are effectively jointly managed, and there are many downstream countries that depend on water flow via rivers from upstream. This dependency can create insecurity, misuse of water, or conflicts. If water is not allocated equitably among the riparian states (both upstream and downstream countries), it can undermine economic development and effective management of international rivers and lakes and protection of catchment areas.

Claims to Scarce Water and Conflicts. Competition among various activities – domestic consumption, agriculture, industry, power supply, livestock, wildlife resources, and recreation – for use of water has now become more intense, contributing to conflicts at the local, national, and regional levels, requiring mechanisms for conflict prevention and resolution. Further, as the region is served by several major drainage systems, competition for limited water resources will increase among riparian countries. Increasing demand and growing water scarcity could cause conflicts between these riparian countries. For example, the Nile, Zambezi, Niger, and Volta River basins have potential for both serious conflicts, as well as cooperation among the riparian countries.

HOW CAN THESE PROBLEMS BE TACKLED?

Clearly, African people need more and better access to clean water and sanitation – and more must be done to reduce water degradation and pollution, improve local capacity, and enhance efficient use of water for agriculture, industry, and commerce. Yet, along with these demands, we should not forget that there have been achievements at the local level, and there are opportunities for sustainable use of water resources. Many governments have undertaken National Environmental Action Plans, highlighting the importance of water in environmental management. Water resource assessments and the reform of water policies and institutions have been carried out or are underway in many countries. National programs for water supply and sanitation are being developed and implemented across the region incorporating new ideas that focus on participation and private sector involvement. SSA countries must now use these achievements as a base to build strategies, develop investment programs, and involve diverse stakeholders in better management of water resources, with a long-term perspective.

African countries need to move toward integrated water resources management (or a systemic approach) to achieve social, economic, and environmental goals to benefit present and future generations. Providing safe water and water for food production will benefit the poor

significantly. Behind this message lies a vision requiring advocacy and long-term commitment. It is a vision of nations and groups of nations, through regional cooperation, sharing and using water resources rationally, ensuring clean water and sanitation services for all the region's inhabitants and providing water to key sectors such as agriculture, industry, and energy for economic development. The vision includes achieving economic growth and food security through wise allocation of water resources and achieving environmental aims through effective conservation and protection of these same scarce resources. Wise use of water resources will have enormous impact on poverty reduction, human health, and women. Finally, let us focus on the fact that making clean water accessible to households will relieve women of the heavy burden of providing water for domestic use.

However, SSA countries will face important choices and tradeoffs in the use and management of water, balancing immediate economic benefits with long-term conservation and sustainable use gains. Many concerns and interests are competing at the local, national, and regional levels as various stakeholders demand water for different uses. Reconciling and managing these diverse interests will be a critical challenge for SSA. African people will need to recognize that water is a scarce good with economic value. Furthermore, African countries will need to do more in defining the roles of the private sector, government, and local communities in water management, reflecting economic, ecological, and equity goals.

There will be roles for both the state as well as the market in water management. Countries in SSA need to make a concerted effort to accelerate a transition from an administrative command and control approach to a more participatory approach that treats water as a scarce good. Whenever feasible and appropriate, SSA countries should develop market-like solutions and adopt policies which favor the use of economic instruments in water allocation and pricing and investment decisions. Allow me to call your attention to the main economic instruments which could be considered:

- market-related and demand-oriented laws, policies, regulations, and incentive structures;
- water markets with tradable water rights;
- more extensive utilization of the private sector; and
- economic pricing of water for specific users.

It is important to recognize that the application of these market instruments will be difficult to implement in SSA countries. Even in the more advanced industrialized countries these instruments are not yet fully adopted for diverse reasons. But as these instruments develop in African countries they will promote more rational behavior from users, both among suppliers and those who demand water resources.

National governments will have predominant roles in creating an enabling environment. The roles of the government will remain important in creating laws, rules, and regulations which provide incentives to use water more efficiently and flexibly in response to changing demands and costs of water for different uses. The government can also reinforce the incentives for improved coordination of demand and supply and protection of the public interest in the process. In addition, the governments can play a vital role in ensuring protection of watersheds and aquatic systems, development of improved technologies, and cooperation among riparian countries sharing waters from international rivers, ground water aquifers, and lakes.

In this broader context, African countries should place greater emphasis on domestic resource mobilization and cost recovery to reduce high dependency on external resources and to generate capital for maintenance of existing systems and to develop new infrastructure. To this end,

African countries need to increase cost recovery from various user groups through appropriate pricing of water supply for various uses.

Strategic Imperatives. In many African countries, sustainable development would include efficient public sector interventions, market-oriented solutions, and popular participation. The strategic underpinning begins with the fact that countries in the region will need to focus on both the supply and demand sides. Water can no longer be supply driven or managed through technical and engineering solutions to capture, store, and deliver water. Policy makers need to focus more on demand management and changing people's behavior through incentives, regulations, and education. They must also turn their attention to reallocating existing supplies to higher-value uses, reducing waste, promoting conservation and water-saving technologies, and facilitating more equitable access. On the supply side, African countries need to modernize infrastructure, improve management practices, reduce costs, and make delivery of water from existing supplies more efficient.

Systemic Approach. African countries need to adopt a systemic approach to water resources management that reflects socioeconomic, ecological, and equity considerations. A call for a more systemic approach should not be interpreted as a call for a more extensive and rigorous central planning role and establishment of administrative arrangements which increase the government's control of water resources. Also, this approach should not imply development of complex projects. It requires users of water resources to think holistically and to make local and sectoral actions consistent with long-term sustainable development goals. Moreover, a systemic approach requires a broad-based partnership including all stakeholders – public and private sectors, farmers, local communities, and NGOs – to participate in water resources management. Such a comprehensive and coordinated approach will allow each sovereign country to assess water needs in a multi-sectoral framework and take into account transboundary considerations. While there is a need for such an integrated, multisectoral approach, in many countries the transition to such an approach will take time.

Priority Focus. In defining strategies for water resources management in SSA, both threats to water resources (e.g., water scarcity, access to water, and water pollution) and the capacity to manage those threats must be considered. An overarching priority is to build capacity and establish an enabling policy environment. Where threats are great and capacity is low, the challenge is greatest, since actions are unlikely to succeed without prior efforts to build capacity. Building capacity and utilizing existing institutions, in an enabling policy environment, implies good governance and involvement of diverse stakeholders and use of indigenous institutions. Further, it includes human resource development, improvement of data systems and sharing information, and mechanisms for regional cooperation and conflict resolution. It also requires a sound legal and regulatory framework as well as a policy and enforcement framework to assess operational efficiency and external consequences.

THE ROLE OF THE WORLD BANK

The World Bank remains an active partner in the development of water resources in SSA. It does this through policy dialogue, technical advice, and investment support in the irrigation, water supply and sanitation, and hydropower sectors. The cumulative World Bank lending to these sectors is now approaching US\$4.6 billion, supporting investments in over 30 countries. Overall, the World Bank's assistance has evolved in response to growing demands for increasingly scarce water resources by competing sectors, as well as the need for capacity building and utilization, and new infrastructure, reflecting the changing socioeconomic and environmental realities of African countries.

World Bank supported operations have helped African countries achieve several sectoral objectives, such as providing safe water and sanitation services to many households in urban and rural areas, expanding irrigated areas to augment food production, and increasing energy supply through hydropower development. Some progress is also being made in several other ways, including beneficiary participation, private sector development, and environmental assessment.

The World Bank will help committed countries to move towards an integrated approach to water resources management involving major stakeholders, to promote private sector development, and to a pricing system which reflects the scarcity value of water resources. Furthermore, the World Bank will give more attention to the needs of peri-urban and rural areas, where most of the poor live. It will also help foster regional cooperation in managing international rivers. Capacity building, utilization, and retention – including policy changes, institution building including regulatory framework, human resource development, resource mobilization, and development of information and new knowledge – will be the cornerstone of World Bank water sector operations in SSA.

In the context of its principal objective of poverty reduction, the World Bank will direct its efforts to five priority areas:

- Household water security: ensuring that a large number of rural and urban poor have access to clean water and sanitation services efficiently and equitably within the next decade;
- Food security and water: supporting measures that lead to increased productivity and food production in both rainfed and irrigated areas;
- Water quality and human health: supporting actions that reduce water pollution and degradation;
- Environmental stewardship: promoting programs that protect wetlands and catchment areas;
- Regional cooperation: promoting mechanisms for conflict resolution and prevention among countries sharing water resources, and multi-national investment programs for development of water resources.

The World Bank will be highly selective and concentrate on its areas of comparative advantage: policy changes, capacity building, human resources development, support of investment operations that promote sustainable and equitable use of water resources, and improvements in donor partnership and collaboration. To this end, World Bank support to countries will be influenced significantly by such factors as political stability, an enabling environment, sufficient information and knowledge, and strong commitment and ownership, and where development impact can be maximized by supporting long-term national programs.

The prevalence of international rivers in SSA presents the Bank with an important challenge in promoting a multi-country focus and regional cooperation in the management of international waterways. International river basin management will require the World Bank to move beyond its traditional support for single-country operations to supporting multi-national initiatives. Specifically, the World Bank will offer, if requested by the riparian states and in collaboration with other donors, its support to potential crisis areas like the Nile Basin and Zambezi and Inkomati Basins in Southern Africa. In this connection, the World Bank may consider using its own diplomatic ability to foster basin cooperation and to mediate in facilitating joint actions by the riparian states supporting specific investments, capacity building and utilization, and training. The Bank can also expand the role of GEF in institution building, development of information systems, and protection of catchment areas in the management of international rivers and lakes.

Since the World Bank's mission is to get results on the ground in poverty reduction in Africa, it will increase results from on-going operations in irrigation, water supply and sanitation, urban development, and hydropower. The World Bank will take a broader sector approach that internalizes African country priorities and builds on existing capacity. Bank operational and sector work will be interdisciplinary and multisectoral, incorporating the "nexus" analytical concept by assessing the linkages among population, environment, poverty, economic activities, and technological variables.

Finally, I want to note that better coordination among donors and other international organizations involved in the water sector is crucial and can greatly help to accelerate the achievement of water management objectives. Without coordination, donors will continue in fragmented ways, supporting narrow goals, undermining African national governments, duplicating each other's efforts, or implementing inefficient projects due to limited institutional capacity in the region. As the World Bank's strategy advocates a systemic approach to water management, it calls for integrated sector operations that focus on stakeholders and the private sector, require long time-horizons, or rely upon community-based systems and market-oriented approaches. Such programs are susceptible to failure when donor activity is uncoordinated. To this end, African governments will need to be proactive in coordinating donor support and in building consensus. Also, the World Bank will need to work with the African Development Bank, UN Agencies, and bilateral agencies, cooperate on regional initiatives, and continue preliminary collaboration on the Global Water Partnership. Collaboration may focus on information exchange and dissemination, identification of critical water resource threats, support of national research, and mobilization of capital resources for capacity building, utilization, and sustainability.

**FAIR SHARE WATER STRATEGY
FOR SUSTAINABLE DEVELOPMENT IN AFRICA**
Walter Rast, Deputy Director, Water, UNEP

1. INTRODUCTION

The overriding interest of UNEP is the protection and maintenance of our environment. This also was a major focus at the United Nations Conference on Environment and Development. It presumably is everybody's view that socioeconomic development is good and desirable. It raises our standards of living and our livelihoods, generally enhancing our lives. At the same time, however, no socioeconomic development is possible without some cost in terms of environmental change. Unfortunately, this change often has negative impacts on us and our environment.

Thus, because we want the benefits of socioeconomic development and because producing these benefits causes environmental change, the key is to appropriately balance the demands of socioeconomic development with the protection and maintenance of the environment. In other words, environment and development are interdependent--this is the essence of sustainable development.

2. AGENDA 21 AND FRESHWATER RESOURCES

The goal of Agenda 21 is to address today's pressing problems, as well as attempt to prepare for the challenges of the future. It is a global consensus and political commitment at "the highest level on development and environment cooperation".

As noted in Chapter 18 of Agenda 21:

"The extent to which water resources development contributes to economic productivity and social well-being is not usually appreciated, although all social and economic activities rely heavily on the supply and quality of freshwater".

Obviously, regions without adequate supplies of freshwater of needed quality do not exhibit significant socioeconomic development. And this problem results not only from an absolute scarcity of water but also from an inability to provide needed supplies where and when needed. Further, some perceived water shortage problems are not so much due to an actual water scarcity but rather from its inefficient use, or from our rendering it unfit for use because of pollution.

Chapter 18 also states:

"The holistic management of freshwater as a finite and vulnerable resource, and the integration of sectoral water plans and programs within the framework of national economic and social policy, are of paramount importance for action in the 1990s and beyond".

To this end, the seven major program areas in Chapter 18 are as follows:

- Integrated water resources development and management;

- Water resources assessment;
- Protection of water resources, water quality, and aquatic ecosystems;
- Drinking-water supply and sanitation;
- Water and sustainable urban development;
- Water for sustainable food production and rural development;
- Impacts of climate change on water resources.

In developing a sustainable freshwater strategy for Africa or anywhere else, the focus must be on the first program area, integrated freshwater resources management. This is the most important component, in that if addressed properly, the other six program areas would likely not be problems; they would be considered appropriately within the context of integrated management.

3. AFRICA AND SUSTAINABLE DEVELOPMENT

Little insight is forthcoming in observing that Africa is beset by substantial economic and social crises and that it is probably at a turning point in its development. Unfortunately, much of the socioeconomic development in Africa over the last three decades has been done without adequately addressing environmental problems, including the sustainable management and use of freshwater resources. For example, UNDP has a classification category of "low human development" countries. This category contains 25 countries, 22 of them in Africa. Of 47 Least Developed Countries, 33 are in Africa. Annual population growth rate is the highest in the world, and fifty four percent of the population are estimated to live in absolute poverty. It also is the only region in the world in which poverty is projected to increase over the next decade. So, no matter how much we may wish to highlight progress made, we must also acknowledge the tasks yet to be completed.

At the same time, however, Africa is a continent with much promise. Over the past few years, three countries have exhibited annual economic growth rates greater than eight percent; eight countries between six and eight percent, and 12 countries between three and six percent. Many countries also are implementing economic reform measures to address economic imbalances and support private sector development. An increasingly strengthened civil society is enhancing possibilities for democracy, pluralism, and more accountable and transparent political systems. So, there is room for optimism as well.

In regard to its freshwater resources, Africa exhibits a diverse hydrologic picture. There are 17 international river basins in Sub-Saharan Africa, more than any other continent. All the countries in Sub-Saharan Africa share one or more international river basins, and fifty rivers or lakes cross, or are part of, international boundaries. So, what is the problem in regard to freshwater resources? In fact, a major problem is that Africa's freshwater resources are characterized by an uneven distribution, both temporally and spatially. In a given region, it often is (i) excessive or too scarce, (ii) not available at needed times or needed places, and/or (iii) unusable because of pollution.

The per capita situation also presents a challenge. It is suggested that a condition of water scarcity on a per capita basis exists when the population as a proportion of renewable water resources exceeds 500 persons/one million cubic meters of water per annum. Based on this criterion, thirteen African countries are facing a condition of water stress. Future projections of

population growth and water consumption indicate that, using this same criterion, more than 3/4 of the Sub-Saharan countries of Africa will face water scarcity within the next three decades.

4. UNEP AND INTEGRATED FRESHWATER RESOURCES MANAGEMENT

Chapter 38 of Agenda 21 states that UNEP, as the principal body within the United Nations system in the field of environment, should continue to play its role with regard to policy guidance and coordination in the field of environment, taking into account the development perspective. UNEP also was recently designated by the UN Secretary General as the UN agency responsible for global mandates for water. The development and promotion of integrated management of freshwater resources, within the perspective of the drainage basin or ground water aquifer as the management unit, is a primary task under this designation.

Prior to this new focus, water management activities many years ago were restricted primarily to engineering and technical concerns. This traditional approach to water management focused on water almost exclusively as a natural resource. The notion of sustainable development has changed this narrow, sectoral approach.

The components of integrated management of freshwater resources include the scientific, engineering, and technical issues as water supply and demand, drainage basin physiography, hydrology and geography, flora, fauna, pollution sources, etc. At the same time, sustainable development also incorporates the social and economic dimensions of water management and use. Such issues as law, economics, institutions, education, health, and politics have equally, and often more, important roles than the strictly scientific/technical concerns. Experience suggests that the "best" technical solution to any environmental problem is virtually never chosen as the ultimate solution. Rather, the "best" solution must also incorporate the important non-technical issues as well. Within this context, UNEP's aim is to see that the concept of sustainable development is put to work.

As a practical manifestation of this commitment, UNEP's approach to integrated management of freshwater resources was launched in 1986. Titled "Environmentally-sound management of inland waters" (EMINWA), the approach deals with the various functions of water resources on equal terms, and within the framework of the integrated water system as a whole. The main aims of the program are to:

- (1) Assist Governments to develop and implement environmentally-sound water management programs for inland waters;
- (2) Train experts and establish training networks to implement environmentally-sound water management programs;
- (3) Develop principles and guidelines for the environmentally-sound management of inland waters;
- (4) Make regular assessments of the state of the environment for inland water systems; and
- (5) Increase public awareness of environmentally-sound water development.

Applied in close cooperation with riparian Governments, the EMINWA program consists of a comprehensive diagnostic assessment, for the purpose of (i) characterizing the drainage basin as a

whole, and (ii) developing the data and information base needed to identify significant problems and possible solutions. The second phase is development of a management action plan to address the interlinked environmental, economic, and social problems identified in the diagnostic phase, as well as to help identify appropriate donors. UNEP focused its initial EMINWA activities on African water systems, although the approach has recently been applied in Latin America and Asia as well.

It is also noted that UNEP recently has consolidated its freshwater program and its oceans and coastal areas program into a single Integrated Water Program. This new Program, developed as part of UNEP's 1996-97 Biennium Workprogram, allows us to consider the water environment (freshwater rivers, lakes and ground water aquifers; coastal waters and the open oceans) as a management continuum. It represents the first practical application of the unified integration of assessment, diagnostic, management, planning, and strategic concerns inherent in these hydrologically interlinked water systems. It also allows UNEP to more readily and comprehensively address its duties as the recently-appointed Secretariat of the Global Program of Action for the Protection of the Marine Environment from Land-Based Activities. Consideration of the upstream-downstream nature of this hydrologic interlinkage, and the myriad of anthropogenic land-based activities affecting it, is at the core of UNEP's approach to address this complex global issue.

5. UNITED NATIONS SYSTEM-WIDE INITIATIVE FOR AFRICA

Also noteworthy is a new African initiative being spearheaded by the UN Secretary General. Called the "UN System-Wide Initiative for Africa", its primary aim is "to identify and develop practical proposals to maximize the support provided by the UN System to African development and to raise the priority given to Africa in the international agenda". Its priorities were determined on the basis of: (i) congruence with priorities identified by Africa's leaders, (ii) strengthening the capacity of Africans to take charge of their own development, (iii) economic and social importance in relation to people-centered sustainable development; (iv) political appeal, feasibility, and affordability; (v) UN comparative advantage and experience, and (vi) early visible impact. Using these criteria, five major priority- areas were identified for actions: (I) Water; (II) Food Security; (III) Governance; (IV) Social and Human Condition; and (V) Resource Mobilization. UNEP chaired the Working Group on Water and worked with its sister UN agencies to develop specific recommendations in regard to (i) equity-led water management and use, (ii) water assessment, (iii) water for food security, and (iv) drinking water and sanitation. The estimated cost of the priorities identified in the Initiative total US\$25 billion dollars over a ten-year period, or about US\$2.5 billion annually from reallocated or new resources.

6. THE FAIR SHARE APPROACH AND AFRICAN WATER STRATEGY

As a contribution to the Secretary-General's African initiative, UNEP proposed an equity-led growth approach to management and use of freshwater resources in Africa, within the context of sustainable development. As noted by the SADCC Report to the 1992 Earth Summit (pg. 32):

"If the poor sometimes behave in a way that degrades the environment, is it not because they choose to do so. They only do so when they have no other choices. The Earth Charter and Agenda

21 must provide a new basis for a new deal for the majority of poor people and countries in order to secure and sustain our common future".

Development is either sustainable or unsustainable--there is no middle ground! The reality over the past several decades has been too much of the latter and an urgent need for the former. To this end, Agenda 21 contains many recommendations for integrating environment and development in all major sectors. It also proposes a broad range and mix of regulatory measures and economic incentives to ensure national development becomes ecologically and economically sustainable. It sets 38 main policy goals to be tackled through 131 priority programs, with a total of more than 2,500 recommendations for national and international action.

Agenda 21, however, does not provide a "new basis" for a new deal for the majority of poor people and countries. Many African countries, sub-regions, and the continent as a whole fall significantly below the averages for all developing countries and the world for a range of key economic, health, and human development indicators. Thus, a third crucial element must be added to "environment and development" to make Agenda 21 more applicable and operational in Africa; namely, the missing link of equity.

Through Africa, the poverty of the poor majority remains the main cause AND consequence of environmental degradation. This reality undermines the possibilities for future economic growth. The problem, ironically, is not so much the poor majority itself, but rather the failure of national development and international aid policies to reach, involve, and benefit the poor majority.

Decades of unsustainable development and billions of dollars have not notably improved the lives and livelihoods of the poor majority of Africans. Thus, a crucial starting point for sustainable development is equity-led growth within and among African countries. It must shift the focus to people, rather than projects or technologies. This means growth strategies which are not economically, socially, and environmentally sustainable are not the rational basis for African development.

At the same time, economic growth is essential to provide greater equity--otherwise, there will be fewer benefits to share. Thus, economic growth also is not the issue--rather the kind and content of the growth. Future African growth must be (i) more equitable, (ii) less polluting, and (iii) more efficient in terms of energy and natural resources (particularly water resources).

The largely separate policies and programs for economic reform, social progress, and environmental improvement must be integrated into a single agenda and strategy for sustainable development. In this new agenda, impact assessments must be incorporated as an integral part of decision-making in three key areas:

- (1) likely *environmental* impacts of economic policies and activities;
- (2) likely *economic* impacts of environmental policies and measures; and
- (3) likely *equity* impacts of both economic and environmental policies.

If an impact assessment of a proposed policy or program reveals it will not lead to at least some improvement in the living conditions and prospects of the poor majority, then a sustainable alternative must be found that does achieve this goal.

In Africa, the dominant challenge in regard to freshwater resources is the equity issue of ensuring that everyone gets reasonable access and a "fair share" of safe water. At present, the poor majority of people in Africa get far less than their fair share. As previously noted, nearly half of the African population lacks reasonable access to either safe water or sanitation. The poor also

rarely share in the benefits of large-scale water supply, sanitation, irrigation, or hydropower projects which dominate investments in the water sectors of most African countries. Moreover, they often are displaced by large-scale water projects, exposed to water-borne diseases through badly-managed irrigation systems and suffer impaired health because of industrial and agrochemical pollutants.

To attempt to address these problems, the proposed "Fair Share" Approach comprises the following elements:

- (1) **A Fair Share for the Poor Majority** - The main political, economic, social, and environmental goal for African governments is to ensure that the poor majority in urban and rural areas get their fair share of safe water and water-based services. This means that their water and water-based needs must also get a fair share of national and local authority budgets.
- (2) **A Fair Share Among Competing Uses** - A fair share allocation of water among competing uses and users, especially agriculture, industry, and households, also deserves high priority on Africa's sustainable development agenda. Ironically, water is widely under-utilized in many African countries, most using far less than their available supply. Thus, increasing water supply to meet rising demand is the main option usually considered by governments. However, protecting, conserving, and making more efficient use of water deserve far higher priority in the future Government plans and budgets.
- (3) **A Fair Share for the Environment** - Human survival requires that aquatic species, habitats, and ecosystems also get their fair share of water. Increasing human water needs, and resulting damming, diverting, and polluting of watercourses with little regard for the environmental services they provide and the services they support, greatly enhance the possibility that nature will lose out in the end, with dire consequences for sustainable development.
- (4) **A Fair Share Among Neighboring Countries** - Countries also must get their fair share of safe water. Most of the "national" water resources in Africa are shared by at least two or more countries. Yet, few internationally-shared water systems are covered by effective agreements on their fair use and environmental protection. This provides the fuel for yet another source of conflict in Africa, where a third of the countries already suffer from civil conflict. Thus, new and more effective international agreements are needed to help avoid serious conflicts over the unfair use or abuse of shared water resources.
- (5) **A Fair Share for Local Communities** - Local authorities, communities, user groups, women, and youth also must have a fair share and a larger role in the planning, development, management, and protection of water resources, consistent with the notion of decentralizing water management responsibilities to local authorities and increasing the involvement of local groups and users in decision-making. Such local involvement also can make major contributions in implementing programs and projects for developing, conserving, and protecting water resources. Few rural water projects have succeeded without direct public participation, and local communities and users become more responsible and accountable for project performance.
- (6) **A Fair Share for Smaller Projects and Technologies** - African national water management programs and benefits often are dominated by large-scale irrigation, water supply, sanitation, and hydropower projects. As noted above, the benefits of these type of projects often fail to reach or benefit the poor majority. Rather than a small number of

large projects, many more small projects on a larger scale, using practical and affordable technologies, have a better chance of involving and meeting the needs of the poor majority, especially those in dispersed settlements and farms.

- (7) **A Fair Share for Capacity Building** - Education and training in the water sector also should receive a fair share of existing and new capacity building programs. The African water sector already is characterized by too many itinerant expatriate experts and too few local experts for conventional water management approaches and disciplines. Higher priority should be given to training of existing and many new experts in the community based, participatory and appropriate technology approaches needed for African water management.
- (8) **A Fair Share for Women and Children** - Although more than 70 percent of the African population are women and children, they get far less than their fair share of water. Further, the costs of too little or unsafe water are borne disproportionately by women and children who spend long hours and many calories collecting water, who get less for drinking and personal hygiene, and who suffer most from poor water quality and water-borne diseases. Thus, future planning and decision-making on allocation and use of water must involve women and children more directly.
- (9) **A Fair Share for Future Generations** - The essence of sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs. Water resources management policies, plans, and programs should have built-in measures to ensure future generations have their fair share of water of sufficient quantity and quality to meet their needs.

The UN Secretary-General's African Initiative has incorporated the Fair Share Approach into its proposed workprogram, in the form of the following five recommendations:

- (1) Assessing all future national and international water policies, plans, and programs in terms of their economic viability, environmental sustainability, and equity impacts;
- (2) Assisting Governments to implement the Fair Share Approach in their water development policies, plans, and programs and secure the active involvement of local communities and peoples in water management planning and decision-making;
- (3) Assisting Governments to implement practical and affordable techniques for helping the poor majority get access to safe water in the shortest possible time. In addition to some large-scale projects, now needed are many more small scale projects and appropriate technologies (e.g., hand-dug wells, household water tanks, rainwater harvesting, etc.);
- (4) Accelerating existing projects to emphasize and demonstrate the Fair Share Approach (e.g., Zambezi Action Plan) and the advantages of community participation in water management planning and decision-making; and
- (5) Assisting Governments to set up more effective water basin agreements and institutions for avoiding or resolving disputes over equitable access and use of shared water resources.

It is clear there are no easy answers to balancing the resource demands and pollution consequences of socioeconomic development on the one hand and the protection and maintenance of the natural environment that makes this development possible in the first place,

which we must do if sustainable development is to become a reality. And, unfortunately, there are more problems on the horizon. A recent article in the *Economist* magazine, for example, predicted that by the end of this decade, 17 of the world's 21 mega-cities (those with populations of ten million or more) will be in developing countries. Ten of these cities will have populations of around 20 million or more. Humanity has never before had to address the problems resulting from concentrations of human beings on this scale, including almost incomprehensible resource demands, as well as the types and massive quantities of pollutants to be produced. It is a sobering thought and will require much attention on the part of all of us.

FAIR SHARE WATER STRATEGY FOR SUSTAINABLE DEVELOPMENT IN AFRICA

- (1) SOCIO-ECONOMIC DEVELOPMENT IS GOOD AND DESIRABLE -- RAISES STANDARDS OF LIVING AND GENERAL LIVELIHOODS
- (2) ALL SOCIO-ECONOMIC DEVELOPMENT RESULTS IN SOME DEGREE OF ENVIRONMENTAL CHANGE -- MUCH OF IT IS NEGATIVE (=RESOURCE DEPLETION AND/OR POLLUTION)
- (3) KEY TO SUSTAINABLE DEVELOPMENT, THEREFORE, IS TO BALANCE DEVELOPMENT DEMANDS WITH ABILITY OF THE ENVIRONMENT TO SUSTAIN THESE DEMANDS OVER THE LONG TERM

CHAPTER 18 OF AGENDA 21:

*"The extent to which water resources development contributes to economic productivity and social well-being is not usually appreciated, although **all social and economic activities rely heavily on the supply and quality of freshwater.**"*

"The holistic management of freshwater as a finite and vulnerable resource, and the integration of sectoral water plans and programs within the framework of national economic and social policy, are of paramount importance for action in the 1990s and beyond."

SEVEN MAJOR PROGRAMME AREAS OF CHAPTER 18:

- Integrated water resources development and management;
- Water resources assessment;
- Protection of water resources, water quality, and aquatic ecosystems;
- Drinking-water supply and sanitation;
- Water and sustainable urban development;
- Water for sustainable food production and rural development;
- Impacts of climate change on water resources.

UNEP AND INTEGRATED MANAGEMENT OF FRESHWATER RESOURCES

Chapter 38 of Agenda 21:

UNEP, as principal body within the United Nations system in the field of environment, should continue to play its role with regard to policy guidance and coordination in the field of environment, taking into account the development perspective.

UNEP was also recently designated by Secretary-General as UN agency responsible for global mandates for water. Development and promotion of integrated management of freshwater resources within perspective of the drainage basin as management unit, is a primary task under this designation.

Environmentally-sound management of inland water (EMINWA; 1986)

Deals with various functions of water resources on equal terms and within framework of the integrated water system as a whole.

Main aims of EMINWA:

- (1) Assist governments to develop and implement environmentally-sound water management programs for inland waters;
- (2) Train experts and establish training networks to implement environmentally-sound water management programs;
- (3) Develop principles and guidelines for the environmentally-sound management of inland waters;
- (4) Make regular assessments of state of environment for inland water systems; and
- (5) Increase public awareness of environmentally-sound water development.

**In close cooperation with riparian governments,
EMINWA consists of:**

- (1) Comprehensive diagnostic assessment to (i) characterize drainage basin as a whole and (ii) develop data/information base needed to identify significant problems and possible solutions;
- (2) Development of management action plan to address the interlinked environmental, economic, and social problems identified in the diagnostic phase and to help identify donors.

Initial EMINWA activities focused on African Water Systems, although approach recently applied in Latin America and Asia.

Components of Integrated Management:

- *Scientific, Engineering, and Technical Issues:*

- water supply and demand;
- physiography;
- hydrology;
- geography;
- flora;
- fauna;
- pollution sources.

- *Non-Technical Issues:*

- law;
- economics;
- institutions;
- education;
- health;
- politics.

"Best" technical solution virtually never used!

UNEP INTEGRATED WATER PROGRAMME:

UNEP consolidated Freshwater Program and Oceans and Coastal Areas Project Activity Center (OCA/PAC) into single Integrated Water Program.

- As part of UNEP 1996-97 Biennium Workprogram, allows consideration of water environment (freshwater rivers, lakes, and ground water aquifers; coastal waters and the open oceans) as management continuum.
- First practical application of unified integration of assessment, diagnostic, management, planning, and strategic concerns inherent in these hydrologically-interlinked water systems.
- Also supports UNEP as recently-appointed Secretariat of the Global Program of Action for the protection of the Marine Environment from Land-Based Activities.

**COUNTRY PERSPECTIVES:
ACHIEVEMENTS AND OPPORTUNITIES**

ANGOLA

1. ECONOMIC STRUCTURE

Angola covers a total area of 1,246,700 sq. km, making it the second largest country in Sub-Saharan Africa. The distance from north to south is 1,277 km and from east to west is 1,236 km. Angola is bordered by Zaire, the People's Republic of Congo, Zambia, and Namibia.

The country enjoys a tropical climate but locally tempered by altitude. The coastal area is arid or semi-arid due to the influence of the Benguela current. The area along the Namibian border experiences very high temperatures and heavy seasonal rainfall. The interior uplands have a much more pleasant climate with low temperatures.

Angola is a sparsely populated country with a total population of 10,020,000 in 1990 (Table 1). Approximately 25 per cent of the total population resides in urban centers. This is mainly due to the 30-year civil war. The high population density in the cities has created serious economic, social, and environmental problems.

Table 1: Principal characteristics of the population (000 inhabitants)

Population	1987	1988	1989	1990	1995
Total	9233	9483	9739	10020	11233
Urban	2933	3209	3448	2836	4902
Rural	6300	6274	6291	7184	6331
Female	4801	4931	5064	5084	5729
Male	4432	4552	4675	4936	5504
According to age					
0-14 years	4132	4243	4357	4510	
15-19 years	900	925	951	982	
20-29 years	1460	1499	1539	1583	
Over 30 years	2741	2816	2892	2945	
Per Province					
Luanda	1302	1379	1459	1545	1892
Huambo	1383	1418	1460	1484	1644
Bié	1019	1044	1069	1093	1215
Malange	822	838	855	872	935
Huila	803	818	834	860	996
Uige	738	761	785	812	921
Other Provinces	3167	3226	3287	3354	3630

Population density is relatively low and unevenly distributed, averaging 7.2 inhabitants per km². The south-east quarter of the country has a population density of less than one person per km², whilst the north-east quarter has a population density of between one and five persons per km².

Large parts of Huambo Province have a particularly dense population concentration exceeding thirty persons per km², as do parts of Kwanza-Sul and Malanae Provinces.

One of the most striking features is the very high rate of urban growth, in particular in the capital city of Luanda. The urban population is estimated to have grown at 7.6 percent per annum during 1986, now constituting 37 per cent of the total population as compared to 23 per cent previously. Between 1980 and 1990, Luanda's estimated population had reached 1.5 million, representing 54 per cent of the total urban population.

There are three major factors which have adversely affected economic growth since independence in 1974:

- the civil war which consumes not only a considerable part of the national budget but also a large part of the country's qualified manpower;
- the exit of thousands of Portuguese after the declaration of Independence, in some cases destroying economic property and leaving the country without qualified personnel to manage the economy and government services;
- the government's economic policy which, influenced by a state of permanent war and the lack of personnel, aimed at directing the economy by quantitative, centralized planning.

These three factors have resulted in slow and sometimes negative growth of the national economy. The economic structure of the country has, over the years, been heavily distorted. The commercial balance of payments has more than doubled since 1987, reaching a net surplus of US\$2362 million in 1990. More than 90 per cent of this revenue came from the petroleum sector. The rest of the economy, apart from diamond extraction, has virtually been grounded to a halt. This does not provide employment opportunities for the millions who are displaced and unemployed. The new government which was elected in 1992 is faced with the daunting task of providing employment opportunities. The rehabilitation of the other sectors of the economy is therefore one of the main tasks. This must be achieved through a strategy which also acknowledges that the present economy is floating on oil, the price of which is entirely dependent on the international market.

2. WATER RESOURCES QUANTITY AND QUALITY

2.1 WATER QUANTITY

Despite the prolonged period of drought in the south (1987-1990), Angola should not be considered as threatened by lack of water. With few exceptions, superficial flows, namely in the Chiloango (Cabinda) and Zambezi Rivers (originates in Zambia a few kilometers from the Angolan border), are formed without "importing" water from neighboring countries.

2.2 SUPERFICIAL AND UNDERGROUND FLOWS

Superficial flow is estimated at between 120-170 km³ per year, and the potentialities of underground flows are virtually unknown. Angola has a complex and vast hydrological network that consists of nearly 50 principal river basins (between 254 km² and 290,000 km²).

2.3 INTERNATIONAL RIVER BASINS

Angola has 5 (five) shared river basins with other SADC countries: Cunene, Cuvelai, Okavango, Zaire, and Zambezi. The following is some information on these international river basins:

2.3.1 The Cunene River Basin

The Cunene River originates in Huambo Province in the Sierra Encoco mountains in south-western Angola. The river flows in a southerly direction to the Ruacana Falls where it turns to the west and proceeds to the Atlantic Ocean. The lower section of the river cuts through a deep gorge which starts at the Ruacana Falls. In the 340 km between Ruacana and the Atlantic Ocean, the river falls more than 1,100 m and this important feature provides the Cunene River Basin with a hydro-electric power potential of approximately 2,400 mw.

Between 1926 and 1969 the Portuguese and South African Governments entered into three Water Use Agreements on the Cunene. In the First Agreement of 1926, it was agreed that Namibia has the right to one half of the flow of the Cunene, provided that a water scheme for such a purpose would be feasible. The Second Water Use Agreement in 1964 related in general to the utilization of rivers of mutual interest between the parties, inferring the inclusion of other rivers like the Cuvelai and the Okavango in Angola or river systems like the Limpopo and Incomati in Mozambique as well. In that agreement, the principle of best joint utilization was accepted and was defined as the allocation and utilization, on an equitable basis, of shared water resources with a view to achieving the optimum benefit for the states concerned, within the limits of the available quantity of water. This agreement was also acceded to by one other country, the Kingdom of Swaziland, in 1967.

The detailed feasibility investigations and related activities for the first phase of development of the hydropower potential of the Cunene River and the diversion of water into northern Namibia set in motion by the 1964 Agreement culminated in the Third Water Use Agreement of 1969 which initiated the construction of the proposed Cunene River Scheme. This agreement established a Permanent Joint Technical Commission (PJTC) and made provision for Namibia to abstract water at 6m³/s at Calueque for diversion to the Cuvelai Basin in Northern Namibia. The project comprised the Gove Dam to regulate the flow of the Cunene, the Calueque Dam and Pump Station for the diversion of water into Namibia, the Ruacana Weir for the diversion of water into Ruacana Power Station, and the power station itself. Of this infrastructure, (refer to Table 2 for more detail), the Calueque Dam was never completed due to the war in Angola at the time. The Gove Dam was completed in 1975 and the works at Ruacana in 1978. Only the Ruacana Power Station, with an installed capacity of 240 mw which can generate 1055 gwh/a, is located in Namibia. This facility has not been operating at its full capacity because the flow of the Cunene was not continuously regulated at Gove. The situation is presently being discussed by the PJTC to convince Angola to honor its obligation to regulate the flow.

At present, the total development of the Cunene River includes the multi-purpose hydropower and irrigation scheme at Matala in Angola. The hydropower facilities at Matala were upgraded from 27 mw to 40 mw in 1989, but the 3000 ha of land available for irrigation are not cultivated due to damage to the canal system. Namibia can presently divert 3.2 m³/s from the Cunene River at Calueque across the watershed to the Cuvelay Drainage Basin to supply the domestic and irrigation water demand in Northern Namibia

Table 2: Major Dams in The Cunene River Basin

Country and name of the river	Name of dam	Dam capacity (mm ³)	Surface area (km ²)	Use of dam
Angola Cunene	Caluque	475	180,6	1
	Gove	2575	178,2	2
	Matala	60	40,8	3
	Ruacana	30	5,0	4
Angola/Namibia Cunene	Epupa (proposed)	7300	295	5

- 1 = Diversion of Water to northern Namibia (Never completed)
- 2 = Flood regulation for Ruacana power station (Completed 1975)
- 3 = Water supply, power supply and irrigation
- 4 = Diversion of water into the Ruacana power station
- 5 = Hydropower generation. Feasibility study being done

In September 1990, some 6 months after the independence of Namibia, the governments of the Republic of Angola and Namibia endorsed and affirmed the previous agreements reached between Portugal and South Africa. The Permanent Joint Technical Commission was re-instated, and a Joint Operating Authority for the Cunene Basin was re-established. The PJTC was also given the task of investigating possible new developments on the Cunene River, hence the present feasibility study on the proposed Epupa Dam.

The future development of the Cunene Basin received immediate attention under the auspices of the PJTC and already led to the completion of a pre-feasibility study on the proposed Epupa Dam hydropower scheme in September 1993. The proposed installed capacity of 415 mw at Epupa will be able to generate 1650 gwh/a. The feasibility study of this project commenced towards the middle of 1995 and calls for a complete re-evaluation of the lower Cunene hydropower potential. Several alternative dam sites are presently under investigation. On completion of the project, the total installed power generating capacity of the Cunene will be about 700 mw.

Other objectives on the Cunene are the rehabilitation of the Matala irrigation scheme, the rehabilitation and completion of the Caluque Dam embankment, and the upgrading of the pumpstation at Caluque to abstract the agreed quantity of 6m³/s from the Cunene for transfer to Namibia. New studies on the hydrology of the Cunene Basin will be undertaken in the near future, probably as part of the proposed SADC Energy Project 3.0.5.

2.3.2 The Cuvelai River Basin

Cuvelai River is an endoreic river, rising in the southern foothills of the Sierra Encoco in southwestern Angola. It drains southwards towards the Etosha Pan in northern Namibia. The Cuvelai is perennial for about 100 km before it ramifies into a delta of ephemeral watercourses which cross a broad plain of low relief. This delta converges again to terminate in the ephemeral Etosha Pan. The water courses, called oshanas, are the life blood of an area where 650,000 people, or just less than half of the population in Namibia, live.

Due to climatic conditions, surface waters and shallow wells dry up from time to time. The ground water is saline, and the only way to augment these rather unreliable water supplies is to import water from the perennial Cunene River. This is the main reason for diverting water from the Cunene River Basin to the Cuvelai Basin. The water scheme is operated by the Namibian

Department of Water Affairs on Angolan Territory and serves as an excellent example of cooperation between basin states. The existing water supply network, distributing water through canals and 9 pipelines to the population, is one of the largest in Southern Africa.

It is clear that any alteration of this international watercourse system in Angola or Namibia will have major repercussions for the fragile, semi-arid ecosystem and the people living on the flood plains. However, there is no specific international agreement between Angola and Namibia on water allocation in or further studies of the Cuvelai Basin.

2.3.3 The Okavango River Basin

The Okavango River rises in the south-western Angolan highland, near and just east of the source of the Cunene and the Cuvelai Rivers. The Cubango flows for more than 600 km in a southerly direction until it reaches the west-east cutline border between Angola and Namibia. From that point, the river forms the border between Angola and Namibia over a distance of some 400 km. It then turns southwards again and ends in the Okavango Swamps in Botswana. The mean annual runoff of the Okavango River at Muhembo on the border between Botswana and Namibia is 10,000 mm³.

The main tributaries of the Okavango are the perennial Cuito River and the ephemeral Omatako River. The Cuito River rises in the highlands in the central Cubanco Province of Angola and contributes half of the flow of Okavango River. The Omatako River rises near the Omatako Hills in central Namibia but contributes nothing to the flow of the Okavango River. Very little is known about water resources development in the upper reaches of the Cubango and Cuito in Angola. It is thought that virtually no development took place in the catchment since the civil war started in Angola in 1975.

It is estimated that about 20 mm³ of water are abstracted per annum from the Okavango River for domestic and irrigation consumption in Namibia. A dam has been built in the upper catchment of the Omatako River to divert water for domestic and industrial consumption in the Windhoek-Okahandja complex in the Swakop River catchment in central Namibia. No major development of the water resources of the Okavango River or the Delta took place in Botswana except for the Mopopi Dam. The dam was built to supply water to the Orapa diamond mine and was created by using the basin of the Putimolonwane Pan and constructing earth embankments around it to impound more water. The reservoir capacity is 100 mm³, and it covers 24.3 km² at full supply. Water is pumped into the dam from the Boteti River which is the outflow river of Okavango Delta.

The institutional arrangements concerning the utilization of the Okavango Basin have been under discussion between the three basin states since 1992. The existing Permanent Joint Technical Commission between Angola and Namibia, which deals with the Cunene River Basin, and the existing Joint Permanent Water Commission between Botswana and Namibia, established to deal with the utilization and management of common water resources like the Okavango, the Cuando-Linvanti-Chobe System, and other water resources like ground water, did not incorporate all three basin states in one commission on the Okavango Basin. In view of the absence of an instrument of cooperation between all three basin states on the Okavango, the Namibian Government took the initiative to bring the members of the existing commissions together to establish a Tripartite Water Commission on the Okavango Basin. This endeavor came to fruition in September 1994 when a Permanent Okavango River Basin Water Commission (OKACOM) was established between Angola, Botswana, and Namibia.

Little is known about future upstream developments in Angola. However, Namibia will have to import water from the Okavango River to supplement supplies to the central area of the country as early as the year 2005 or not later than 2009. The water project to achieve this objective is called the Eastern National Water Carrier and has been under construction in phases since 1969. The project links three state dams in the central area of Namibia and ground water resources at Grootfontein in the north, but the final phase which is a pipeline of about 250 km between Grootfontein and the intended abstraction point on the Okavango River at Rundu must still be constructed. The intention is to abstract 4 l/s or 100 mm³/a from Okavango by the year 2020. Botswana is aware of this requirement.

In Botswana the development of the proposed Southern Okavango Integrated Water Development Plan was shelved temporarily in 1992 before a review report by the World Conservation Union (IUCN) on the project was published in October 1992.

2.3.4 The Zambezi River Basin

The Zambezi River Basin is the largest of the African river systems flowing into the Indian Ocean. It is shared by eight basin states and supports a population of more than 20 million people. The major tributaries of the Zambezi rise in Angola, Malawi, Tanzania, Zambia, and Zimbabwe. There are five major swamps, the Borotse, the Eastern Caprivi, the Kafue, the Busanoa, and the Lukanga, covering an area of 20,000 km² at high flood periods.

Apart from a number of smaller lakes, the most significant natural lake is Lake Malawi (30,000 km²), but there are also two major artificial lakes, namely Kariba (5,180 km²) and Cahora Bassa (2,660 km²). Other reservoirs with large surface areas are the Kafue Dam (809 km²) and the Ithezitshi Dam (365 km²). It is estimated that more than 160,000 metric tons of fish are caught per annum in these water bodies.

The mean annual runoff in the Zambezi at selected sites is reflected in Table 3.

Table 3: Mean Annual Runoff in The Zambezi

LOCATION	MEAN ANNUAL RUNOFF MM ³
Kongola (on the Cuando in Namibia)	1,300
Katima Mulilo	41,000
Victoria Falls	38,000
Kariba Dam	46,000
Cahora Bassa Dam	88,000
Liwonde (lake Malawi outflow)	15,000
Indian Ocean	94,000

More than 28 dams with a storage capacity in excess of 12 mm³, of which Kariba is the largest (160,000 mm³) and Cahora Bassa the second largest (52,000 mm³), have been built for domestic, industrial, and mining water supply, irrigation and power generation. The countries with dams are Malawi (1), Mozambique (1), Zambia (4) and Zimbabwe (21), plus Karibia which lies between Zambia and Zimbabwe.

At present the major hydropower facilities in the Zambezi Basin are at Victoria Falls (108 mw), Kafue Gorae (900 mw), Kariba (1,266 mw), Cahora Bassa (2,075 mw) and on the Shire River at NKula A and B (124 mw), Tedzani (90 mw), and Kapichira (125 mw), the latter presently under construction. Some examples of future hydro-electric development possibilities are at Katombore

upstream of Victoria Falls, the Batoka Gorge (1,600 mw), and Devil's Gorge (1,240 mw) both sites between the Victoria Falls and Lake Kariba, the Mupata Gorge (1,000 mw) located between Kariba and Cahora Bassa, as well as the development of the middle Shire River between Kholombidzo and the Hamilton Falls (600 mw potential of which 339 mw has been developed so far). More dams are possible downstream of Cahora Bassa at Mpanda Unca, Baroma, Lupata, and Mutarare in Mozambique.

Although the available water resources in the Zambezi Basin in general exceed the demand at present, this situation may deteriorate as a result of the increase in population, more industrial and mining development, increased irrigated food production, a higher standard of living of the population, and by taking the environmental water demand of the system into account. However, it is estimated that the most significant increase in water consumption will most probably be a result of large-scale irrigation projects.

More than 250,000 ha of land are presently under irrigation, but the development of large irrigation projects to secure the food supply situation may become necessary in the future. It is estimated that more than 500,000 ha of land could be brought under irrigation in the next 30 years. Other development projects which have been proposed are a 40,000 ha irrigation project (with Shire water) at Bangala in Malawi, a 10,000 ha sugar cane project in the Eastern Caprivi in Namibia, the proposed Bulawayo Water Diversion project in Zimbabwe to supply water for domestic and agricultural consumption from the Zambezi, and the abstraction of water from the Zambezi at Kazungula or Katima Mulilo in the Caprivi to augment the water supplies in Botswana and South Africa by the year 2020. Some of these proposed projects are also typical examples of projects which may not be feasible to implement due to their questionable economic viability.

It is clear that the Zambezi River is the main life supporting artery of eight basin states, and the creation of an effective River Basin Commission to manage this vital resource is crucial to the socioeconomic well-being of all basin states.

2.3.5 The Zaire River Basin

The Zaire River originates in highlands located in eight co-basin states. However, most of the contribution to the runoff at the mouth of the Zaire River is generated in the middle courses of the river in the central tropical rainforests of the Zaire Basin on the equator. The flow in the upper reaches of the drainage basin is of lesser magnitude, especially in Angola, the Central African Republic, and Tanzania. The annual average runoff in the Zaire is 1,260,000 mm³, and the average flow is 40,000 m³/s. The historic minimum and maximum flows vary between 21,400 and 73,600 m³/s respectively, but 98% of the time the river flow exceeds 26,400 m³/s.

The main potential of the Zaire River is for the generation of hydropower. There are many falls and rapids which provide potential sites for development. The river has a total theoretical generating capacity of 100,000 mw, and total presently installed generating capacity is more than 2,500 mw. In spite of the many waterfalls and rapids, the Zaire River is a very important waterway because the river is navigable over long distances and provides good opportunities for boat transport and trade between the basin states. There are large wetlands and lakes in the Zaire Basin within Zambia and Tanzania which provide important grazing, fish, and wildlife resources to the population. About 20 large dams have been built on the tributaries of the Zaire River within Zaire, but none within the SADC Region. Most of the dams are used for water and power supply.

A major hydropower supply development on the Zaire River is at the Inga I Dam and the Inga II Dam. Installed capacity is 350 mw and 1,400 mw, respectively (total 1,750 mw), but this is dwarfed by the proposed Grand Inga Dam which will have a total installed generating capacity of 30,000 mw (equal to the total installed capacity in South Africa) or a power supply of 23×10^{12} KWh per annum. On completion of the Grand Inga Dam, it will be the largest hydropower facility in Africa.

There are immediate plans for further development of water or electricity supply infrastructure on the Zaire River within the SADC States. The Namibian Head of State mentioned the possibility to link the Zaire River with the headwaters of the Cunene and Cabango Rivers.

2.4 WATER DUALITY

There is no substantial pollution of water because industrial production has been insignificant over the last decade. A certain amount of pollution in the rivers of the Lunda-Norte Province occurs because of diamond mining, but the direct recipients of these waters are the tributaries of the Casai River in Zaire, immediately to the north. An increase in manufacturing and mining could create higher levels of water pollution, and it needs to be noted that there is no existing legislation which would control future pollution levels.

In Luanda, capital of Angola, the water quality is monitored by the EPAL water analysis laboratory, located on the Marcal site. The laboratory is working in a very satisfactory manner giving highly reliable analysis results. Raw water for drinking is taken either from the Rio Bengo (the case of Margal and Kifangondo plants) or from Rio Kwanza (Kikuxi plant). Both rivers have regulating dams upstream, and for this reason the water quality is relatively stable over the year. Unfortunately, only the analyses of the Bengo River water are available; the Rio Kwanza is not yet subject to periodic analyses. Some key parameters (turbidity, color, oxidability, alkalinity) often subject to seasonal variations are monitored.

Mean turbidity values are approximately 4 NTU, with maximum values during the rainy season (August-December) never rising above 100 NTU. Oxidability values range from 2-3 mg/l kmnO_4 with maximum values at 7 mg/l, indicating a relatively low presence of organic matters in the river water. Color values follow significantly the variations in turbidity and oxidability.

Mineral salt contents are stable over the year, as well as chloric, sodium, and potassium ions as measured in hardness, alkalinity, or conductivity. All mineral content is moderate.

Particular constituents of health significance such as arsenic, heavy metals, benzene, phenols, and haloformins, are not monitored, but as the captive area of the Rio Bengo is not industrialized no problem should occur concerning these parameters.

In conclusion it is found that the Rio Bengo water presents no major problems for water treatment by the means of a classic coagulation-sedimentation-filtration process. Seasonal variations are moderate and should not disturb the treatment. Salt contents are low and will not affect the organoleptic quality or cause corrosion of pipes and pipe equipment.

3. POLICY, LEGAL, AND INSTITUTIONAL ASPECTS

A water law has not yet been passed in Angola. Included in the technical assistance component to DNA (National Directorate of Water) is the Infrastructure, Rehabilitation Project (IRE) financed by the World Bank. It was decided to elaborate the Draft Water Law, which at present is being discussed among all entities involved in the water and sanitation sector. We expect to have the law passed by Parliament during this year.

The Water Resources Management Strategy and Plan of Action is included in the Proposed Urban Water Supply and Sanitation Project which will be appraised by the World Bank mission during next month. However, DNA decided to discuss some elements of that strategy, in order to address some issues resulting from users conflicts, mainly concerning the agricultural sector. In April, a short-term Plan of Action will be presented by DNA for discussion in a national workshop.

The Guidelines for Water Supply and Sanitation in Angola were discussed during the Second National Meeting on Water Supply and Sanitation held in Lobito (South of Angola) last December 1995. While the Water Law and the Water Resources Management Strategy and Plan of Action are not yet ready for approval by government and the parliament, these guidelines will replace the two legal and policy papers. The Guidelines for Water Supply and Sanitation in Angola give some guiding principles for water supply and sanitation such as: i) water quality, ii) water and sanitation coverage, iii) cost recovery, iv) institutional framework (the role of government, the role of international cooperation, the role of NGOs), v) community participation, vi) private sector intervention, vii) training and capacity building, viii) finance and tariffs policy, etc.

The Government of Angola approved the tariff policy in principle by increasing, gradually, the water tariffs up to cost recovery level. On a quarterly basis, the Minister of Finance will issue the decree on water tariff policy to be implemented by the water authorities.

The water and sanitation activities are very fragmented among the following ministries and sectors: Energy, and Water, Geology and Mines, Health, Agriculture, Internal Affairs, Planning, Provincial Governments, NGOs. To address this situation and strengthen the water and sanitation sector, the Minister of Energy and Water created the CRESA - Water Sector's Reform Commission, under the leadership of DNA.

4. SUMMARY OF ACTIVITIES

4.1 PUBLIC INVESTMENT PROGRAM

The program is being financed by the government itself. The objective of the two year investment program is to undertake urgent and essential actions in the urban water systems and sanitation destroyed by the war while the Rehabilitation and Development Program is being discussed and negotiated with the ESA (External Support Agencies). The estimated cost is USD 5 millions.

4.2 WORLD BANK

The International Development Association (IDA) mission led by Mr. Lance Morrel is preparing and appraising the Proposed Urban Water Supply and Sanitation Project. The proposed project has three primary objectives: i) to contribute to the reduction of the level of poverty and improve the general level of public health by increasing the quantity of water available to residents of the city of Luanda and other provincial capitals (sanitation and solid waste management services currently available to the residents will also be rehabilitated), ii) to assist the government in its efforts to develop a national water sector policy and to reform the water sector into one that is financially self-sufficient and capable of meeting the needs of residents through the use of private sector operators working with the existing agencies under management contracts, and iii) to mitigate against further environmental degradation in the cities. The proposed project will be implemented over a five year period from 1996 to 2000. The estimated cost is USD 100 million.

4.3 COMMUNITIES REHABILITATION PROGRAM

The program was presented to the international community last year during the Brussels Round Table. The objectives of the project are: i) to rehabilitate basic community services (water supply and sanitation, schools, hospitals, electricity, roads, demining, soldier demobilization, resettlement, etc.) and ii) national reconciliation.

As far as water supply and sanitation is concerned, the amount secured is about USD 50 million, to be used through bilateral cooperation. DNA has already defined the utilization strategy of these funds, on the basis of geographical area, local consultants and contractors participation, training, sustainability, institutional strengthening, the role of indigenous NGOs and CBOs (community based organizations), users payment, women's involvement, project management and implementation, etc. The program starts with Dutch Cooperation in Huila province and with Germany Cooperation in Kwanza-Sul and Benguela provinces. DNA will discuss with the European Community and other bilateral cooperation agencies the strategies and elements of implementing the Communities Rehabilitation Program in other provinces and municipalities of Angola.

4.4 DNA - UNICEF RURAL WATER SUPPLY AND SANITATION PROGRAM

DNA and UNICEF implement the peri-urban and rural water supply and sanitation program all over the country (where it is reachable). The program is approved by the government and implemented by local water authorities, communities, and NGOs under coordination of the DNA and technical and financial assistance from UNICEF. The estimated cost for 1996/97 program is USD 5 million.

4.5 INITIATIVES FOR AFRICA ON WATER SUPPLY AND SANITATION

INITIATIVE AFRICA 2000: The program was officially launched in Angola, taking into account that Angola in its capacity as a WHO state-member has subscribed to the AFR/RC44/3/12 Resolution which brought into force the said Initiative in the course of the 43rd African Regional Committee session. A steering committee was created at the national level for coordination not only of Initiative Africa 2000, but other initiatives such as: i) Lusophone Initiative of Water Supply and Sanitation Collaborative Council (Angola is coordinator-country), ii) UN Secretary General Initiative on Africa, iii) Bamako Initiative, iv) Brussels Initiative, etc. The coordination group, which is chaired by DNA, is composed by representatives of the Ministries of Health, Finance, Planning, Environment, Social Affairs, Agriculture, UNICEF, WHO, World Bank, European Union, NGOs, and other organizations to be invited.

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BOTSWANA

1. INTRODUCTION

Botswana is a semi-arid country covering an area of 582,000 km², 80% of which is covered by Kgalagadi Desert sand.

The population is about 1.4 million people and growing fast at a rate of 3.4% per annum. At this rate, it is estimated that the population will more than double within the next 25 years with about 30% of the people staying in urban areas.

The country's fast growing economy is based mainly on mining and livestock for its foreign exchange. The development plans of Botswana have been based on four national planning objectives, namely:

- rapid economic growth;
- social justice;
- economic independence; and
- sustained development.

Economic growth is putting more stress on the scarce water resources.

2. WATER RESOURCES AND MANAGEMENT

2.1 WATER RESOURCES

Water is a vital resource to Botswana's economic development, but it is scarce and costly to develop. Most of the water originates from rainfall which is erratic and unreliable. The long-term average annual rainfall varies from minimum 250mm in south-west to a maximum of 650mm in the extreme north.

This results in an average of 450mm per annum against an estimated annual evaporation of 2000mm. Most of the rivers are in the eastern part of the country and are ephemeral. The only perennial systems are the Chobe and Okavango Rivers in a thinly populated area in the north-west and north. These two rivers constitute about 95% (12.5×10^9 cubic meters/annum) of the total surface water. The ephemeral systems have an estimated yield of 700×10^6 cubic meters per year of which about 19% is already stored in man made reservoirs.

Though the surface water resources may appear attractive, to a certain degree, for reservoir developments, there are difficulties, including:

- rivers are mostly ephemeral;
- highly variable river flows;
- high rates of evaporation;
- very flat topography; therefore poor damsites;
- dams may take several years to fill;

- most demand is in the south-east; remaining resources are mostly in the north and north-east;
- environmental constraints in some areas;
- very large capital investments needed.

The ground water on which about 80% of the population and livestock depend has an estimated extractable volume of 1×10^9 cubic meters.

Development difficulties are also prevalent, and the main ones are:

- very low recharge rates;
- danger of depleting non-renewable resources (mining);
- poor quality over much of the country;
- low success rates in striking water;
- aquifers at greater depth;
- large number of boreholes needed.

The wastewater re-use (effluent) is another source in particular that has to be studied as demands increase. The return flows may either be recycled or may support agriculture. The estimated return flows from urban areas were 10.4 million m^3 /year in 1990 and are expected to grow to 63 million m^3 /year in 2020.

2.2 WATER DEMAND

The water demand is divided among settlement, mining, energy, agriculture, and wildlife.

The settlement component comprises domestic, commercial, industrial, and institutional demand, while agriculture is split into demands for livestock, irrigation, and forestry. The total demand also includes distribution and treatment losses.

The present total demand is estimated at about 156 million cubic meters per annum, and the demand will more than double to 336 million cubic meters per year by the year 2020. This is a big increase which will exceed the available resources.

2.3 INSTITUTIONAL FRAMEWORK

Responsibility for water in Botswana at present is shared between a number of ministries, departments, parastatals, and other bodies. This reflects the way in which the country has developed over the years since gaining Independence during which the institutions and laws have been adopted to meet the changing needs and circumstances.

The institutional framework for water normally varies from country to country. In Botswana, the *Ministry of Mineral Resources and Water Affairs* is responsible for policy formulation, planning, development, and management of water and mineral resources. Its portfolio responsibilities relating directly to water are discharged through the Department of Water Affairs, Department of Geological Surveys, and a parastatal, the Water Utilities Corporation.

The Department of Water Affairs is responsible for overall water resources planning; investigation, design and construction, and operation and maintenance; of 17 major villages' water supplies. The major villages contain about 23% of Botswana's population. The villages are semi-urban centers with modern infrastructure. The Department of Water Affairs has personnel in these

villages who manage the water supply schemes. The Department also designs and constructs rural village water schemes under the Rural Village Water Supply Programme which on completion are handed over to the respective district councils for their operation and maintenance. The villages under this programme contain about 37% of Botswana's population. The projects within this programme are quite complex because some schemes are due for upgrading, rehabilitation, and source augmentation in parallel with the on-going programme. During drought periods, planning and execution of the projects become more complex. The Director of Water Affairs is also the Registrar of the Water Apportionment Board, a quasi-judicial body with important powers and duties to record, grant, refuse, vary, or terminate water rights under the Water Act 1968 and for administration, in so far as it affects water rights and the Aquatic Weeds Control Act.

Responsible for the overall assessment of the ground water resources, the *Department of Geological Surveys* interfaces on a broad front with the Department of Water Affairs. The Department maintains the National Borehole Archive, which provides a data base for the assessment of ground water potential throughout the country and is charged with the administration of the Borehole Act 1956, which requires those sinking boreholes or carrying out related operations to furnish information and records to the "Director". To date, there are about 17,000 registered boreholes in Botswana.

The Water Utilities Corporation was established in June 1970 (by the Corporation Act Cap 74:02 - Laws of Botswana) with the intention that its activities should be restricted to the urban areas where public water supply services could be financially self supporting. The act regulates the commercially aligned principles of financial operations to be followed. The corporation's activities are governed by the Waterworks Act which requires, inter alia, that its tariffs be subject to ministerial approval.

About 18% of the population of Botswana live in scattered lands area, and to date they are not directly part of the Rural Village Water Supply Programme. A Lands Area Water Supply Study is on-going, and the emphasis is on the alternative technologies suitable to support this segment. Experience has shown that costs per capita become very high when targeted settlements have a population of less than 500 people.

2.4 LEGAL FRAMEWORK

All the water in Botswana belongs to the state, whatever its source. The main body of laws in Botswana directly concerned with water comprises four acts and some were subsequently modified by short amending acts. These are:

- (a) Water Act 1968 Cap 34.01
- (b) Borehole Act 1956 Cap 34:02
- (c) Waterworks Act 1962 Cap 34.03
Waterworks Amendment Act 1983
- (d) Water Utilities Corporation Act 1970 Cap 74:02 (WUC Amendment Act 1978 (3/78))

Besides these there are other acts which have a bearing on water, though some only marginally. The Public Health Act, for instance, gives environmental health officers power to ensure the purity of public water supplies. The Local Government District Councils Act enables the district councils to provide water supplies outside any areas for which a water authority has been appointed under the Waterworks Act. The Aquatic Weeds Control Act prohibits the importation

or transportation of undesirable aquatic weeds into the country or from one body of water to another without permit. The provisions of the principal acts are summarized below:

The Water Act 1968 is the base statute and contains what might be termed the "common law" aspects of water: the status of public water; the inherent rights of individuals to the use of water; the recording, granting, variation, and termination of formal rights to use or impound water or to discharge effluents into it; the obligations of those taking water to use it properly; conditions controlling pollution of public water, and so on. This act established the Water Apportionment Board as the licensing authority and prescribed its constitution, powers, and duties. The Board Secretariat is provided by the Department of Water Affairs.

The Borehole Act 1956 is a short statute which stipulates the records and samples which have to be kept and furnished to the Director of the Department of Geological Surveys by anyone sinking a deep borehole more than 15m below the surface or deepening an existing borehole. Contractors engaged in drilling operations on behalf of clients are required to comply with the provisions of the act.

The Waterworks Act 1962 and its short amendment provide for constitution of water authorities in townships and other areas designated by the "Minister" and confer powers and duties upon them. Included among these are: the right to acquire existing waterworks; to construct new works; to curtail supplies in time of drought and other emergencies, etc. They also deal with charges for water supplies, supplies to non-statutory areas, and the misuse and pollution of water. Further, they authorize the "Minister" to make regulations on such matters as prevention of waste, suspension of supplies, and the inspection and testing of meters and other appurtenances.

The Water Utilities Corporation Act 1970 established the Water Utilities Corporation for the supply and distribution of water within the Shashe Development Area and elsewhere and conferred the necessary powers to develop water resources. The act specifically addresses the constitution of the corporation, the appointment of members, procedures, powers of acquisition of works, and other matters. The financial principles and methods of charging for water which must be observed are also specified. The act further provides that the corporation shall be the "Water Authority" for the purpose of the Waterworks Act so that all the provisions of the latter act apply to it.

2.5 WATER RESOURCES PROTECTION

The Department of Water Affairs carries routine water quality sampling and sanitary inspections throughout the country. Bacteriological, chemical, and physical parameters are analyzed. There is an urgent need to protect the environment and safeguard water resources against pollution, particularly sewage. Protection zone studies for major wellfields and dams are completed. The Department of Water Affairs is responsible for the planning, design, and implementation of water-borne sewage systems in conjunction with the upgrading of the major village water supplies. Operations of the water-borne sewage schemes are carried out by the respective District Councils. Water-borne sewage schemes in rural villages are planned, designed, and implemented by the Ministry of Local Government Lands and Housing, and the respective District Councils are responsible for their operation. In urban centers, the Town/City Councils are responsible for sewage planning, design, implementation, and operations.

2.6 PRICING POLICY

The pricing policy for water in Botswana is based on principles of equity and affordability. Those who can afford it should pay the full cost price, and those who cannot afford it do not pay for water consumed.

There is no government subsidy on water in urban areas, but those who use large quantities pay more to subsidize those who use less.

Water from communal standpipes is free to consumers in major and rural villages thus ensuring that everyone has access to safe drinking water. Those with private connections in rural areas who use only a minimal amount of domestic water pay a price which is lower than the cost of production. Those who use excessive quantities pay a price which is roughly equal to the production cost.

Both rural and urban tariffs are stepped-up with the former targeted to recover full recurrent cost by the early stages of next plan period (1998/99) while the latter fully recover costs. To date, the rural tariffs cover less than 50% of the operational costs.

3. LONG-TERM WATER RESOURCES DEVELOPMENT PLAN

3.1 NATIONAL WATER MASTER PLAN (NWMP)

Water is a scarce resource in Botswana and, with the recent droughts, indeed in the whole Southern African region.

Therefore more coordinated and careful planning at national and regional levels is required in order to meet ever increasing water demands.

To ensure that Botswana's water resources are developed in a sustainable way, maximizing limited resources for the benefit of the nation and future generations, the government has finalized a national Water Master Plan.

The NWMP is based on an exhaustive analysis of alternative options for the development of Botswana's water resources so as to meet the water requirements of all sectors of the community over a period of thirty years (1990-2020). The plans not only outline the basic physical and engineering developments needed, but also take into consideration environmental, economic, social, institutional, and legal factors.

Under the NWMP, all Botswana's water demands are carefully balanced against the resources available to meet them, while solutions to the problem of growing demand are determined by evaluating the environmental and economic ramifications of a variety of options, including different combinations of surface water reservoirs and ground water development strategies.

With regard to water development and the environment in Botswana, the policy emphasis is on:

- close monitoring of ground water wellfields to avoid excessive depletion of these non-renewable water resources. In cases where the rate of extraction is greater than the rate of replenishment, alternative water resources must be found;

- greater use of alternative technologies to develop and conserve water resources; e.g. desalination;
- encouraging management and the development of water supplies by local communities;
- greater coordination between government institutions in the planning and development of water resources;
- including environmental impact statements (EIS) as an integral part of all project feasibility and subsequent studies for water development projects;
- interconnection of water supply schemes as a measure to respond to drought.

3.2 MEETING BOTSWANA'S WATER NEEDS

The needs of the heavily populated eastern region of Botswana can be met up to the year 2020 by a two-phase dam project in the north east of the country and by construction of a transfer carrier. Needs thereafter will probably be met from the Zambezi River System, which is shared with Angola, Namibia, Zambia, Zimbabwe, and Mozambique, and to a less extent Malawi and Tanzania.

Unlike the Okavango River, which flows from Angola through the Caprivi Strip in Namibia and ends on a inland delta, the Chobe River flows through the Zambezi into the sea. The environmental consequences of abstraction from the Chobe are less problematic than from the Okavango River. Unfortunately, the Chobe is a long way from major population centers. Extraction from the Okavango Delta to supply the eastern heavily populated areas of the country has been ruled out, but use for local communities is still open for further consideration.

The south-west of the country is historically sparsely populated. Government plans do not include any substantial development because water is so scarce. Desalination units are being installed so that the needs of existing communities there may be met from large reserves of salty water under the Kalahari Desert.

The long-term implication of the NWMP is that due to scarce water resources the development of water-intensive agriculture and industry cannot be accommodated. Botswana has given up its plans for self-sufficiency in food because of the lack of water and has moved instead to a programme of food security in its 1991 Agriculture Policy.

3.3 TRANSBOUNDARY WATER ISSUES

It is imperative for Botswana's long-term water resources to target the transboundary river systems. In this regard, a Joint Permanent Technical Committee (Botswana/South Africa) has been formed with particular reference to the Limpopo, Molopo, and Nossb Rivers. The OKACOM (Angola, Botswana, and Namibia) was signed last year with particular reference on the Okavango River Basin System.

The ZACPLAN (Zambezi System) is being initiated.

3.4 DATA AND INFORMATION SYSTEMS

Hydrological data collection in Botswana is concentrated along the eastern part of the country, the Okavango Delta, and the Kwando/Linyanti/Chobe region.

The eastern part of the country consists of tributaries of the Limpopo River, and other rivers flow into the Makgadikgadi pans. All stations in this region are equipped with automatic water level recorders.

To assist in the storage, retrieval, and analysis of the data, the department has acquired the HYDATA package from the Institute of Hydrology in the United Kingdom. Satellite data stations are also installed to capture the rainfall, water levels, and wind direction. Water quality and wellfield monitoring databases are in place.

4. ACTIVITIES IN WATER RESOURCES MANAGEMENT

The development strategies as outlined by NWMP are carefully followed. Currently, there are a number of major ground water assessment studies being undertaken. A National Water Carrier and its feeding reservoir are being implemented. All major wellfields are being monitored (quantity and quality). Hydrological data collection on all catchments is continuing. The Rural Village Water Supply Programme emphasises operation and maintenance, rehabilitation and expansion of schemes, improved management of resources, and capacity building in human resources.

Water conservation and nonconventional water sources are areas that will become the integral parts of the water sector in the next plan period that is being drafted.

In conclusion, we are currently preparing our next National Development Plan (NDP8) and top on the agenda are:

- Waste water re-use;
- Rain water harvesting;
- Alternative technologies, e.g. solar driven units, desalination plants, etc.;
- Water supply to scattered settlements with emphasis on appropriate technologies and improvement of traditional water sources;
- Capacity building with particular reference to local authorities; this is a major prerequisite to successful decentralization;
- Water conservation;
- Consideration of areas which could be privatized; and
- A way forward on transboundary issues.

Presented By Deputy Director Of Water Affairs O.A. Masedi

BURUNDI

1. APERCU SUR LES RESSOURCES EN EAU

Généralités

Du point de vue ressources en eau, le Burundi ne connaît pas de carences remarquables: le pays est bien arrosé, excepté une partie de la plaine de l'Imbo.

De part son climat tropical d'altitude, tempéré et humide, le pays jouit dans son ensemble d'une pluviosité comprise entre 800 mm et 2.000 mm. Au cours de l'année le pays connaît l'alternance de quatre saisons, deux saisons sèches et deux saisons pluvieuses.

La grande saison sèche se situe entre juin et septembre tandis que la petite est comprise entre mi-janvier et mi-février. Le reste de l'année connaît une période de pluie qui varie d'intensité (de 700 mm à 2.000 mm) suivant que l'on s'oriente des plaines vers la crête. Cette dernière partage le pays en deux grands bassins versants: le bassin du fleuve Nil et celui du fleuve Zaïre.

Les températures moyennes varient de 10 à 23°C. Les températures les plus élevées s'observent aux mois de juillet et août. Les conditions géologiques (lithologiques et/ou tectoniques) ajoutées à celles climatiques, favorisent la disponibilité des ressources en eau superficielles et souterraines.

Eaux superficielles

Doté d'un réseau hydraulique relativement dense et bien réparti sur l'ensemble du territoire, le Burundi est partagé entre les bassins du Zaïre et du Nil.

La totalité des ressources en eaux superficielles au Burundi a été calculée à 267 m/s, soit un volume de 8.409 mm³ par an (TBW, 1993).

En moyenne, les ressources en eaux superficielles peuvent être estimées à 27% de la précipitation annuelle dont la moyenne est de 1.226 mm.

Les débits spécifiques les plus élevés se trouvent dans le bassin versant du Zaïre qui draine 40% des ressources du pays.

Eaux souterraines

Le relief montagneux, qui justifie l'appellation du Burundi, "Pays de mille et une collines," favorise la présence de nombreuses et sur les versants de la crête Zaïre Nil environ une source par km² en moyenne.

Par contre, dans les plaines de l'Imbo et du Mosso, ainsi qu'au nord-est du pays, les sources sont rares. Ainsi, dans la région Nord de Kirundo, on trouve seulement 0.05 source/km².

Qualités des eaux

En général, la qualité ne pose pas de problème à l'utilisation, même si, par endroits, on remarque des concentrations excessives de matières organiques (éléments nutritifs) dues aux effluents agro-industriels et aux rejets domestiques, de fortes teneurs en fer (surtout dans le nord du pays).

Le principal problème reste toutefois la contamination bactériologique des sources, surtout dans les régions très densément peuplées.

Intervenants dans le secteur de l'eau

Une des difficultés à laquelle est confronté le pays est la trop grande diversité des intervenants dans le secteur de l'eau.

Les principaux sont:

- Le *Ministère de l'énergie et des mines*; responsable de l'exploitation hydroélectrique et de l'alimentation en eau potable dans les centres urbains. La REGIDESO, société para-étatique sous la tutelle de ce Ministère s'occupe de la gestion et l'exploitation de tous les équipements, tandis que la Direction générale de l'énergie élabore la politique sectorielle du Ministère;
- Le *Ministère du développement communal*, par la Direction générale de l'hydraulique et des énergies rurales (DGHER) et quelques projets de développement comprenant le volet hydraulique. La DGHER coordonne les interventions en milieu rural, celles des ONG incluses;
- Le *Ministère de la santé*, qui a dans ses missions le contrôle de qualité de l'eau de boisson, l'éducation à l'hygiène;
- Le *Ministère de l'agriculture*, qui a en charge les programmes d'aménagement des marais et d'irrigation. La pêche dépend également de ce Ministère;
- Le *Ministère des transports* qui intervient essentiellement sur le Lac Tanganyika, les rivières n'étant pas navigables;
- Le *Ministère de l'environnement*, qui a en charge l'aménagement du territoire et la politique de protection des ressources naturelles. Une institution para-étatique IGEBU, qui est sous sa tutelle, constitue une source importante de documentation sur l'hydrologie du pays.

2. PROBLÈMES À RÉSOUDRE

Informations

Du fait de la diversité des intervenants dans le secteur, il résulte:

- un éparpillement des données et des difficultés d'accès à l'information;
- des difficultés de coordination de la planification des projets, qui provoquent des conflits;

- une certaine concurrence et des conflits entre les intervenants (AEP – irrigation, hydroélectricité – agriculture, etc.).

Demande en eau

Eau potable

La demande en eau potable est aujourd'hui honorée par l'aménagement de sources protégées et quelques adductions d'eau. Il se pose toutefois deux problèmes:

- la protection des sources reste précaire contre la pollution;
- la quantité d'eau captée dans les sources sera rapidement insuffisante, compte tenu de la pression démographique.

Irrigation

La demande en eau pour l'irrigation augmente relativement vite à cause de la pression démographique, de l'exiguïté des terres, mais aussi, dans certaines régions, à cause de la sécheresse.

Transport

Pour les besoins du transport aucune rivière au Burundi n'est exploitée. Seul le lac Tanganyika est utilisé pour la liaison avec le Zaïre, la Tanzanie et la Zambie.

Pêche

La pêche n'est développée que sur le Lac Tanganyika, dont les ressources sont très mal gérées par manque de réglementation en la matière.

Les eaux internationales

Le Burundi partage avec ses voisins les eaux ci-après:

- Au Nord, le Burundi partage avec le Rwanda les lacs Cohoha, Rweru et la rivière Akagera (Kainyaru);
- Au sud-est, le Burundi partage avec la Tanzanie le lac Tanganyika et la rivière Maragarazzi;
- Au sud-ouest, le Burundi partage avec le Rwanda et le Zaïre les eaux de la rivière Ruzizi.

Une concertation entre tous ces pays est indispensable pour harmoniser les règles d'exploitation de ces ressources communes (pêche, hydroélectricité, irrigation, etc.).

3. PRINCIPALES ACTIONS MENÉES PAR LE GOUVERNEMENT

Pour résoudre les problèmes institutionnels rappelés ci-dessus, le Gouvernement a, depuis quelques années, initié les actions suivantes:

Création de la Commission nationale de l'eau et de l'énergie

Cet organe a été mis sur pied en 1989 pour assurer la coordination et l'harmonisation des activités du secteur eau et énergie. L'objectif poursuivi était la sauvegarde et la protection des ressources hydrauliques et énergétiques.

A son actif, on peut citer, notamment, dans le secteur eau:

- la loi de l'eau;
- la lettre de politique sectorielle en matière d'eau et d'assainissement;
- la note organisant la gestion des infrastructures hydrauliques en milieu rural.

Création du Service national du suivi des secteurs eau et assainissement (SNSSEA)

La création de cet organe avait pour objectif de développer un système d'information sur les secteurs eau potable et assainissement, et ainsi améliorer la planification des investissements des deux secteurs.

Le SNSSEA, créé en 1991, est rattaché à la DGEIER.

Renforcement de l'IGEBU

Cette institution développe un système d'information sur la pluviométrie, l'hydrologie et les ressources en eau en général.

Loi de l'eau

Citée parmi les produits de la Commission nationale de l'eau et de l'énergie, la Loi de l'eau mérite une mention spéciale. Décrétée en 1992, cette Loi prend en considération tous les aspects de l'utilisation des eaux.

La Loi a pour objet la protection du milieu aquatique, la préservation de la ressource commune en eau et la conciliation des différents usagers, dans l'intérêt de tous.

Elle devrait être complétée par des directives d'application dans les différents domaines, comme cela a été fait dans celui de la pêche et de l'aquaculture.

Renforcement de la DGBER

Celle-ci assure la coordination des interventions dans le secteur de l'eau potable et de l'assainissement en milieu rural. Le développement de cette institution a permis:

- la mise en place d'une politique sectorielle tendant à instaurer plus d'équilibre dans la desserte en eau en lançant des programmes de couverture maximale de toutes les provinces. Le taux de desserte dépasse aujourd'hui 50% en milieu rural.
- la création du SNSSEA ci-haut cité la DGBER a par ailleurs largement contribué à la confection de la Loi de l'eau.

Le Plan directeur national de l'eau

Initié par le Ministère de l'énergie et des mines, ce Plan constitue l'action la plus récente dans l'organisation du secteur de l'eau. Le Projet a commencé en 1993 et sera terminé en 1996.

L'objectif de cette étude est la définition des dispositions visant à assurer une gestion rationnelle des ressources en eau du Burundi en optimisant son utilisation.

Cet objectif sera réalisé en passant par:

- la collecte des données relatives à tous les secteurs de l'eau et une préparation des informations pour les décideurs afin de contribuer à une meilleure coordination;
- l'identification de la demande en eau, accompagnée de l'élaboration du bilan entre les ressources et la demande;
- la proposition d'une structure institutionnelle opérationnelle pour le développement du secteur eau.

Hydroélectricité-exploitation régionale

Le secteur hydroénergétique semble être le plus privilégié par rapport à d'autres secteurs, en terme d'exploitation concertée entre pays frontaliers. En effet, sur la Ruzizi deux barrages ont été déjà aménagés pour fournir de l'énergie au Rwanda, au Burundi et au Zaïre sous forme de réseau interconnecté. Au titre de projets, deux grands aménagements sont attendus: il s'agit du barrage de Ruzizi III qui intéresse les pays de la CEPGL et l'aménagement du bassin de la Kagera où un barrage a également des visées agricoles; il intéresse à des degrés différents: l'Ouganda, le Rwanda, la Tanzanie et le Burundi.

Dans le cadre de projet régional, le lac Tanganyika fait l'objet d'une étude de contrôle et de surveillance contre la pollution ainsi que de connaissance en richesse halictique. Ce projet intéresse les quatre pays riverains, à savoir le Burundi, le Zaïre, la Tanzanie et la Zambie.

4. LES STRATÉGIES D'AVENIR

Le développement socio-économique du Burundi tel que le prévoient les plans actuels de développement s'appuiera fortement sur l'exploitation des ressources en eau.

Agriculture: Une planification correcte et une gestion rationnelle des ressources en eau aideront le secteur agricole à se maintenir au stade de l'auto-suffisance alimentaire d'abord et à se hisser ensuite à celui du surplus commercialisable.

A cet effet, elles lui permettront d'augmenter les superficies irriguées, celles drainées dans les marais et protéger le patrimoine foncier contre l'érosion hydrique.

Energie: Le secteur énergétique du Burundi n'a pas encore un réseau étendu à tout le pays. Le développement des activités artisanales et industrielles fera naître de nouveaux besoins en énergie. Le pays a donc besoin de poursuivre la construction de nouveaux aménagements hydro-énergie tout en étant

indépendant des importations de combustibles de plus en plus chers et de la de plus en plus pesants sur l'économie nationale.

Eau potable: La poursuite et l'intensification du programme d'adduction d'eau potable exigent une connaissance plus approfondie des eaux souterraines. Des recherches hydrologiques sur les ressources devront être poursuivies. L'extension et l'intensification des activités de ce programme élèveront la consommation à un niveau supérieur à celui que peut satisfaire de simples captages de sources. Il faudra songer également au prélèvement et au traitement des eaux courantes des rivières.

Pêche: Une bonne protection des cours d'eau et lacs contre la pollution ainsi qu'une législation réglementant la pêche sont des obligations que l'Etat devra honorer pour développer les ressources piscicoles et la pêche.

Le Gouvernement du Burundi a déjà pris les mesures institutionnelles permettant de mieux répondre aux intérêts sectoriels.

En effet la mise sur pied d'une Commission Nationale de l'Eau et la promulgation d'un nouveau code de l'eau constituent une étape importante dans la coordination des activités relatives aux ressources en eau.

L'adoption du Plan directeur national de l'eau complétera toutes ces actions en orientant la politique générale du secteur et en proposant une structure de coordination des interventions opérationnelles.

Ces dispositions doivent être complétées par des actions de dimension régionales. Les autorités Burundaises en sont conscientes.

Le Burundi s'est en effet toujours associé aux programmes régionaux de développement des ressources en eau:

- Participation et organisation des conférences sur le lac Tanganyika;
- Membre de l'Organisation du Bassin de la Kagera (OBK);
- Observateur au Comité de la Coopération technique pour la promotion du développement et de la protection du bassin du Nil (TECCONILE);
- Exploitation des eaux de la Ruzizi en collaboration avec le Zaïre et le Rwanda pour la production de l'énergie hydro-électrique.

HAVYARIMAN Pierre, Directeur Général de la DGHÉ;
KAGARI Joachim, Ingénieur chargé des études et de la planification du secteur eau à la
REGIDESO;
NTUNGUMBURANYE Gérard, Responsable du service hydrologie à l'IGÉBU.

ERITREA

1. THE NATION'S WATER RESOURCES AND THEIR MANAGEMENT

Eritrea is an arid and semi-arid country and is not endowed with rich water resources. Furthermore, being part of Sahelian Africa, it has been the victim of recurrent and devastating droughts.

Rainfall in Eritrea is torrential, of high intensity, and short duration. It is very unpredictable and occurs sporadically. Due to the rugged topography of the highlands, thin soil formations, unfavorable geological formations, and completely deforested terrain, most of the rain turns into flash floods. Thus soil-water infiltration is very low. In the lowland areas, even though there are favorable geological formations, infiltration is also low (even though higher than in the highlands) due to high evaporation rates and lower intensity of rainfall.

No detailed and comprehensive assessment of the water resources potential of the country has been undertaken. The Eritrean physiography is criss-crossed by valleys, and there are major drainage systems in the country. Except for the Settit, all the other Eritrean river systems are intermittent. At the same time, there are no natural fresh surface water bodies in the country. Artificially dammed water bodies are found here and there in the highland parts of the country. Due to lack of published stream flow data, estimates of the runoff of various river systems in Eritrea are based on precipitation and drainage characteristics.

Regarding ground water, scanty information indicates that the ground water resources of the country are limited and are under pressure from a number of factors. Ground water can be tapped in all parts of the country but not in quantities and qualities desired. The dominant geology of the country is made up of basement rocks which have very low porosity and permeability. Furthermore, as mentioned previously, the rainfall in the country is basically torrential and of short duration. The above facts coupled with deforested and rugged terrain result in short duration flash floods and low seepage of water into the ground. Thus, except in the area covered by soft rock formations and intensively, as well as extensively, fractured/faulted/jointed formations, the possibility of tapping fair amounts of ground water is very low.

Except for the water-related articles in the transitional civil law and some local traditional customs, no other written water law exists in the country. Furthermore, there are no water quality standards for drinking, industry, bottling, or effluents. No regulations regarding spacing and allocation priorities exist.

Given the country's scarcity of water and ever-increasing demand for it, it calls for an effective approach to its development and management. The approach that is being proposed is based on the following four guiding principles:

- a holistic management approach which links the social and economic development with the protection of the natural ecosystem, including land and water linkages across catchment area or ground water aquifers;
- participation and involvement of all concerned parties, i.e., users, planners, engineers, contractors, and policy makers at all levels;
- recognition of the economic value of water in all its competing uses, and

- the central role of women in provision, management, and safeguarding water resources.

The Ministry of Energy, Mines and Water Resources is the only water-related authority in the country. Following the recent reorganization of the governmental structure, a Water Board chaired by MEMWR and comprised of relevant water users will be formed. This board will have the responsibility of coordinating all water-related works in the country. Water supply systems in all the urban areas are operated and managed by each individual municipality or town administration.

2. ISSUES IN WATER RESOURCES MANAGEMENT

1. There is water scarcity in the country for all activities. The per capita daily water consumption of the population in the rural and urban areas of the country is very low. Taking a daily per capita consumption rate of 20 liters, the national coverage is only 7%. The inhabitants of Asmara are consuming on the average less than 20 liters per capita per day, and the situation in the other urban areas is not better.
2. The issue of pollution is also cropping out. The pollution problems we are facing now are basically related to domestic sewage. A large part of the ground water in the Asmara area has very high nitrate content, which is due to the effects of the many latrines located in the town. Industrial pollution as well as irrigation-related pollution are not yet problems because of the limited activities of the two sectors.
3. Because of the lack of a promulgated, effective water law, some negative consequences have resulted from the allocation and appropriation of water. Uncoordinated activities in the water sector have been going on, and hopefully this will be ameliorated with the proclamation of a water law by the end of 1996.
4. In the rural areas water is considered a gift from God, and thus it will be a great uphill battle to inculcate the principle of water having an economic value to the rural population.
5. Acute shortage of trained manpower and lack of standards in the sector.
6. There is a lack of historical data regarding water resources, and whatever is reported as available has not been collected.
7. The demand for water and energy is increasing in all sectors. Eventually, national sources of water will be utilized to address these issues, and this will create problems in water resources management.

3. SUMMARY OF ACTIVITIES

Achievements in water management:

- decentralization of urban water supply administrations;
- acceptance of the proposal for the formation of a Water Board;

- limiting legislative, supervisory, controlling, and monitoring activities;
- popular community participation in water works.

Plans to resolve water management issues:

1. undertake a detailed study of the water resources potential of the country and thus have a clear understanding of the resource.
2. address the issue of sanitation properly and effectively.
3. promulgate and enforce water and waste standards.
4. promulgate and enforce a comprehensive water law.
5. undertake a coordinated and effective water sensitization program among the population.
6. concentrate on human resources development, both in-country and abroad.
7. collect and properly document existing data and make them available to all users.

Areas of cooperation:

1. exchange of available hydro-meteorological data with neighboring countries;
2. mutual exchange of experience with other countries (south-south relationship);
3. using the water-related training facilities of other countries.

4. RECOMMENDATIONS

MEMWR takes the critical nature of water resources situation as the main bottleneck in the development of our region and thus would like to recommend that all the countries of the region tackle this issue in a concerted manner, primarily depending on themselves as far as possible.

Finally, I would like to take this opportunity to thank the organizers of this workshop for the timely holding of a workshop on the burning issue of the day, that is water resources management.

Presented By H. Woldetensue

ETHIOPIA

1. THE NATION'S WATER RESOURCES AND THEIR MANAGEMENT

WATER RESOURCES QUANTITY AND QUALITY

With an area of about 1,129,062 km², Ethiopia's total surface water resource availability is estimated at about 110 billion m³. The area and average annual flow of the 12 river and lake basins as well as the regions and countries sharing the water resources are shown in Table 1.

Table 1. Ethiopian River Basins

River Basin	Area (km ²)	Volume x 10 ⁹ m ³ /annum	Dependable 75%	Ethiopian Regions	Other Countries
Tekeze (Atbara) ⁽³⁾	90.001	7.63	5.73	Tigray, Amhara, Benshagul	Sudan, Egypt, Eritrea
Abbay (Blue Nile)	210.846	52.62	51.48	Amhara, Oromia, Benshagul	Sudan, Egypt
Baro Akobo	74.102	11.81	8.51	Gambella, Oromia, Benshangul, SEPAR ⁽⁴⁾	Sudan, Egypt
Omo-Ghibe	78.213	17.96	14.46	SEPAR, Oromia	-
Rift Valley	52.739	5.63	4.36	Oromia, SEPAR	-
Genale Dawa	171.042	5.88	4.58	Oromia, Somali, SEPAR	Kenya, Somalia
Wabi Shebele	202.697	3.16	2.34	Somali, Oromia, Harar	Somalia
Ogaden	72.121	-	-	Somali	-
Awash	112.696	4.60	4.10	Afar, Oromia, Somali, Amhara, Addis Ababa	-
Afar Denakil	62.882	0.86	0.57	Afar, Tigray, Amhara	-
Aysha	2.223	-	-	Somali	-
*Mereb Gash	-	-	-	-	Eritrea, Sudan
TOTAL	1.123.062	110.15			

*The data for Mereb-Gash have not yet been ascertained.

Water resources availability in terms of space indicates a marked difference when one goes from east to west. The eastern part of the country comprises seven basins with only 11 % of the water resources and two thirds of the population while the west comprises five basins with 89% of the water resources and only one third of the population. The country is also characterized by a high variability of rainfall mostly falling in a single, three month-long wet season which is often unreliable.

The marked variability of available water resources both in time and space will have a major impact on the nation's water resources planning and management and would require storage reservoirs for irrigation schemes and likely interbasin transfers to meet the various water demands of the population.

Moreover, except for the Awash and Omo River Basins, all the other major river basins of Ethiopia are transboundary in nature, 75% of which flow to other neighboring countries (Ethiopia being the source country). This fact also constrains the development of the full potential of the available water resources within Ethiopia. Due to the establishment of a federal system of government in Ethiopia, the major river basins are also shared by two or more regional states and could thus give rise to potential inter-regional disputes over both quantity and quality of the water resources in the future.

There is scant information of the available ground water resources of the country. The current estimate of the available ground water resources is 2.6 billion m³. Since the geological formation of the country is complex, it suggests that there is limited ground water resources though there is some potential for development in the dry lowland valleys.

Over all, Ethiopia is a country which suffers from the effects of recurrent droughts, the major causes of which are attributable to variability of rainfall and to decades of uncontrolled deforestation and soil erosion resulting in ecological imbalances. The country's population, which is currently estimated to be in the order of 55 million and increasing at an annual rate of 2.9%, requires more food, potable water and clothing. Agriculture, the mainstay of the economy, is mainly rainfed, at a subsistence farming level, and characterized by unreliability and low productivity.

Presently, only 20 percent of the rural population and 80 percent of the urban population have access to safe drinking water while only 7 percent of the total population have sanitation services. Thus, providing safe water and sanitation services for both the rural and urban population is a major priority. The other major priority is the improvement and expansion of irrigated agriculture to grow food crops and provide raw materials for local industries and foreign currency earning. On the other hand, the low level of industrialization in the economy is a reflection of the low development of the energy sector.

The above clearly indicate the extent and magnitude of the need for accelerated development of the available water resources of the country. Hence, in the foreseeable future, these resources will have to be tapped and harvested in order to attain food security, maintain sustainable industrial growth, and improve the overall standard of living of the people of Ethiopia.

As regards water quality, there are few activities currently underway to protect water against point and non-point pollution. Monitoring is underway in some areas already known to have poor quality water, such as the saline areas downstream of the Amibara irrigation scheme and industrial pollution downstream of Akaki. New policies and legislation to be introduced by the Environmental Protection Authority (NEPA) should help to incorporate water quality issues into the planning process.

WATER RESOURCES DEVELOPMENT AND POTENTIAL

Irrigation

Until recently, the development of irrigation schemes at all levels has been minimal. However, in recent years, the combination of land degradation, lack of adequate rainfall, and increasing

population pressure have caused a series of crop failures leading to widespread famine. Therefore, in order to stabilize and increase the agricultural production, it has become necessary to increase the momentum of irrigation development.

The potentially irrigable land area of the country is estimated to be 3.5 million hectares. As far as development is concerned, however, so far only about 161,010 hectares or about 3% of the potential has been developed and is used mainly for cotton, citrus fruits, and sugar cane production (Table 2).

Table 2. Irrigation Potential

Basin	Potential Gross Irrigation Area (ha.)	Net Area Under Irrigation (ha.)	% Utilized
Abay (Blue Nile)	977.915	21.010	2.10
Rift Valley Lakes	122.300	12.270	10
Awash	204.400	69.900	34.2
Omo-Gibe	450.120	27.310	6.10
Genale Dawa	435.300	80	0.02
Wabi Shebele	204.000	20.290	9.9
Baro Akobo	748.500	350	0.05
Tekeze	312.700	1.800	0.57
Mereb	37.560	8.000	21.30
Ogaden	None	None	None
Afar	3.000	None	None
TOTAL	3495.957	161.010	4.60

Source: 5th Country Program Improvement of the Resources Population Sustainability Balance; Water Resources Development MNRDEP, 1993

Hydropower

Ethiopia's hydropower potential is in the order of 161,421 Gwh/year. To date, only about 2% of the potential has been developed. (See Table 3.)

Table 3: Hydropower in Ethiopia

(a) Existing Interconnected System Generation (Hydropower)

Plant	In Service Date	Firm Energy (Gwh)	Average En. (Gwh)	Installed Cap. (MW)	Dependable Cap. (MW)
Koka	1960	80	110	43	30
Awash2	1966	120	165	32	32
Awash3	1971	120	165	32	32
Fincha	1973	618	634	110	100
M. Wak	1990	434	543	153	150
Tis Abbay	1983	55	55	11	3

(b) Hydropower Projects at the Planning or Construction Phase

Plant	Capacity	Status
Gilgel Ghibe	180 MW	Under Construction (Completion 1999)
Aleltu	180 MW	Feasibility
Beles	270 MW	Pre-Feasibility
Chemoga Yeda	200 MW	Pre-Feasibility
Halele Weabesa	3430 MW	Pre-Feasibility

(c) Small Hydro Projects

Name	Rated Capacity Kw	Annual Energy Gwh
Neri Stage 1	4000	35
Neri Stage 2	25000	na
Achani	1500	6.3
Aleltu	310	na
Hoha	1100	6.9
WEYIB	1000	1.1

With the establishment of a federal system of government in Ethiopia, water resources management in the country is decentralized to a great extent with federal and state (regional) jurisdiction and the management of water resources provided by legislation.

The Constitution of the Federal Democratic Republic of Ethiopia (F.D.R.E) contains relevant provisions with respect to the management of the water resources of the country.

Ownership of land, both rural and urban, and of all natural resources is vested in the state and the people of Ethiopia as stipulated in Art. 40(3) of the Constitution. Furthermore, under Art. 51(5) of the Constitution, the federal state has the power to enact laws for the utilization and protection of natural resources whereas the regional states have powers to administer the natural resources (within their respective regions) in accordance with federal laws (Art. 52(d)). From these two articles, the federal state has extensive proprietary rights as well as legal and regulatory powers over the management of the water resources of the country whereas the regional states have the responsibility to administer the water resources within their region on the basis of laws and regulations enacted by the federal state.

Although the Constitution gives power to the regional states to administer the water resources within their region, this should be given a wider meaning to include the development and protection of the water resources in the regions.

This power is clearly given in Art. 10(6) of Proclamation 7/1992 which provides that national/regional governments have special powers to administer, develop and protect the natural resources of the regions in accordance with relevant general policy and law of the Central Transition Government.

The salient features are;

- most water users are require to apply for permits from the appropriate authority;

- water fees and charges are to be levied by the appropriate authority;
- permits exempted for use of water by peasants, artisans, miners, traditional fishermen, and persons rendering traditional water transport services;
- permits may be transferred on approval of the appropriate authority;
- obligations of permit holders and the basis for the revocation of permits are outlined.

Although Proclamation No. 92/1994 covers some aspects of the previously drafted National Water Code and regulations, there are some fundamental issues that need to be considered in order for it to be comprehensive and to manage and develop the nation's water resources in a planned and coordinated manner. The following are some of the fundamental issues to be addressed.

- Under the definition of "regional water resources" and "appropriate authority", tributaries of a river existing within a regional state are the responsibility of the region. The regional states are thus responsible to issue permits and levy water charges with respect to water resources found in their regions. This could thus open the basis for inter-regional disputes over water between competing users upstream and downstream in a particular river basin and seems to ignore the dynamic nature of water;
- Under Article 3(2) of the proclamation, a permit is not required for water use by peasants. Thus, although irrigated agriculture requires a permit, it would not be necessary if the irrigation is to be carried out by peasant farmers. This could result in vast quantities of water used without a permit.

Despite some outstanding fundamental issues not covered in the proclamation as cited above, a precedent has been set by the proclamation which covers certain necessary aspects for appropriate water resources management that can be improved upon.

INSTITUTIONAL FRAMEWORK

At the federal government level, the recently established Ministry of Water Resources has the main responsibility for water resources management. Among the major responsibilities of the ministry are:

- to prepare policies for the appropriate management, development; and protection of the water resources of the country;
- to prepare laws and regulations for water resources utilization and protection;
- to determine the means of equitably allocating the water resources of the country for different uses as regards water that flows across or lies between two or more regional states and to issue permits and levy water charges for such purpose;
- to study and prepare policies for the utilization of transboundary rivers and follow up their implementation upon approval;
- to prepare plans for the appropriate development of the water resources of the country and follow-up their implementation upon approval.

The regional states have responsibility for the administration, development, and protection of the water resources in their own regions. There are regional bureaus which have the specific responsibility for the management of the water resources in their respective regions.

Apart from the Ministry of Water Resources, there are other sectoral ministries and regional bureaus responsible for some aspects of water resources management in the country. These are:

The Ministry of Agriculture and Natural Resources and respective regional bureaus - these are responsible for all aspects of agriculture, soil conservation, forestry, fisheries, and livestock and are also responsible for small scale irrigation schemes up to 250 ha.

The Ministry of Mines and Energy and respective regional bureaus responsible for large-scale production and supply of electricity. The latter responsibility is mainly undertaken by an autonomous parastatal agency under the Ministry of Mines and Energy, the Ethiopian Electric Light and Power Authority (EELPA). Thus, EELPA is the sole producer and supplier of grid electricity in the country; it controls generation, transmission, and distribution. The Ministry of Water Resources deals with implementation of hydropower plants. The regional bureaus are involved in small and medium hydropower development, and the private sector is permitted to invest in small or medium-scale energy production.

The Ministry of Health and respective regional bureaus have some responsibility for water quality and water-borne disease.

The National Environment Protection Authority, which has recently been created and falls under the Prime Minister's Office, has general responsibilities for defining laws and policies relating to the environment, encompassing such issues as water quality standards, environmental impact assessments, etc. It will be a regulating and coordinating body while other sectoral departments and agencies will be responsible for implementation.

WATER RESOURCES MANAGEMENT POLICIES

To date, a clear and comprehensive water resources policy is lacking. However, during the past few years, the government has been aware of this fact and is currently undertaking the preparation of a comprehensive water resources management policy which would include all sectors. A committee comprising members from different departments of the Ministry of Water Resources, with the participation of other technical ministries, has been given the responsibility of policy formulation. A workshop where all stakeholders will give their views and present technical papers is also planned at a future stage.

Aside from this, at the macro-economic policy level, the federal government focuses on grassroots development through integrated rural development (including food self-sufficiency) and agricultural-led industrial development. The government has also prepared a National Conservation Strategy and a population policy.

The current policy on hydropower is for the provision of reliable, low-cost power to support industrial development and regional and rural electrification while mitigating reliance on both imported hydrocarbon fuels and fuelwood.

Another important policy prepared in 1994 relating to water resources is the National Science and Technology policy which includes the following:

- supports research that would help improve the quantity, quality, conservation, and utilization of ground and surface water;
- supports efforts toward multi-purpose water resources development for the integrated provision of water resources for agriculture, energy, transport and private use;
- encourages appropriate technology for support of reliable and clean water for rural and urban dwellers;

- supports efforts to develop awareness of the control of sedimentation, watershed management, and the use of rain water;
- facilitates conditions for the expansion of water as a source of energy;
- encourages the use of irrigation schemes of different scales and form to secure reliable production. It is expected that the comprehensive water resources policy will be consistent with the above general policy provisions.

2. ISSUES REGARDING WATER RESOURCES MANAGEMENT

WATER QUANTITY AND QUALITY ISSUES

As most of the water resources of Ethiopia have not been developed to a significant extent to date, the issue of allocation and utilization of water resources in quantitative terms has not raised much dispute among competing users both nationally and internationally.

Due to the federal system of government now put in place and decentralization of water resources management at the regional level, the number of competing users at the national and international level has increased and will have a direct impact unless proper policy, institutional, and regulatory measures are taken speedily. Moreover, there is no international agreement on water allocation between Ethiopia and other neighboring countries.

Demand management policies and strategies will be increasingly relevant and have to be given due consideration with both social culture and economic objectives taken into account.

Very little is known about the ground water potential of the country, and therefore its use is unplanned. This is of considerable importance in the semi-arid areas, so stated policy objectives cannot be achieved without a better understanding of ground water resources.

As regards water quality and the environment as a whole, there is a need to put in place comprehensive legislation setting standards to control and monitor agricultural and industrial pollution as the privatization drive in the country is taking hold at a greater momentum.

POLICY AND REGULATORY ISSUES

As mentioned earlier, there are as yet no specific and comprehensive policies covering water resources management. The whole range of policy issues in water resources management is currently being considered in the Ministry of Water Resources, and it is expected that all stake holders would be involved at one stage or another in the policy-making process.

Due to the federal structure of the country, issues of regulating transregional conflict over water resources management to be based on river basins and the role of the federal government and regional states in planning water allocation and the resolution of disputes should be clearly articulated.

INSTITUTIONAL AND HUMAN RESOURCES ISSUES

The recent establishment of the Ministry of Water Resources at the federal level attests to the fact the water resources in Ethiopia are increasingly being considered as a major resource which require special attention as regards their management and protection.

The policy of decentralization whereby regional states have a greater role in the water resources management of the country is also one major positive step and will enhance participation of stakeholders at the local level. However, clear lines of communication and mechanisms of co-ordination need to be established between the central and regional levels for effective water resources planning and management. Also, inter-sectoral coordination for water resources management is weak and needs to be strengthened. Moreover, although the participation of the private sector and local communities in water management has recently increased, it needs to be further enhanced and their roles clearly defined.

There is also a lack of adequately trained manpower at the policy-making and technical levels in the public sector. One of the reasons for this is the recent proliferation of the private sector in which highly trained professionals have high demand. Moreover, at the study, design, and implementation level of irrigation projects, there is a need to build capacity of local consultants who often lack the necessary material and technical resources to implement projects within the required time frame.

TRANSBOUNDARY WATER ISSUES

The major river basins of Ethiopia are transboundary in nature, and all of them originate in Ethiopia and flow to neighboring countries. This has been a constraint to the full utilization of the potential water resources available within the country in meeting the various water demands of the population.

There are no international agreements on water use and allocation between Ethiopia and neighboring countries. Thus, there will be a need to develop a legal and institutional framework on the basis of equitable sharing of the water resources among the concerned co-basin states. This is specially true of the Nile in that development in the upstream countries such as Ethiopia is being unduly hampered due to a lack of consensus on equitable water allocation.

THE CHOICE BETWEEN RAINFED AND SMALL-SCALE AND LARGE-SCALE IRRIGATED AGRICULTURE IN ETHIOPIA

Although agriculture is the only proven potential resource of Ethiopia and has been the mainstay of the greatest number of the country's population, it is beset with numerous problems. Rainfed agriculture is being affected by degradation of land resources and recurrent drought and irrigated agriculture by rising costs and proscriptive investment policies.

Out of a total area of 122 m ha in the country, 79 m ha. are considered to be suitable for agriculture. However, only about 7m ha. are currently being cultivated, 90% of which is in the highlands (above 1500 masl), constituting 44% of the area of the country. It could thus be assumed that there exists considerable scope for expansion of rainfed agriculture. On the other hand, the frequency of occurrence of drought that was manifest, particularly in the last few decades, is a sign that rainfed agriculture is highly vulnerable to the vagaries of nature in Ethiopia.

Various studies have shown that soil erosion is seriously affecting the land, causing rapid deterioration. Some of these studies have concluded that at the current rate of soil degradation, 75% of the highland region would be unable to support their populations by 2010. Projections indicate that the Ethiopian population will reach more than 250 million in the next 40 years, reducing the per capita land holding from 1.2 ha per person to 0.24 ha. per person in the highland region of the country where rainfed agricultural potential is confined. This will naturally necessitate the utilization of the sparsely populated lowland areas.

Agriculture in the lowlands, however, will not be possible without artificial supply of water through irrigation. The 3.5 million hectares of potentially irrigable area are, in fact, mostly located in this lowland area of the country.

Population support capacity modeling studies indicate clearly that a large part of the irrigable land potential in the country has to be developed in order to assure food security even if it is assumed the production will increase (almost threefold) from the current 7 million tons/yr. to 18 million tons/yr. in 50 years time. While rainfed agriculture is subject to drought from time to time, the potential for small scale irrigation is limited to 250,000 ha.

Large scale irrigation development to date is concentrated in the Awash River Basin where infrastructure is relatively developed. Attempts have also been made at various times to develop large scale irrigation in other parts of the country as shown in Table 4.

Table 4: Cost & EIRR of Irrigation Projects in Ethiopia

No	Project	Net Irrigable area (ha.)	Cost		EIRR ¹	Study Year
			Total Million (USD)	Foreign Compment %		
1	Dabus	5.100	238.5	57	10.0	1982
2	Weito	4.500	101.6	42	12.0	1982
3	Gelana	5.400	120.4	56	0.02	1988
4	Kessem	14.000	235.1	53	0.05	1987
5	Koran Kogoga	1.260	29.2	24	7.4	1988
6	Welkite Darge	1.400	11.9	36	4.4	1989
7	Welkite Kulit	1.400	13.3	35	4.5	1989
8	Amibara	10.300	-	-	13.2 ³	1976
9	Angelele Bolhamo	11.100	183.5	45	13.3 ³	1986
10	Awash Lower Plains	60.000	69.4	-	10.5	1975
11	Koga	6.000	36.6	-	12.07	1995
12	Birr	10.000	34.5	31	3.1	1995

Note: Recommended discount rate = 14%

The studies of irrigation projects in the past show that medium and large-scale projects are unlikely to be viable given the existing (1992) criteria for investment (10% and 11% for combined domestic and foreign sources and foreign borrowings respectively). Cost and benefit comparisons for various types of schemes and crops in Ethiopia are as shown below in Table 5.

Table 5

Scheme Type	Annualized Cost Birr/ha	Capital Cost Birr/ha	Returns		
			Cotton Birr/ha	Sugar Birr/ha	Cereals Birr/ha
Small Scale	1850	7000	1340	3550	1775
Medium Scale	2620	30000			
Large Scale	3500	40000			

It can be seen that only sugar production can cover solely the operating cost. The situation is not different with water supply schemes.

Using the World Bank recommendation of charging four percent of the household income, a recent feasibility study for water supply of eleven towns indicates that there is a huge gap between revenues to be collected and both the initial and the operating cost as shown below. (Table 6)

Table 6

Town	Dupti	Mili	Bati	Wetrota	Aykel	D/Tabor	N/M/ha	Chagri	Bure	Bina	Dejen
FIRR	3.8	4.6	4.6	3.9	6.1	3.7	4.4	4.4	4.1	3.8	4.2
W% of Initial K	50	90	80	60	100	55	75	85	95	65	8585
FIRR W 80% I.K.	8.3	1.9	4.6	7.3	<0	8.3	5.5	3.3	0.9	6.9	2.7

Note: recommended discount rate = 14%

The study concludes that the initial cost is too huge to bear for WSS (water supply and sanitation) in any of the eleven centers.

Water resources development in Ethiopia, as the above discussion indicates, faces tremendous problems. The solution to these problems is wide-reaching and cannot be oversimplified to a few cases such as demand management and the market value of water. The millions of Ethiopians that were affected by drought and those that wander around herding their animals to locate watering points certainly recognize the value of water. It is rather the policy makers and development agents that fall short of recognizing the strategic role that water plays in economic development and the actual benefit that can be derived from it. It will thus be necessary to carry out an in-depth study of the benefits and required measures to solve the above problems. These could be in areas of integrated development, methodology for evaluation of water, capacity building, and policy, legal and institutional measures.

3. WATER RESOURCES DEVELOPMENT ACTIVITIES IN ETHIOPIA

MASTER PLAN STUDIES

Integrated Development Master Plan Projects are under study for Blue Nile, Tekeze, and Baro-Akobo Basins which contribute about 80 percent of the Nile flow. The purpose of the studies is to

enable the country to nationally plan and develop the resources of the basins for the welfare of its people with due consideration of the environmental aspects followed by such undertaking. The studies are expected to establish a scientific basis for all developments that may appear in the basin in view of the country's legitimate entitlement and utilization of the resources to meet the country's short and long term demands.

The master plan studies will also contribute towards the formulation and preparation of the National Development Master Plan which will be based on the detailed study and analysis of the water resources of the country, the demand for them, and their allocation and use.

The Integrated Master Plan Studies will be continued for other basins of the country as funds are available for undertaking the studies. The basins which will be included in the near future are Rift Valley, Wabi Stiebele, and Genale Dawa. In addition, feasibility studies for hydro-power and irrigation will be carried out for selected sites in different parts of the country.

DOMESTIC WATER SUPPLY DEVELOPMENT ACTIVITIES

The domestic water supply situation of the country is one of the lowest in Africa in terms of coverage of safe water supply. Only 27 percent of the total population has access to improved water supply systems. The situation in the rural areas is worse at 20 percent. The situation in the urban areas is better. The systems need rehabilitation and extension work to meet the increasing demands of the people.

To meet the increasing demands, the government has given due emphasis to increase the coverage to both rural and urban areas by the end of the century.

The targets are to provide safe and reliable water supply services to 41 percent of the rural population at affordable costs and at the rate of 20 liters per capita per day and to provide safe and dependable water supply services to 93 percent of the urban population.

The sanitation conditions are worse at present, covering 1 percent of the rural population and 60 percent of the urban population. The target by the end of the century is to raise coverage to 13 and 73 percent, respectively.

To achieve the above goals, construction activities will be carried out for 35 urban centers, and expansion and rehabilitation works will be done for 12 other towns which have inadequate water supply services. Construction of rural water supply services will continue in the different Regional Administrations for a number of communities, with the active participation of the users.

Meteorological Studies

The government has given due emphasis to the collection, analysis, and dissemination of meteorological information for the use of national and international organizations. Meteorological occurrences are transboundary in nature, and exchange of information with neighboring countries and world wide has to be encouraged.

In the next five years, the main activities regarding meteorology are the following:

- to establish and strengthen regional offices;
- to establish and strengthen 1200 meteorological stations which includes early warning stations, climatological stations, and air pollution stations;

- to install and strengthen data collection and communication instruments including DCP (Data Collection Platform) and DRS (Data Receiving System) from satellites and SSB (Single Side Band) radios;
- to strengthen meteorological research and dissemination of information for different uses.

Hydrological Studies

The hydrological network in Ethiopia does not cover the country adequately, and the gauging stations were sited at locations where access was easy rather than representative. To make matters worse, most of these sites were out of order due to security problems and hence were in disuse for a long time.

With the security problem alleviated now, rehabilitation of the gauging stations is taking place actively. However, lack of vehicles and equipment is still a major constraint for adequate coverage of hydrological data collection.

Irrigation and Drainage

A number of large and medium-scale projects has been studied at the pre-feasibility and feasibility levels. Two large scale projects, i.e. Alwero and Gode, are currently being implemented. There are also the Phase I Amibara Drainage Project under construction and Amibara Drainage Phase II with design work being undertaken. All of these schemes suffer from being far behind schedule.

Hydropower

There is a power supply crisis which came about, on the one hand, due to the shortfall in capacities of existing reservoirs because of siltation and occasional rainfall deficits and, on the other hand, due to increasing demand. Efforts have been made to undertake construction of a power plant at Gilgel Ghibe for along time but have not been successful, and the project is being rearranged under a new design and construction contract.

At the same time, medium-scale emergency projects (40-60 MW capacity) have been started at three sites, and the tendering process has just been completed.

Beside the above activities, numerous rural water supply schemes are being undertaken by the regional governments with the assistance of NGOs.

It can be observed that there is considerable activity going on in water resources development. However, the activities tend to be concentrated in the water supply sector. Although water supply should appropriately be considered a priority, development of irrigation in Ethiopia is also essential for food security reasons vis-à-vis the recent history of drought and famine in the country. Foreign assistance in this sector is also much less than it should be.

4. RECOMMENDATIONS

1. Water resources development should be undertaken, fully integrated into the process of economic development and taking into consideration all natural resources. The costs of development per sector can be minimized, and the total benefits can be maximized in this manner, thus relieving the cost burden on water resources.

"A water resources project that does not integrate all resources will not be bankable."

2. Some methodology of giving value to the unquantifiable benefits should be developed so that the real benefits of water resources are recognized and the costs are distributed accordingly. A Canadian (Alberta) example is a good precedence in this respect: after making a detailed analysis of the distribution of benefits, it was concluded that 86% accrued to other sectors and 14% to the irrigation farm, and hence the costs were shared in similar proportions by the irrigation project and the public.

3. The foreign component of the cost of water resources developments imposes great burdens and inhibits water projects.

Policy measures to encourage the private sector should be taken for the production of these components. Since the imports include foreign expertise, capacity building particularly in local consultancy should be encouraged.

4. The development of water resources is regarded as a very powerful instrument for social and economic progress of a country, and it has been established that development of these resources stimulates the chain of activities and helps to raise living standards. Water, therefore, should not be considered an ordinary commodity but rather a super commodity that would cause the existence of other commodities. This fact should be recognized by policy-makers.

5. The major part of Ethiopia's water resources is transboundary and poses great threats to water resources development. Efforts made to resolve these issues are not met with transparency and in such a manner as to face the realities and the consequences. Both co-basin states and other stakeholders should deflect from the current positions before we reach an irreversible situation.

Ministry Of Water Resources - Federal Democratic Republic Of Ethiopia

KENYA

1. OVERVIEW

The drainage system of Kenya is determined and influenced by the Great Rift Valley running approximately north to south. From the flanks of the Rift Valley, water flows westwards to Lake Victoria and eastward to the Indian Ocean with the Rift Valley itself having an internal drainage system. The drainage system of Kenya is therefore divided into 5 drainage basins primarily on account of topography and the natural drainage of the country's major perennial rivers.

These basins have become focal points of regional development, thereby attracting intensive multiple land use which has accelerated environmental degradation through siltation, water pollution, and increased flooding frequency. Further, the multi-sectoral uses of water have created competition among the various water users without due regard to the need for ecological sustenance. This pattern poses serious management problems.

Water quality in most Kenyan lakes ranges from moderately to highly saline, and hence most of the lakes are of little importance from a water supply point of view. However, they have economic and ecological importance including their richness in biodiversity. Exceptional to the above salinity characteristics are Lakes Victoria and Naivasha which are freshwater lakes. The lakes located in the Rift Valley drainage area form closed basins and are vulnerable to pollution effects from the activities in their catchment areas. Such vulnerable lakes include Nakuru and Naivasha.

In order to redress the above problems and to ensure sustainable use of the existing resources, there is need for an integrated approach to management. This entails review of policy and legal mechanisms on water resources, land tenure and land use, Marine national parks and reserves, manufacturing and service industries. Human and fiscal capacities existing within these institutions need to be strengthened. Community participation in the management and conservation of water resources should be improved to ensure sustainable development.

Water Resources Quantity and Quality

The mean annual rainfall over Kenya is estimated at 62 mm while the mean annual volume of rainwater that falls is estimated as 360,000 million m³. However not all of this rain water contributes to the surface and ground water resources due to evapo-transpiration. According to the National Water Master Plan report (1992), the overall national annual water volume potential is estimated at 20,209 million m³, and the projected annual water demand for the years 2000 and 2010 are 3874 and 5817 million m³ respectively. This implies that the demand by the year 2010 will still be less than 30% of the total water resources potential.

However, poor distribution and unreliability of rainfall coupled with lack of planning for rising water demand result in water shortages. Supply and distribution of ground water are influenced by geomorphological factors and seepage rates which are influenced by rainfall intensity and type and expanse of vegetation cover.

Surface Water

The surface water potential from the perennial rivers has been estimated as 19,590 million m³, which represents 5.6% of the national annual rainfall. The availability of this resource for socio-economic and ecological demands is primarily influenced by its quantitative distribution in space and time and its quality. Country-wide distribution is influenced by the mean annual rainfall and also varies from one drainage basin to another. The surface runoff and ground water recharge rates are influenced by variation in rainfall intensity and the land condition.

Generally the quality of river water in Kenya is good. However, this is under threat due to local pollution, particularly where there are intensive industrial, agricultural, or human settlement activities. River water is generally neutral to slightly alkaline with some rivers having slightly acidic headwaters. The concentration of metal ions in most rivers is low.

Ground Water

Based on the available information and data, the annual ground water potential is estimated to be 619 million m³. This is comprised of deep seated aquifers exploitable through boreholes and shallow aquifers exploitable through shallow wells in the ratio of 31% and 69% respectively.

The ground water in Kenya is extremely variable in chemical composition, and the variation occurs both spatially and seasonally. Its quality is essentially influenced by the geological formation in which the aquifer occurs. In Central and West Kenya, the quality is generally soft with moderate alkalinity. From a chemical point of view, the water is satisfactory for domestic purposes. In the Coast, Eastern, and North-Eastern regions, however, the water is saline and of poor quality. In general, the major problem with ground water exploitation is salinity and fluoride levels. In the case of fluoride, its concentration generally exceeds the WHO drinking water guidelines of 1.5 mg/l in many areas. This represents one of the major factors limiting ground water utilization in Kenya.

Status of Water Resources in River Basins

Table 1: The distribution of water resources by major drainage basins in Kenya.

BASIN	SAFE YIELD IN M ³ PER DAY	
	SURFACE WATER	GROUND WATER
Lake Basin	11,993,184	107,926
Rift Valley	208,580	316,833
Athi River	582,336	224,926
Tana River	2,055,456	19,753
Ewaso Ng'iro	674,784	602,181

Source: National Water Master Plan Study, 1992.

Table 2: Comparison between available water resources and future water demand in the year 2010.

Catchment Basin	Safe Yield in m ³ /day		Water Demand in the Year 2010 in m ³ /day			
	Surface Water	Ground Water	Domestic & Industrial	Livestock Demand	Irrigation Demand	Total Demand
Lake Victoria	11993184	118622	1285913	154561	3873456	5313930
Rift Valley	211680	318192	562731	94981	1680926	2338638
Athi River	582336	222319	1465010	50859	3484864	5000733
Tana River	71841600	431499	541110	166089	2180966	2888165
Ewaso Ng'iro	674784	602281	276751	87128	434462	798341

Extracted from the National Water Master Plan, 1992.

Management of Water Resources

Over the years, the exploitation and use of water resources in Kenya have occurred on an ad hoc basis. However, to sustain the socio-economic level and to apportion the water resources to the various development needs, there is a need to have efficient management and well coordinated exploitation and utilization of these scarce and vulnerable resources. Environmental management is one of the critical considerations in order to ensure that the surface and ground water sources are not polluted by wastes resulting from human development activities.

All activity relating to water development in Kenya has been governed by the Water Act. However, a comprehensive policy document on water resources, setting out the objectives of water management and utilization, has been lacking for a long time. However, this shortcoming has now been overcome as a comprehensive National Water Policy has been formulated and submitted to the government for approval and adoption. The policy document will be the guiding policy document in water resources management and utilization. It will guide the management and development of the nation's water resources so as to attain the following broad objectives:

1. To identify, assess, preserve, conserve, and protect available water resources and apportion them in a sustainable, rational, and economic way;
2. To have access to water of acceptable quality and in sufficient quantities to meet the various water needs while ensuring safe disposal of water;
3. To have an efficient and effective institutional framework to achieve systematic development of the water sector;
4. To achieve a sound and sustainable financing system for water resources management and water supply and sanitation development.

However, for this policy to be effective, it needs to be supported by other related policies on land, forests, and the environment.

2. BRIEF REVIEW OF ISSUES FACING WATER RESOURCES MANAGEMENT

Water Quantity/Scarcity and Water Quality/Pollution Issues

Geological, topographical, and climatic factors influence the natural availability and distribution of water in a respective drainage basin with the rainfall distribution having the major influence. In this regard, the status of the water resources varies seasonally from basin to basin in terms of quality and quantity. On the national scale, it appears that the country has more than enough water resources to support the country's development. However, due to its mal-distribution locally, most areas suffer from surface water deficit while other areas have a surplus.

This is confirmed by the national water demand projection carried out under the National Water Master Plan study which revealed that demand by the year 2010 will be less than 30% of the available water resources. In spite of this apparent abundance, access to these resources is still restricted in space, time, and quality. At the local scale it is noted that, in most areas, the water demand exceeds by far the amount of water available. In this regard, most of the areas experience water deficit. In view of the important role that water plays in the country's socio-economic development, there is a need to develop and manage this resource sustainably and equitably on the national scale. One of the main issues, therefore, is to develop water sources in areas of water resources scarcity.

Changing land use practices have also contributed significantly to the aggravation of the water scarcity problem due to encroachment of vital water catchment areas and failure to incorporate water catchment protection into land use practices. The only way out of this problem is to place more emphasis on the appropriate land use practices that take into account their role in water conservation.

In some areas, particularly in the arid and semi-arid areas, extremes of flooding and drought conditions are experienced at different times, and this is an issue that needs urgent attention. The ideal solution to this would be the impounding of flood waters for use during drought periods, but the financial resources required are a major constraint.

It has become clear that surface water availability is limited to a very large extent by its quality. The main contaminants of water resources are silt, agro-chemicals, industrial effluents, domestic sewage, and solid wastes.

Soil erosion is a major problem in many river catchment areas. Hence the total sediment load transported by many rivers is very high in the middle and lower reaches, particularly during the rainy season. This has a direct impact on water quality and the life of the reservoirs, irrigation channels, and the aquatic ecosystems in general.

Industrialization is seen, in most countries, as the main key to any country's development. A lot of emphasis has been placed on industrialization, and Kenya is no exception. However, industrialization has also become the major source of pollution to water resources as the water bodies are the chosen recipients of the liquid and in some cases solid wastes. This is an issue that requires urgent attention and that also requires the existence of a water quality monitoring program to monitor industrial pollution. A water monitoring network comprised of *Reference and Impact Stations* has been developed with the latter being sited at known point sources of pollution specifically for pollution control purposes.

Policy and Regulation Issues

The Water Act Cap. 372 gives the regulatory procedures for the management of the nation's water resources. One of the main issues is the proper apportionment of the available water resources amongst the many competing sectors and users. However, the starting point for dealing with this issue is the determination of the actual quantities and quality of the available water. To obtain this information, water level gauging stations have been established country-wide to monitor the wide variations of hydrological and water quality characteristics of springs, rivers, and lakes within various river basins. Inadequate financial resources continue to be the main constraint in the successful operation of the gauging network. This network is examined, from time to time, with a view to making it more responsive to national needs.

Ground water assessment is occurs on a demand basis. Monitoring is done on the basis of available information from operational boreholes, on an ad hoc basis. However, as surface water becomes scarce in many areas, development of ground water resources is becoming important and hence the need to have a regular ground water monitoring network. Over abstraction of ground water has been experienced in some areas, and in this regard the Water Apportionment Board has gazetted certain areas as ground water conservation areas in order to prevent over-abstraction. In all cases, authorization from the board is required for sinking and abstraction of ground water from deep based aquifers. Availability of adequate and appropriate information and data concerning ground water continues to be a major issue in the proper management of the ground water resources.

Some of the problems which have been experienced in water resources management in this country can be attributed to the weaknesses of the Water Act. They include:

- over-abstraction without due regard to the needs of the downstream riparians and ecological sustenance;
- lack of legally binding environmental requirements to be complied with in water development activities;
- duplication of responsibility leading to lack of accountability.

Conflict in water resources has been witnessed and is envisaged in the following areas:

- (a) preference is placed on urban water supply, and secondary attention is placed on the needs of rural people while carrying out inter-basin transfer of such waters through canals and pipes to urban areas remotely placed from the source;
- (b) on industrial and domestic water needs in urban areas, it has been established that the unplanned development of industrial projects will impose a high demand on existing water supplies thus leaving the basic needs of water for urban dwellers not fully catered for. In many instances, this compels urban dwellers to go for alternative sources of water which at times do not meet acceptable standards for quality and quantity;
- (c) there is conflict between industrial water users and other users in agriculture, fisheries, recreation, livestock, and wildlife supply because most industrial wastewater discharges are rarely controlled in terms of quality, thus impairing the quality for other intended purposes, as a result of pollution;
- (d) there is conflict in land use for water conservation and agriculture with the latter being given more emphasis. The lack of a clear land use policy is a major handicap.

Institutional and Human Resource Issues

There are various players in the management of the Water Resources Programs with the overall responsibility being vested in the Ministry of Land Reclamation, Regional and Water

Development. Others who are involved are Ministries of Energy; Local Government; Environment and Natural Resources; Culture and Social Services; Health; Tourism and Wildlife; Research, Technical Training & Technology, and the Office of the President which administers the District Development Committees. Apart from the above mentioned government ministries, there are other related organizations; parastatals, corporations, non-governmental organizations, and private bodies.

The main issues here are the coordination of the activities of all these actors. It has been observed that there are a lot of duplication and conflicts due to an overlap in the mandates of these institutions. There is a general lack of clear roles for the actors which has precipitated this situation.

Water resources assessment, both quantitatively and qualitatively, is mainly carried out by the Ministry of Land Reclamation, Regional and Water Development (MLRRWD). The Ministry has infrastructure to ensure national coverage in assessment and hence the proper management of the water resources. However, its capacity is lacking in terms of logistical support and in certain cases lack of adequate personnel at the local level. The Basins Development Authorities also carry out water resources assessment within their respective areas of operation. However, these authorities have limited skilled manpower whose operations are also restricted because of financial constraints. Lack of adequate and appropriate equipment is another constraining factor to proper water resources management. In the field of research, we have not done much particularly in the area of land use effects on water resources.

In the past, a lot effort has been directed toward the development of the hardware side with little or no emphasis on the software side of water development. Experience has taught us that the software is just as important as the hardware and that there is need to re-train our personnel to equip them with a broader perspective of water development, incorporating also the environment.

Lack of capacity to undertake environmental impact assessment studies on projects associated with water resources development has been also a major issue that is now receiving attention.

Data and Information Issues

Any valid decision is based on correct and up-to-date data. Water resources management can only be effectively practiced where there is appropriate data and information flow. Proper water resources management, therefore, requires that a comprehensive Water Resources Database be put in place with well defined dissemination and acquisition procedures. In addition to this, the following issues have to be properly-addressed:

1. accuracy of existing data and data updating;
2. how to deal with data gaps;
3. storage of both raw and analyzed data with emphasis on the appropriate format.

Following the National Water Master Plan study carried out between 1990 and 1992, a National Water Resources Database was developed with the objective of storing existing water resources and related data, including the data acquired during the course of the study. The database has since been updated and expanded to cover a wide range of data, both raw and processed, for use by the water sector users. Comprehensive data acquisition and dissemination procedures have been put in place in such a manner that the database will be self-sustaining. Any user is free to requisition any data following the specified procedures.

Transboundary Water Issues

Kenya has a substantial amount of shared water resources. It is also a signatory to various international conventions and treaties governing the management of internationally shared water resources. While these conventions and treaties give guidelines on how these resources should be utilized, they may not have addressed specific regional management and conservation issues. In this regard, it becomes necessary for the concerned countries to come together and chart out strategies on how to manage the shared resources, not only on their use. The end result should be a shared water resources policy that will provide guidelines on the management and utilization of the shared water resources and that clearly stipulates the shared responsibilities.

3. BRIEF SUMMARY OF ACTIVITIES

Achievement in water management

In the past, there was more emphasis on water development, and very little attention was given to management of water resources. This position is no longer valid, and a lot of emphasis is now being placed on water resources management. As a follow up to this:

- the Water Act is being reviewed to reflect this position;
- a National Water Policy, which emphasizes water resources management, has also been developed, and its implementation will ensure proper management and utilization of the water resources;
- a National Water Master Plan which gives an assessment of the available water resources and demands at the national level has been formulated. The plan also gives guidelines on how the nation's water resources should be equitably developed and utilized;
- a Kenya Forestry Master Plan has been formulated. This plan lays a lot emphasis on the role of forests in water conservation. Built into this plan formulation is a Kenya Forest Policy which re-emphasizes this aspect;
- district Water Boards have been created in all districts with the responsibility of managing the water resources at the district level. The membership of these boards is such that all the relevant actors are effectively represented to ensure an integrated approach to water resources management;
- in various districts, Water and Sanitation Committees have been established to address water and sanitation issues and by so doing to assist the District Water Boards;
- as a country, we have formulated the National Environmental Action Plan (NEAP) which brings in environmental concerns to development activities.

Plans to resolve water management issues

Through the new Water Policy and the revised Water Act, procedures are being put in place to resolve water management issues. In addition to this, there is a pilot program aimed at formulating an operational integrated river management system which is expected to be

replicated in all other river basins. There are also plans to develop a National Water Resources Management Strategy which will go a long way in ensuring proper use of the nation's water resources.

At the local level, the District Water Boards and the Water Catchment Boards provide a forum for addressing water rights and resolving any water management issues while at the national level the Water Apportionment Board approves these decisions.

4. RECOMMENDATIONS

1. There is need to diagnose the relationships between climatic factors and stream flow variability in the major drainage basins in the country. This will assist in developing and evaluating specific quantitative indicators of the vulnerability of hydrologic systems to climate as an asset to water resources management.
2. There is need to have a well established and regular water quality assessment and monitoring system covering all the nation's water.
3. There is need to carry out an assessment to establish the full water resources potential of the shared water resources with an aim of putting in place an integrated management and utilization plan for the same.
4. There is need to incorporate environmental impact assessment in water development activities.
5. There is need to improve sanitation in urban areas to be in line with development in water supply as a means of protecting water resources.
6. There is need to develop a National Management Strategy for combating drought and floods.
7. There is need to evolve a strategy which will ensure the management of water resources on a self sustaining basis at all times.
8. There is need to formulate joint integrated water resources development plans for the shared water resources.
9. There is need to harmonize land use, environment, and water policies.
10. There is need to accelerate initiation of the Regional Program on water quality studies.
11. There is need to intensify research and technology activities to bring about efficient utilization of resources, to keep abreast with the most up-to-date, appropriate technology.
12. There is need to review the mandate and roles of the existing water and environmental management institutions with a view to streamlining their responsibilities and operations as well as strengthening their capacities.

Presented By Erastus K. Mwongera, Ebs, Ogw,
Permanent Secretary, Ministry Of Land Reclamation, Regional And Water Development

LESOTHO

1. INTRODUCTION

Lesotho is a land-locked country occupying an area of some 30,700 square kilometers, much of which is a rugged mountainous terrain. Altitude ranges from 1389 meters above mean sea level (m.a.m.s.l.) in the southwest (confluence of Senqu and Makhaleng Rivers) to nearly 3400 m.a.m.s.l. on the Drakensberg mountain range escarpment. The peak, Thabana Ntlenyane, stands at 3482 m.a.m.s.l.

The population of Lesotho is estimated to be 2,028,750 (1994), with a gender distribution of 51.22% (1,039,116) female and 48.78% (989,634) male. 54.7 per cent of the population is working age (15-64 years). Young people under the age of 14 years comprise 40.4% of the population. Nearly 50% of households in the country are classified as poor, with 85% of the population living in rural areas where poverty is much deeper and severe.

Lesotho is minimally endowed with natural resources, except water, air, and human resources. One of the major problems facing the country is rampant soil erosion caused by natural phenomenon such as topography, soil erodibility, high intensive storms. However, these natural phenomena are exacerbated by human activities such as human pressure on the land, mismanagement of the resources (in particular the rangelands because of overgrazing), poor methods of land tillage, inadequate and out-dated land tenure system, etc.

Soil erosion is a critical problem that threatens agricultural production sustainability. The estimated annual loss of soil through erosion totals over 40 million tons as a result of sheet, rill, and gully erosion.

The above figure of soil loss of 40 million tons per annum is distributed as follows: 25 million tons of soil are lost from croplands and 15 million tons from rangelands. These figures indicate that an average of 1320 tons soil are lost per square kilometer per annum.

2. AVAILABILITY OF WATER RESOURCES

Mean annual precipitation (MAP) ranges from 500 mm in the southern and western lowlands and in the Senqu Valley zone to over 1200 mm in the north-eastern quarter of the highlands region.

More than 80% of the MAP is received during the summer months, October to April, as short and intense thunderstorms. During the other months, rainfall is highly sparse and variable. It is during these winter months when the highlands region experiences some patchy snowfall. The contribution of snow to the total runoff is considered to be insignificant. However, there is no sound scientific research to back up this claim.

Current knowledge on the availability of freshwater resources of Lesotho is some 170 cubic meters per second, both surface and underground water.

The Senqu (Orange) River as it leaves Lesotho is assessed to yield a long-term annual estimate of some 115 cubic meters per second. Refinement of these figures is a continuous process (water resources assessment); however, in Lesotho it is retarded by lack of training and development in human resources at all levels of the profession, lack of capacity building at various levels of the community and, most of all, inadequate remuneration for those few with the technical know-how, resulting in continuous resignations from public service.

Recently, inadequacy in water resources assessment is exacerbated by increased vandalism of the hydrometric and meteorological stations, and insufficient funds allocated to the hydrological and meteorological services have curtailed the routine operations. Continuity is the essence of water resources assessment.

In Lesotho, as in most developing Sub-Saharan African countries, the quality aspects of water resources assessment are less understood than the quantity aspects. The main causes are lack of equipment, lack of instruments, and lack of laboratories and technical staff.

Out of a hydrometric network of 80 stations, almost 40% of the coverage monitors suspended sediment transport with an average total sediment yield of 1320 tons per square kilometer per annum.

Other quality aspects of the waters of Lesotho are far less monitored, except on an ad hoc and sporadic basis within the reach of the river passing through the capital city, Maseru. Availability of water quality data is an essential aspect in the management of water resources.

3. WATER RESOURCES MANAGEMENT

In the administration of the water resources of Lesotho, the Water Resources Act, 1978, states that "the ownership of all water within Lesotho is vested in the Basotho Nation".

The act addresses the water resources agencies' responsibilities on surface water and borehole drilling.

Furthermore, the act touches vaguely on pollution control and the rights of the users, water associations, etc. The act does not address the tradability of the water rights.

A philosophy of equity and reasonable allocation of water is totally missing in the present act. The act promotes a "first come, first served" principle. However, during a period of water scarcity, the minister is given the authority to temporarily dispossess the individual users of their water rights and revert the resources to the community.

The act is being revisited, and a draft bill is ready to go for debate in the Parliament. The new or revised act is intended to give the poor population accessibility to the resources they need to improve their livelihood.

The draft bill addresses water quality standards, effluent discharges standards, and the penalties for breaches.

Institutional mechanisms have been put in place so that all public agencies dealing with water are now under one minister, and the draft bill re-emphasizes this issue and sets up a *water apportionment committee* which, unfortunately, has a majority of representatives of government

agencies. In fact, the only non-government members of this committee are from the parastatal agencies. This is not a participatory approach.

In Lesotho water is considered a free commodity, and hence the economic value of water in domestic use is not fully appreciated even in the urban areas. However, it is the urban and peri-urban poor who pay exorbitant prices for water, levied on them by the water vendors due to low coverage of distribution mains in the poor sectors of the towns.

In the urban areas, the current policy is to increase supply and accessibility by eliminating public stand pipes gradually while increasing the number of yard connections.

All rivers originating from Lesotho enter into the Republic of South Africa before reaching the oceans. But, unfortunately, there is no legal framework between the two countries on the use of these rivers. The only exception is the treaty on the water transfer project, the Lesotho Highlands Water Project, which reverses the flow of the Senqu River back into the Vaal River through a series of dams and a tunnel.

Although the government policy has shifted from self-sufficiency in food supply to food security, a number of irrigation schemes has been identified mainly for cash-crops, but Basotho are accustomed maize growers. All the same, there are no mechanisms in place to accommodate tariffs on irrigation water. As such, if this water is valued at its economic worth, then such irrigation undertakings may turn out to be financially unviable and economically infeasible.

4. THE VISION IN WATER RESOURCES MANAGEMENT

Lesotho's future in the water resources sector recognizes that water is life for the nation and hence that dynamic water management policies and strategies have to be developed and implemented. Such strategies, including policy principles, must originate from the people, the users, stakeholders, and interested groups. An enabling environment must be created for establishing planning approaches and designing norms that are appropriate, cost effective, and efficient.

The vision into the 21st Century should be based on participatory planning. There must be a general agreement on the need for a bottom-up approach and farmer participation. There is inadequate understanding of what the process entails and what is needed to ensure its success.

Capacity building, at all levels of the society, will ensure the appropriate degree of participation depending on the type and scale of the project. Tailor-made types of projects for the community will have to be done away with and replaced by community-originated projects.

In some projects it may be sufficient merely to inform the community or to obtain their agreement while for others it will be necessary to consult community leaders for input into the planning process. For other types of projects, full participation is needed. The problem to solve is how far do you go. The answer to this is capacity building and public awareness at the lowest level in the community, the village.

Capacity building and public awareness enhance information dissemination and data acceptance and appreciation because the participatory process does not end with the implementation of infrastructure but continues in the managing, operating, and maintenance processes.

Data exchange and information dissemination are the cornerstones of project planning because it is extremely difficult to withdraw and to back-out from an unsound project once commitments have been made, hence the importance of the first stages of project idealization and program conceptualization. A well-conceived project curbs over-conservativeness which often leads to over-design, possibly resulting in viable projects being turned down on grounds of inadequate water resources or excessive costs. This confirms the notion that water resources assessment is a continuous process.

In order to crystallize the short and long-term options in water resources management, the government has financed a study entitled "Water Resources Management: Policy and Strategies." This study is aimed at taking the country into *integrated water resources management* as opposed to *water resources management*.

The overall attitude in water resources should be "freshwater security for all," whereby policy-makers, water managers, water resources planners, stakeholders, and users cross-fertilize their views on water management, water demand, and cost recovery strategies.

The Water Resources Management: Policy and Strategies study is geared towards assisting and guiding decision makers in water allocation; in the effective administration and management of allocated water; in the conservation and protection of the resources; and in the allocation of investment resources for water development to transfer the highest value from its use to the country.

The Water Resources Management: Policy and Strategies study is viewed to address several policy issues as well as strategies towards attainment and implementation of the water policy. Such strategies must define the available water resources and the sources both in quantity and quality; the demand including location of the users where possible shortfalls in supply must be stated; institutional structures at all levels of the sector; drought management strategies, and the involvement and support of the users and the public; effective legislation and specific legal agreements; and public awareness tasks. On top of the above issues, there must be in place a political will and an enabling environment, where capacity building is the foundation for successful *integrated water resources management*.

5. RECOMMENDATIONS

These recommendations take into consideration the program areas of Chapter 18 of Agenda 21 while bearing in mind that the major theme of Agenda 21 is "the need to eradicate poverty by giving poor people access to the resources they need to live sustainably."

In water resources assessment, there is a need to increase the awareness of the decision makers regarding the value of water resources assessment and that the value of more or better water resources information justifies increased investment.

There is a need for more research into the quantity and quality in the future for the growing populations; hence there is a need to protect the integrity of aquatic ecosystems and to protect their degradation.

Such resource degradation calls for the immediate and mandatory environmental impact assessment of all major water development projects that have potential to impair water quality and aquatic ecosystems.

A community participatory approach must be employed which will improve the willingness to pay and satisfaction of ownership and accountability.

One of the recommendations in water resources management is the introduction and encouragement of the formation and creation of water boards, water-user associations, etc., and these can be achieved by the provision of an enabling environment and appropriate legal framework.

Managerial improvements in water resources development will be achieved by the introduction and provision of market-like incentives as an encouragement for the achievement of adequate service.

Local government authorities have to closely liaise with communities at all levels of governance so as to ensure that standards of service adequately reflect willingness and ability to pay and resource ownership.

The introduction of water levy mechanisms on specific water resources projects will create a fund to be used to address lack of adequate catchment protection measures. Overgrazing is rampant in Lesotho.

Appropriate technologies in water harvesting have to be introduced in order to address water supply shortages during the drought period.

By S. Makhoalibe, Department Of Water Affairs

MADAGASCAR

1. BRIEF DESCRIPTION OF THE NATION'S WATER RESOURCES AND THEIR MANAGEMENT IN MADAGASCAR

1.1 WATER RESOURCES QUANTITY AND QUALITY

The island of Madagascar, with an area of some 592,000 km², a length of 1,600 km north-south, and a maximum width of 600 km east-west, is situated between 12° and 25°30' south latitude, 400 km off the eastern border of the African Plate in the austral intertropical zone.

The repartition of water resources depends on three main factors:

- geological structure;
- geomorphology;
- climatology.

1.2 GEOLOGY

Madagascar is constituted by Precambrian igneous and metamorphic rocks over 2/3 of its area forming the crystalline basement (high plateaus) and over 1/3 by sedimentary rocks.

1.3 GEOMORPHOLOGY

Madagascar is divided into two whole masses:

- a region called the high plateaus, extending over 2/3 of the total area and representative of the weathered and levelled Precambrian basement. This region has properties for water streaming (gradient) and thus surface water resources;
- coastal sedimentary basin occupying 1/3 of the total area. Four basins can be distinguished, the North Basin, the great Western Basin, the South Basin, and the limited Eastern Coast Basin.

In those regions, water can accumulate and constitute ground water resources.

1.4 CLIMATOLOGY

Madagascar has a tropical climate with two distinct seasons, the rainy season from October to April and the dry season from May to September. The annual average rainfall is around 1300 mm with only 300 mm in the southern part and 3000 mm per year in the coastal area.

Based on various differences of precipitation-potential evapotranspiration (P-ETP), we can distinguish five climatohydrological zones in Madagascar.

Zone	P-ETP	Characteristic
I	superior - 1,000 mm	hyperhumid zone
II	from 200 - to 1,000 mm	humid zone
III	from -200 m to 200 mm	dry zone
IV	from -400 to -200 mm	semiarid zone
V	inferior -400 mm	arid zone

All these factors determine water resources. Generally, except in few zones especially in the southern part, Madagascar has an excess water balance. Natural water resources are not

mineralized. However, ground water from western and southern sedimentary formations are more mineralized. Water resources are very rich in iron. Surface water resources are loaded with suspended solid particles which confer reddish tones and turbidity. Chemico-physical data related to surface water are very fragmented because no systematic analysis has been performed at present. Concerning ground water resources, the main hydrogeological area, aquifers, capacity, and quality are as follows:

Region	Aquifer type	Average Depth (m)	Specific Capacity (l/s/m)	Water Quality
Mahajanga (sedimentary in area northwest)	-Alluvium	few	85	presence of iron, bicarbonated
	-Coastal Sand	few	2-15	weakly mineralized, low content of bicarbonate
	-Eocene (Limestone or Sandstone...)	20-100	27-63	calcic bicarbonated with magnesium
	-upper Cretaceous	>100	36 (artesian)	aggressive, rich in iron calcic and calcic bicarbonated
	-Middle and Lower Cretaceous	high	3-60	aggressive, rich in iron
	Jurassic (Isalo)	100-200	19 (sometimes artesian)	sodic chloridized
Antsiranana (sedimentary rock in northern part)	-Alluvium	5-10	0,2-2	calcic bicarbonated
Toliara (sedimentary rock in southwestern area)	-Alluvium	20	1,69-2,54	calcic bicarbonated
	-Coastal Sand	few	0,6-1,05	weakly mineralized
	-Eocene (Limestone or Sandstone)	20-100	14-83	calcic bicarbonated
	Jurassic (Isalo)	100-200	high (>50)	sodic chloridized
Southern-part (sedimentary rock)	-Alluvium	few (<20)	11,8	most mineralized
	-Dune Sand (Beloha)			
	-Coastal Sand and Recent Dune	few (1-5)	0,17	generally bicarbonated
	-Middle Quaternary	few	0,4-2,6	salty
	-Old Quaternary	10-20	0,016-4	very variable
	-Neogene	50-100	0,04-0,55	most salty
		50-150	0,019-1,55	salty
High plateaus	-Alluvium	few	3-6	bit mineralized, rich in iron
	-Weathering Sand	few	0,4	bit mineralized
East coast (sedimentary)	-Alluvium	few	11-28	rich in iron
	-Coastal Sand	few	0,53-6	aggressive, rich in iron
	-Cretaceous	middle (20)	0,18	most mineralized, sodic, and bicarbonated

1.2 WATER LAWS

In Madagascar, the existing water laws are composed of various dispensed regulatory texts, most which are derived from colonial text directly copied from French, already obsolete, very difficult to apply, insufficient, and not at all adapted to the national socio-political context.

It is necessary to better coordinate programs and actions for the benefit of the water and sanitation sector. Therefore, the Madagascar Government, through the National Water and Sanitation Committee, is making an effort to set up new "water laws".

In irrigated agricultural, water resources are very important for field rice irrigation. The law concerning the management, maintenance, and hydroagricultural networks policy defines the hydroagricultural network as well as the respective roles of the users and the state. This law is applied within the limit of the withdrawal policy (see annex). Users apply to form associations and must elaborate a "DINA".

1.3 WATER RESOURCES MANAGEMENT POLICIES

The study entitled "Sectorial Strategy and Action Plan" (SSAP) for water and sanitation sponsored by UNDP and undertaken in 1990 tried to analyze the present situation of the sector in Phase I. Phase II started in March 1993 and focused on setting up the SSAP and an investment program to be undertaken in the short, medium, and long-term. The principal purpose of the SSAP, approved by the government on May 1995, is to apply adequate structural adjustment for the sector on the one hand and on the other hand to improve the standard of living and the welfare of the population.

1.4 WATER INSTITUTIONS

It is often stated that there are a great number of governmental agencies, public services, and other organization dealing with water resources in Madagascar. To better coordinate and follow up the actions, the government has set up the National Water and Sanitation Committee created in 1989. The minister in charge of the plan is appointed as the President of the Committee. The two most important governmental organizations concerned which have essential roles in water resources development are:

- Ministry of Energy and Mines through the Directorate for Water;
- Ministry of Agriculture and Rural Development through the Directorate for Rural Engineering.

Besides JIRAMA, a state-controlled firm formed in 1975 has the monopoly over water and electricity facilities on a national seal and is under the control of the Ministry of Energy and Mines. There are also some NGOs dealing with water supply.

2. BRIEF REVIEW OF THE ISSUES THAT THE NATION FACES IN WATER RESOURCES MANAGEMENT

2.1 WATER QUANTITY (SCARCITY) AND QUALITY (POLLUTION) ISSUES

As regards the water balance, it can be said that Madagascar is one of the well-watered countries. But in some areas, like the southern and south-western parts, severe drought often occurs. Generally, there is no chemical pollution in Madagascar except for those rivers and water table which receive industrial effluents. However, Madagascar faces problems of biological and organic pollution because of environmental degradation (erosion, etc...). There water table level has fallen, and surface water is unsuitable for direct consumption or usage without previous treatment.

2.2 POLICY AND REGULATORY ISSUES

The existing regulatory texts, having not been adapted to the context, are not respected or honored by the users. Social groups do not have the same benefits, and this situation can lead to conflicts between users. Before setting up water facilities, beneficiaries are not contacted. They do not participate in the realization of the project nor of the organizational structure for the operation and maintenance of facilities. They have not been given a reason for this because no one specifically has the responsibility to respond to them. Operation and maintenance cannot be guaranteed in the long-term because of the following factors:

- no framework is organized for the beneficiaries to take part in operation and maintenance;
- running cost and maintenance are disproportionate compared to local finance;
- no periodical maintenance occurs, leading to the deterioration of the facilities.

Additionally, the coordination mechanisms are weak.

2.3 INSTITUTIONAL AND HUMAN RESOURCES ISSUES

In the majority of cases, facilities have been at community disposal without having appointed or set up an institutional organization in charge of management.

2.4 DATA AND INFORMATION ISSUES

The water sector already has two databases:

- one for ground water resources;
- another for surface water resources.

These are insufficient because data must be collected, and there is not enough data sharing among the organizations dealing with water resources.

3. A BRIEF SUMMARY OF ACTIVITIES

Since the colonial period, all water resources data were managed by the public organizations which in charge of hydrology. Since 1992, two databases have been set up:

- Database for ground water managed by the Directorate of Water/Ministry of Energy and Mines;
- Database for surface water resources managed by the Directorate of Meteorology and Hydrology/Ministry of Meteorology and Transports.

Moreover, the first report concerning ground water research projects kept at the Ministry of Energy and Mines was dated in 1990. The main studies, results, and achievements in the region are summarized:

- works and study in the southern area;
- geological, hydrological, and hydrogeological study (1910-1940) by GIRAUD, DECARY, and CARLE;
- geological and hydrogeological study by H. BESAIRIE (1929-1958), with the first test drilling;
- drilling works by the National Public Works Society (SNTP) in 1952-1953;
- Ambovombe drilling works, 1954;
- second drilling work by SNTP in 1955;
- ARCHAMBAULT mission, 1956-1957;
- geophysical prospecting by hand drilling in 1959 by J. De SAINT OURS;
- drilling works by grain Aid and Cooperation Fund (French) in 1961;
- Aerial photographical survey by Geothecnip in 1963;
- geomorphological study (thesis) by R. BATTISTINI in 1964;
- drilling works by the Directorate of Mines/Hydrogeology Division in 1969-1973;
- hydrogeological prospecting conducted for 60 dug wells by European Development Fund (FED). Creation of 140 water points in the southern part of Madagascar by J. MARCHAL and H. RAKOTONDRAINIBE in 1973;
- FED project execution (60 dug wells and 80 impluvia) in 1974-1976;
- water balance and potentiality of Androy area by LONGHI ANTONIO in 1975-1976;
- water resources survey by Land System in 1981-1982;
- JICA project;
- dug well works by the Lutheran Church in 1984-1986.

South Crystalline Zone with low rainfall

- creation of 150 water points by UNICEF in 1994;
- creation of 140 water points by FED;
- water supply project for 9 centres (15 boreholes) by African Development Bank.

Toliara Area (Southwest)

Since 1925, the first dug well for Toliara water supply was completed, and many works and studies were conducted in the area between Manarandra and Mangoky Rivers, summarized as follows:

- KARCHE thesis on eocene limestone aquifer of Mahafaly Plateau;
- execution of many boreholes by USAID in Toliara and Befandriana areas (1965-1967);
- United Nations Project for the Befandriana Plain by BRGM in 1968-1969;
- littoral Plain Study by RANDRIANARISOA, Nhelison;
- ground water development study (1989-1991) and ground water development project (1993-1995) by JICA;
- many works and studies by the Hydrogeology Department, especially by C. DOMERGUE;
- geological and hydrological prospecting by L. FERRY, F. ARTHAUD, B. DUSSARAT, J. RALAIMARO, and J.C. GRILLOT in 1991.

Morondava Area (Southwest)

Execution of hydrogeological prospecting and drilling works by the Hydrogeology Department, financed by USAID (1965-1967) and with BRGM in 1968-1969.

The main aquifers exploited are:

- sandstone Cretaceous aquifer of high productivity (artesian well);
- sandstone Jurassic (Isalo) aquifer exploited at Beroroha;
- alluvium aquifer of Morondava Area, used for irrigation and water supply;
- sand dune aquifer used for rural water supply.

Mahajanga Area

The sedimentary basin of Mahajanga was prospected by:

- the Hydrogeology Department, financed by the USAID in 1965-1967;
- the FAFIFAMA's project with BRGM (1978-1980);
- the Hydrogeology Department project, financed by JICA "Ground Water Development in North-Western region of Madagascar".

The main work was implemented in:

- limestone aquifer (eocene);
- Cretaceous sandstone at Marovoay (flowing well);
- sandstone and sand at Ambato-Boeni;
- river bed exploitation at Antsalova and Morafenobe;
- Jurassic sandstone (Isalo) at Antsohihy.

East Coast

Some studies and exploration were realized by the Hydrogeology Department concerning the main localities of water supply along the East Coast. Dug and drilled wells were carried out by the Hydrogeology Department in rural areas in 1966-1967, financed by USAID.

The main aquifer exploited was:

- alluvium (river bed at Sambava and Antalaha, dug and drilled wells for Fenerive East);
- sand dune (dug well of Mahanoro, Vatomandry, Mananjary, Vohemar).

The main problems issued from those aquifers are generally:

- salt ascent;
- organic pollution from domestic waste.

The High Land (high plateau) of the Centre

The main studies and realizations of the Hydrogeology Department in this region took place on:

- some wells drilled in 1967;
- Alluvium aquifer like the Antananarivo zone in 1973;
- weathering sand at Ambohitrakoho in 1986;
- fissured bedrock.

These few studies mentioned above suggest the following:

- The alluvium aquifer has high productivity. It can produce a specific discharge rate of 25m³/h/m. However, the iron nitration is very high.
- The weathering sand indicates low mineralization and discharge rate.
- Little is known about the fissured bedrock.

The exploitation of the weathering sand and fissured crystalline rock aquifers is important for the following reasons:

- during the dry season, they allow the maintenance of the river's flow-rate;
- they provide water for the rice fields;
- the weathering sand aquifer is the main water supply for the rural areas in High Land.

Northern Region

Very few hydrogeological investigations have been done in this area. However, the surface water resources are markably abundant. Investigations have focused only on the alluvium aquifer under Namakia Plain, Mahavavy River at Ambilobe, the volcanic aquifer of Nosy Be, and the sand dunes of Nosy Be. These investigations suggest the following:

- sand dune aquifer: 10 to 12 m³/h.

GENERAL POLICY FOR THE DEVELOPMENT OF THE IRRIGATED SECTOR

The government strategy for the irrigated sector is to promote the necessary favorable conditions for intensification and diversification of irrigated agriculture. More precisely, the government will encourage the WUA to be in charge of the management and maintenance of irrigated areas which are now essentially performed by the administration. This is carried out by giving technical assistance and by creating groups of farmers' associations. Particularly, the government will:

- focus efforts and resources to improve the institutional functioning of the irrigation sector by defining the capacity of private sectors, public sectors, and operators in the irrigation sector to carry out their responsibilities. Beneficiaries' participation and wishes (demands) will be particularly taken into account;
- reduce government aid and grants to the irrigation sector to a level where it can still fulfill its duties. Diminishing grants and aid will allow the full utilization of existing irrigation substructures and the intensification of agriculture. This withdrawal of public resources are to be used for roads, agricultural extension, agricultural research, marketing information, and the facilitation of agricultural intensification and diversification;
- subject all new investments in the irrigation sector (whatever the financing sources) to the following principles:
 - (i) encouraging full participation of all beneficiaries of the said investments in management and maintenance charges of all irrigation structures (substructures);
 - (ii) taking systematic account of environmental problems so as to assure security and longevity of investments;
 - (iii) assuring satisfactory return from the investments for the beneficiaries as well as for irrigated areas as a whole.

RECOMMENDATION

It must be pointed out that there is a need for help from External Support Agencies (ESA) in order to satisfy conditions for undertaking both reforms and program/projects included in the sectoral strategy and action plan (SSAP) for water and sanitation, and for the ongoing strategy and political issues already applied within the framework of irrigated sub-sectors.

MALAWI

1. BACKGROUND

Malawi is immensely endowed with a variety of natural resources which include, amongst others, rich agricultural soils and vast expanses of water systems. The latter includes Lake Malawi (28,750 km²), Africa's third largest freshwater lake, Lake Malombe (303 km²), an inflation of Shire River, Lake Chilwa (683 km²), and a dense network of perennial rivers. The intensity and methods of use of these resources can, if not properly regulated, result in their serious deterioration and/or depletion.

The growth in population over the years has resulted in an increase in demand for water for domestic consumption, irrigation, power, transport, and other uses. Furthermore, the country's economy has until now been based on agriculture as the main source of foreign exchange earnings, especially estate farming, which itself consumes large quantities of water.

Another area of focus that needs serious attention is the national energy requirement. While the country has marginal reserves of coal as an energy resource, its exploitation and marketing have only benefitted the urban industrial sector and have not yet become an alternative or substitute to woodfuel which is the single largest energy source in the country, meeting more than 95% of the energy demand in the rural areas. As a result, deforestation has increased over time from subsistence level to the current commercial scale in order to satisfy demand for wood energy and for survival.

The tourist industry in Malawi which derives its base on the natural beauty of the country, while being in its infancy, plays a major role in the economy of the country. Unfortunately, cross-border migration of tourist facilities such as boats and dinghies can result in the introduction of exotic aqua-culture into the country's water systems, resulting in the infestation of the systems. In most cases, the resultant damage is irreversible.

In other sectors of the economy, the government has implemented projects aimed at import substitution. However, the extraction of natural resources for the manufacture of these substitutes has had an adverse impact on the environment which in turn has affected water as a resource.

Finally, the excessive use of chemicals in agriculture either as fertilizers or as pesticides, the unregulated discharge of industrial effluent into water systems, and the careless disposal of domestic waste all have a detrimental effect on the quality of water and its management.

Water as a finite resource must therefore have a policy that guides its conservation, allocation, and utilization, and strategies to achieve these policy objectives. To this end, the Government of Malawi has put together a Water Resources Management Policy to guide the country in the sustainable use of water and in sanitation.

2. EXISTING WATER RESOURCES QUANTITY AND QUALITY

Malawi has an ample supply of surface water in its rivers and lakes. Apart from the lakes and the Shire River, availability depends to a great extent on seasonal rainfall. Generally, recharge of the deep aquifer is limited to the wet season. This, in combination with a marked seasonal variation in rainfall, means that runoff normally drops very quickly during the wet season. Without a persistent base flow in the dry season, many streams and rivers dry up for one or several months.

Hence, the marked seasonal variation seriously limits the potential of many streams and rivers as reliable raw water sources for water supplies, at least without storage. There are no major storage reservoirs, but there are a number of medium-sized and small structures, primarily in the estate sector. A few recently constructed large water supply schemes are, however, based on dams and reservoirs, such as the Mzuzu Municipality, Kasungu Town, and Mpira-Balaka Rural Piped Water Supply scheme.

With an area of about 28,750 km², Lake Malawi is the third largest freshwater lake in Africa. It is used for a range of functions, including navigation, lakeshore water supply, irrigation, fishing, recreation, and, indirectly, hydropower. Its level fluctuates widely; the variation this century has been some six meters between a low point in 1917 and a high point in 1980. This, of course, presents problems for a number of the above functions.

Most surface waters can be classified as soft to moderately soft water (typically < 100 mg CaCO₃), with total dissolved solids < 100 mg/l. The major water quality problem with surface waters, particularly the smaller streams, is a high content of suspended solids during the wet season, which poses problems for water supplies. The problem is aggravated by soil erosion due to population pressure which has resulted in deforestation and cultivation of steep slopes in the upper catchment areas. A deterioration of the bacteriological water quality of the surface waters is also caused by habitation activities in the upper catchment areas.

The presence of ground water in Malawi is associated with two main types of aquifers: the extensive, but relatively low yielding, weathered pre-cambrian basement complex which underlies approximately 85% of Malawi and the higher yielding, quaternary alluvial deposits in the lakeshore plains and the Shire Valley. The yields in the weathered zone are typically 1-2 l/s, while yields up to 15 l/s have been obtained in the alluvial zone. Ground water in the basement complex is found mainly in the in-situ weathered zone overlaying the fresh rock. As the lower part of this weathered zone is the most productive, ground water abstraction should be based on boreholes drilled to a depth averaging 50 meters.

In some areas, the weathered zone is very thin because of erosion. In these areas, fractures must be located as they may be the only places where perennial ground water can be found. However, the fractures are often associated with late tertiary faulting and can yield saline ground water, which makes the fractures not suitable for water supply. In addition to the fact that the boreholes penetrating alluvial deposits generally have higher yields than boreholes drilled into the basement system, the static water levels are most often quite shallow (4-8 meters) in these deposits.

The ground water in the basement aquifers is characterized by the dominance of alkaline earths in the cation group and by the carbonate system in the anionic group. Total dissolved solids are typically around 350 mg/l and generally < 1000 mg/l. The ground water quality in the alluvial aquifers is generally more mineralized than the weathered basement aquifer. Some chemical

parameters are causing problems for water supplies in some areas. The main parameters causing problems are iron, fluoride, sulfate, nitrate, chloride, and total dissolved solids.

Malawi is divided into 17 Water Resource Areas. Each Water Resource Area consists of a river basin, and most Water Resource Areas are again subdivided into sub-basins called Water Resource Units. Details on this are attached.

The National Water Master Plan (1986) has characterized surface water resources as soft throughout the country, however these resources are being threatened by the use of chemical and industrial waste. The extensive opening up of land for agriculture use is equally threatening the quality and quantity of both surface and ground water resources. Measures are currently underway to look into these shortcomings. These are being performed through the National Water Development Program, the Natural Resources Management and Environmental Support (NATURE) program, and the National Environmental Assessment Program.

3. WATER RESOURCES MANAGEMENT POLICY

The water resources management policy in Malawi has evolved with time, basically being dictated by the level of political and administration economical development that the country experienced in the early days during the colonial era. Emphasis was on serving white settlers in the agricultural field and towns and administrative posts. As Malawi got independence, the policies had to shift towards satisfying a larger population than before. In 1980 the government decided to put together all government activities concerning delivery of water services and water resources management in an attempt to fulfill this. Thus the creation of the Department of Lands and Valuation and Water took place to provide surface water resources, ground water, water supply, and sanitation and irrigation services. In 1986-96 the government issued a statement of development policy. In this document the government consolidated policies and strategies including those for water resources development and management. The emphasis was on provision of potable water for all people of Malawi. The policies and strategies for irrigation (energy) hydropower, fisheries, transport (navigation) etc. that benefit or affect water resources management were also elaborated. In 1993, having recognized that there was neither a comprehensive water resources management policy or strategy, the government initiated and completed their development and published such a document. This document has stipulated the following statements which form the broad policy framework.

1. Water should be managed and used efficiently and effectively so as to promote its conservation and future availability in sufficient quantity and acceptable quality.
2. All programs related to water should be implemented in a manner that mitigates environmental degradation and at the same time promotes the enjoyment of the asset by all.
3. The approach to allocation of water should be designed in a way that recognizes water not only as a social but also as an economic good, and in a manner that achieves maximum benefit to the country.
4. In planning and providing water supply services, consideration should be given to safe disposal of the resultant waste water.

5. Investment of public funds in water and water related programs should be guided by the expected net economic, social, and environmental benefits of the program to the country as a whole.
6. The government shall facilitate the participation of stakeholders (including users and special target groups) both in the public and private sectors to ensure that the needs of relevant interests are taken into account in the development of water systems.
7. The pricing of water should reflect demand and the costs of water services. Pricing policy should aim at the reduction of government financial support to the sector over time.

This policy document will further be reviewed to ensure that minimum problems arise with the current environmental management policy and strategy that are currently being developed. It will also be reviewed in the context of policy and legislation in fisheries, forestry, wild life and national parks, mining etc. as part of consolidating natural resources management policy strategy and legislation which aims at improved sustainable development in Malawi.

4. WATER RESOURCES LAW AND ADMINISTRATION

NATIONAL WATER POLICY FORMULATION

The legal instrument currently available for the regulation of Water Resources is the Water Resources Act, 1969. This act replaced the Waterworks Act, 1926. Whereas the earlier act gave power to the Water Undertaker to manage the resources and guided the *modus operandi* of the management of water systems, the 1969 Act sets guidelines for the allocation of water for various uses and the monitoring of its quality. The Water Resources Act, 1969, was amended in 1990, resulting in the Water Resources (Amendment) Act, 1990.

Complementary legislations are the Blantyre Waterworks Act, 1971, and the Lilongwe Waterworks Act, 1987, which give legal status to the Blantyre and Lilongwe Water Boards to operate water works in cities of Blantyre and Lilongwe, respectively.

WATER RESOURCES ACT, 1969

Whereas the Water Resources Act, 1969, gives the President authority over all water resources in the country, the duty to oversee the application of the legislation rests with the minister responsible for water through a Water Resources Board which the minister appoints.

It is generally accepted that current legislation on the use of water resources has evolved in a piecemeal manner to respond to ambient demands. Several areas where it is weak have thus been identified, necessitating a review aimed at strengthening areas where it lacks flexibility, notably in the devolution of certain functions to subsidiary regulations.

Complementary regulations have not been developed to cover comprehensively specific issues of sanitation in so far as these relate to water resources and the control of aquatic weeds and hazardous wastes that have adverse effects on the environment.

THE WATER RESOURCES BOARD

As has already been mentioned above, the legal authority for the management of water resources is vested in the minister responsible for water who in turn delegates this function to the Water Resources Board.

Membership on the board is for a term of three years after which period the minister has to appoint new members. Although this is required by legislation, no changes have been made to the membership for a long time, and it therefore means that ministries have most often delegated functions to officers of such low rank as to be unable to take decisions.

The functions of the Water Resources Board include the granting of water rights for abstraction, the provision of consent to discharge effluent into public waters, the determination of acceptability of civil water works and the provision of right of easement where this involves two or more owners. The functions include collaboration with other institutions responsible for environmental monitoring and control, for instance, the Department of Research and Environmental Affairs, Forestry, and, the Ministry of Works. The Board is also responsible through its technical subcommittee for the regulation of the flow of the Shire River which is vital for the energy supply of the nation.

The Parliament passed the Waterworks Act, 1995, establishing Regional Water Boards in the three regions of Malawi that will takeover the establishment of existing water supply and sanitation delivery services in the urban and semi-urban centers in each of the three regions. Like the water resources management policy, water-related legislation will also be reviewed under international program in order to improve environmental management and other natural resources management legislation.

5. INSTITUTIONAL AND ORGANIZATION MANAGEMENT

The Water Resources Act established a Water Resources Board which is the main regulatory institute dealing with location, protection, conservation, and utilization of water resources of the country. The board members have been prescribed in the act and consist of public sector holders in water resources management. The minister has powers under the act to include six more members from private and individual sector holders who have interest or experience in water resources management. With this act, the users of water resources apply for and are granted a water right from the minister responsible for water resources through the board. On the other hand, the water department is responsible for water resources management and water supply and sanitation. However, when the regional boards are fully constituted, responsibility of water supply and sanitation will be transferred to them in urban and semi-urban areas only. The Irrigation Department is responsible for the planning, development, and management of public irrigation schemes. There are also private irrigation schemes of which the major ones are Sucoma and Dwangwa Sugar Corporation with more than twenty thousand hectares and a water demand of more than 50m³/s. The hydropower development is run by the Electricity Supply Commission of Malawi which has developed a total capacity of 170 mega watts, mainly on the Shire River. Very few private hydropower plants have been installed.

6. MAJOR WATER RESOURCES MANAGEMENT ISSUES AND CONSTRAINTS

THE NEED FOR A WATER RESOURCES MANAGEMENT POLICY AND STRATEGIES

The water resources of Malawi are relatively abundant. They are, however, coming under increasing pressure. Land use is intensifying, causing increased demand and a range of actual and potential threats to the quality and availability of water. At the same time, water supply and water-borne sanitation services are proving difficult not only to expand to meet the needs of communities in a number of areas but also to maintain in good operating condition.

The water sector is at a turning point. Unless new and pro-active approaches to water resources management and the provision of water services are developed and adopted, the water sector will increasingly be characterized by water services which fail to provide effectively and efficiently for an increasing proportion of the population, and by water resources that will be degraded in quality in a number of areas.

A coherent set of policies guiding the management of water resources and the efficient and responsive provision of water services, supported by strategies and proposals for change to ensure their implementation, can provide a route to a new and positive future for the water sector in Malawi and for all those who benefit from it.

POLICY FRAMEWORK

A set of statements of policy are proposed to guide the sustainable management of water resources and the provision of services. They cover:

- the management and use of water for conservation and environmental protection and for the benefit of the community;
- stakeholder involvement;
- the allocation of water;
- the investment of public funds; and
- pricing.

They prescribe how decisions should be made on the management of resources and the planning and provision of services, to secure maximum benefit for all those who may be affected and to ensure that water resources are well managed and protected.

OVERVIEW OF THE WATER AND SANITATION SECTOR

It is only from an understanding of the status and condition of the water resources of Malawi and of water and water-borne sanitation services to its communities that a true assessment can be made of the problems that resources and services face and of the opportunities for their solution.

The geographical distribution of surface and ground water resources, the current status of their development and use, and adverse effects on water quality resulting from inappropriate land use indicate that Malawi's water resources, although relatively abundant, are coming under pressure in some areas.

Malawi's infrastructure providing water supply and water-borne sanitation services is characterized by rapidly growing demand and difficulty in ensuring the financial and physical sustainability of existing schemes.

The legal and regulatory structure for water resources management, the institutional and organizational arrangements under which the water sector operates, the pricing and tariff arrangements, and the practice of most water supply systems of obtaining funding from central government sources rather than from those benefitting directly from the services are all arrangements and practices which, though no doubt appropriate in days gone by, act today often to discourage effectiveness, efficiency, and responsiveness to the needs of the community.

Degradation of water quality is resulting from increased suspended solids and turbidity, caused by deforestation and inappropriate land use. Inadequate sanitation and waste disposal arrangements in many settlements are resulting in increasing contamination of water resources, with potential risks to human health. Improper application of agricultural and hazardous chemicals and industrial wastes also present risks of contamination to receiving waters. The legal and institutional arrangements for national environmental management have been recognized as needing to be upgraded to enable more effective management of multi-sectoral environmental issues.

7. STRATEGIES FOR WATER RESOURCES MANAGEMENT

OBJECTIVES

The water sector in Malawi is characterized by rapidly growing demand and difficulty in ensuring the financial and physical sustainability of existing schemes. The existing water supply and sanitation services were fragmented among several ministries and institutions with inadequate coordination between them. Water and waterborne sanitation programs are largely centralized, and technologies being utilized are in many cases inappropriate for the users. Community participation is lacking in most cases, resulting in relatively centralized systems of operation and maintenance which are expensive to run. At the moment, supply of water to the rural community is free, a practice which tends to create a pattern of services and facilities not well matched to the needs of the community and difficult to sustain.

As a result, Malawi has seen the need for considerable investment to rehabilitate existing systems and extend services to new areas. Revenue is insufficient to provide any funds for capital requirements and in some areas insufficient to fully fund operations and maintenance with no provision to cover depreciation. The reasons for this include an established and justified government policy to provide financial support to those unable to pay for basic domestic services. The appropriate response to these problems requires an integrated set of strategies, leading to actions which will lower operating costs, reduce water losses, better match technology and service with the level desired by the communities served and with their willingness to pay, and reform pricing policies and practices. The performance of the sanitation sector also requires strengthening. The coverage is low, and rapid urbanization has resulted in the production of waste in quantities far beyond the capacity of the sector agencies, causing pollution of the environment from public waste.

While it is recognized that Malawi is endowed with abundant water resources, the distribution of these resources sometimes restricts its optimum development and use. The government therefore

seeks to undertake a number of initiatives in the water sector, including further reform and development of the institutional arrangements of the sector, the provision of new and upgraded infrastructure and services, and management of the nation's water resources. Its aims are to ensure that the water sector makes a strong and lasting contribution to the achievement of objectives in the areas of community health and welfare, economic development, and environment protection.

THE OBJECTIVES OF THE GOVERNMENT FOR THE WATER SECTOR:

Community Services

To ensure that all citizens of Malawi have and will continue to have convenient access to water in sufficient quantity and of acceptable quality for basic needs or drinking, cooking, washing, and personal hygiene, and to have available adequate sanitation; and such higher levels of services as communities agree as appropriate to their requirements and for which they confirm their willingness to pay in cash or kind.

Economic Development

To provide water infrastructure and services that will underpin the development of all sectors of the economy and to do so in the most economically efficient manner.

Environment

To manage water resources and implement, operate, and maintain water facilities for the benefit of the community and the preservation and enhancement of aquatic and riparian environments.

The current Water Resources Management Policy and Strategies document provides Malawi with a set of policies to give broad guidance to the formulation of strategies and actions to help achieve the objectives.

To make the the policies effective and to ensure that maximum benefit is gained from the deployment and use of the limited human, financial, and water resources that are likely to be available, a set of coordinated strategies are required. Strategies are required in the areas of:

- institutional capacities and human resources of the sector;
- environment protection;
- sanitation;
- investment allocation;
- stakeholder involvement;
- water allocation;
- the pricing of water.

Strategies in the areas of investment allocation, stakeholder involvement, water allocation, and water pricing should all be based on a common understanding of the value which a community attaches or should attach to water, and accordingly the concept of the value of water needs to be developed as a precursor to each of these four strategies.

In seeking to implement the policy and achieve the government's objectives in each of the above areas, the strategies contain, among other things, the following:

- an integrated approach is proposed for the provision of expanded water supply and water-borne sanitation programs to both rural and urban areas;
- improved approach to water resources development and allocation and the efficient use of water will be important factors in upgrading the institutional arrangements for the water supply and sanitation sector. When water resources are scarce, priority will be given to the provision of drinking water. All users of water will be encouraged to conserve water;
- decentralization of the sector should include appropriate mechanisms for channeling funds to sector institutions from government, whether the funds are sources from government or via the government from donors;
- human resources development is invariably the most difficult problem faced by the sector, but this needs to be implemented continuously both in the short and long-term;
- availability of resources should be one factor in determining whether or not a program should be implemented.

8. CHANGES REQUIRED TO IMPLEMENT THE POLICY AND STRATEGIES

INSTITUTIONAL ARRANGEMENTS

In order to achieve the aims of this policy, there is a need to strengthen the existing central policy advisory body through the reconstruction of existing institutions and a more appropriate allocation of responsibilities. It is recommended that this be done as a matter of urgency. The current functions of the Water Resources Board should be reviewed and strengthened as described in this document. Its membership should include representatives of stakeholders as well as other ministries, and these should be at the highest level possible to facilitate on-the-spot decision making. In addition to policy, the Water Resources Board would have the primary responsibility of managing the nations' water resources and act as a central policy regulatory body.

DECENTRALIZATION

Decentralization of the implementation and operational functions of the sector is an immediate need. This should include appropriate mechanisms for channeling funds to sector institutions. Decentralization will result in rapid improvements in efficiency and greater user satisfaction. Three regional water boards should be formed and made operational.

SANITATION

The institutional arrangement for the management of sanitation should incorporate the capacity for integrated policy-making, to ensure that the minister responsible for water affairs has a

combined responsibility for both water and sanitation. All sanitation activities should be undertaken by the local Water Boards, enabling current operational deficiencies to be redressed.

ENVIRONMENTAL MANAGEMENT

A legal framework should be enacted, encompassing national conservation principles, to empower and support the government in achieving its conservation objectives for the environment. A central environment regulatory body, possibly based on a strengthened Department of Research and Environmental Affairs, should be created and charged with assuming this role for the government. Its role and obligations should include coordination of those ministries and departments whose activities may affect water supplies, sanitation, and aquatic environments. In support of environmental objectives, all new water and sanitation projects should be supported by adequate environmental investigations.

9. CAPACITY BUILDING

SUSTAINABLE DEVELOPMENT OF WATER UNDERTAKINGS

To achieve a level of skill and expertise sufficient to ensure sustainability of the developmental, operational, and maintenance activities of the water services undertakings, a target will be adopted so that by the year 1999-2000 greater than 50% of all rehabilitation and new system implementation will be undertaken with Malawian human resources, with minimal foreign technical assistance.

HUMAN RESOURCE DEVELOPMENT

A program of training and staff development will be initiated to ensure a continual upgrading of the skills and expertise of the staff of all agencies of the water sector, encompassing all disciplines and all levels of staff, sufficient to enable the above target to be achieved.

CENTRAL SERVICES TO THE WATER INDUSTRY

Within the Water Department, existing capabilities should be reorganized and strengthened to enable it to provide a full set of key central services for the water sector.

10. STAKEHOLDER INVOLVEMENT

Decisions on water resources management and infrastructure services often require subjective judgments and detailed local knowledge. Neither governments nor aid agencies are suitably equipped to make judgments on how local people value these services and their environment.

The process of local stakeholder involvement therefore is essential to ensure a sense of ownership, contributing to efficiency, sustainability, and project success, especially when participation takes place through arrangements created and managed by the beneficiaries themselves. It is,

therefore, proposed that the involvement of stakeholders in the development of the sector be promoted and strengthened.

11. WATER MANAGEMENT

A new, more integrated approach to water management is recommended, as discussed in the strategies, to guide the allocation of water, the allocation of investments, and the pricing of water services. This new approach is based on the continuing recognition of the social value of water while giving much more attention to the economic value of water, at its source and in its various uses. Allocation of both water and investment in water-using schemes aims at achieving the maximum net benefit to Malawi from its water resources now and in the future. Appropriate and feasible technologies will be encouraged and promoted which lead to optimal levels of water conservation. Increased coverage and expansion of efficient and financially sustainable water schemes will be most strongly and rapidly supported by providing services which people want and are willing to pay for in cash or in kind, and by charging for services on this basis. Continuing government financial support should be reserved for services for those who prefer a basic service level to their existing or traditional source and who cannot pay in cash or in kind for such services, as well as for those aspects of service, such as advanced treatment of water borne waste, which reduce water pollution and provide substantial benefits to more people than the users of the sewer system.

In other water services development schemes, the users will be expected to pay the full cost of the service in cash or in kind.

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MOZAMBIQUE

1. INTRODUCTION

The water sector in Mozambique is undertaking a major review in order to meet the governments objectives in improving the provision of water related services and to adapt existing structures to the new political and economic conditions of the country. This report describes the present situation in the water sector.

2. COUNTRY DATA

Mozambique lies on the east coast of Africa and has a land area of 799,380 km². It is crossed by 10 major rivers systems which flow to the Indian Ocean. The average temperatures lie between 18°C and 26°C, being generally higher in the north and towards the coast. Average relative humidity at the coast is around 71%, falling to 64% inland. Potential annual evapotranspiration ranges from about 700mm to 1,600mm. This compares to an average annual rainfall which varies widely from 300mm to over 1200mm. The rainy season normally lasts from November to March.

Mozambique is largely a rural society. In 1980, population census indicated the population to be 12 million. Estimates based on later partial census data suggest that the population is now about 16 million, of which 3.2 million live in urban areas.

World Bank reports classify Mozambique as the poorest country in the world. Just before Independence in 1975, the economy went into sharp decline. This was inverted in the late seventies to reach its post-Independence economic peak in 1981. Since 1987, the economy has again grown slowly. Around 70% of rural and 50% of urban households live in absolute poverty. This is reflected in the high mortality rate, which for children under five years is 273 per 1000 live births.

3. WATER RESOURCES

3.1 AVAILABLE WATER RESOURCES

The main source of water in Mozambique is surface water. Around 216,000 million cubic metres of surface water are potentially available, an average of about 50m³/day/person (compared to the world average of 27m³/day/person). However, only 46% of this originates from local rainfall, and the irregular distribution of rain during the year means that considerable water storage is required to make use of this water.

More than 100 river basins can be identified, most of which flow to the Indian Ocean. Most of these have torrential flow regimes, flooding during the wet season. Many have no flow during the dry season, especially in the south where almost 90% of the flow comes across international

borders. There are also two large natural lakes, both shared with neighboring countries. The area of Kale Niassa within Mozambique is 7,000km² and that of Lake Chigue is 7km².

The availability of surface water resources is monitored by the hydrological network. In 1975 this consisted of 260 flows and 340 rainfall stations. Due to security problems this was reduced to 60 flows and 75 rainfall stations by 1990. Flood warning systems have been installed on the Incomati and Limpopo Rivers, with a network of 20 receiver-transmitters feeding a flood routing model. Similar systems have been designed for the Buzi and the Zambezi but have not yet been installed. There is a national sampling program for collection of water quality data on international rivers but no routine sampling of sediment load. Specific studies have been undertaken on salt intrusion in estuaries and sediment load in six of the major rivers. All the existing hydrological data is available on computerized format at the National Directorate for Water.

Ground water resources can be divided into three main hydrogeological units which are described in detail in the national Geohydrological Map. The Crystalline Complex, covering the north-west of the country, contains two types of aquifers, those in the saturated zone and those in fractured rock. Typical yields are 1-2m³/h, rarely greater than 6m³/h. Low uneconomic yields (0.5-0.8m³/h) are also encountered. The degree of mineralization depends on the water bearing formation and typically lies between 700mg/l and 1,500mg/l. Little information exists about aquifers in the Karro Formations, found mainly in the inland areas of the center of the country. Some wells give yields of 2-5m³/h, but the water is highly mineralized with total dissolved solids up to 7,000mg/l. The Post-Karro Formation found south of the River Save and along the coastal areas in the north contain highly saline waters unsuitable for consumption.

Near surface aquifers, suitable for low-yield hand-pump extraction, can be found in nearly all parts of the country except in some parts of the Crystalline Complex. The best ground water resources are to be found in the productive alluvial aquifers along the various major rivers. These have been developed for water supplies to Pemba, Xai Xai, Tete, and Chokwe. The main constraint in the use of ground-water is often water quality, for example, the high population densities and increased use of latrines in peri-urban areas have lead to severe ground water pollution, making ground water from shallow wells unfit for consumption.

3.2 WATER DEMAND

The consumption of potable water for urban domestic use is now about 25mm³/year. This is far from meeting the demand of the existing population. By 2002 an improved coverage with 70% of the urban population being served would result in a consumption of 56mm³/year.

In rural areas typical water use is 10-12l/p/d and falls to 4l/p/d in areas distant from a water source. At the present level of access to improved supplies the consumption is estimated to be 28mm³/year. To reach the target of coverage -40% of the rural population with access to improved sources and high levels of consumption (around 20l/h/d)- would result in increased demand to 58mm³/year.

Industrial and commercial demand in urban areas is now about 12mm³/year, of which two thirds occurs in the City of Maputo. Other industrial centers are Beira, Nacala, and Chimoio. This demand is likely to increase to 20mm³/year by 2002.

Present estimates indicate that about 98,000 hectares of irrigation have been constructed, of which about half is in use with an annual demand of 540mm³/year. This demand is expected to double by 2002 when all the irrigation areas have been rehabilitated.

Electrical power production capacity within Mozambique is estimated to be about 12,000MW of which 2,160MW have already been developed.

3.3 WATER CONTROL STRUCTURES

Twelve large dams have been constructed, with a total storage capacity of 44,900mm³. The two largest are Cahora Bassa and Massingir, with capacities of 39,200mm³ and 2,260mm³, respectively. Cahora Bass and Chicamba are for hydroelectric generation. The others are multi-purpose. Two dams, Massingir and Corumana, have problems of infiltration. Massingir is now being rehabilitated; the problem at Corumana is under study. Three other dams are planned, Moamba, Bue Maria, and Montepuez. A survey in 1974 registered 600 small dams, but many of these are thought to have been destroyed. There is no information on the degree of reservoir siltation.

There is no central government structure with clear responsibility for land drainage, river flood control, and coastal protection structures. The little maintenance that is carried out is done by local authorities or those with economic interest in the areas concerned. Flood protection dikes are principally found around irrigation areas in the Limpopo and Zambezi Valleys. Land drainage is associated with irrigation areas or the agricultural zones Maputo and Beira. The coastal cities and towns, especially Beira and Maputo, have severe problems of coastal erosion. In these two cities, projects have been prepared for the rehabilitation of the coastal works.

3.4 INTERNATIONAL RIVERS

Almost all major rivers in Mozambique are international rivers, and water consumption by upstream riparian states reduces the availability of water for the future economic development of the country. South Africa, Swaziland, and Zimbabwe now abstract 40-60% of the flow. In the semi-arid southern provinces, only 10% of the natural river flows are generated within Mozambique. As a result of this consumption by neighboring states, the previously perennial international rivers in these provinces are now dry for several months of the year. These rivers are the source of water for the City of Maputo and the economically important irrigation areas in the Umbeluzi, Incomati, and Limpopo Basins.

In 1967, the Governments of Portugal and the Republic of South Africa signed an agreement for "best joint utilization" of "common interest rivers" to allocate water resources to achieve the optimum benefit to the states concerned. Swaziland adhered to this agreement later the same year. A formal agreement on the division of water has only been reached for the Umbeluzi, which supplies Maputo City and the Umbeluzi irrigation schemes. This was signed with Swaziland in 1976. There have been further formal conversations for the three other major river basins in the south.

Portugal presented a development plan for the Maputo River in 1967, followed by one from South Africa in 1972. The Maputo Basin has been given low priority by Mozambique because of the lack of favorable sites for dam construction within national territory.

Regular technical meetings of the riparian states of the Incomati and Sabie Rivers were resumed in 1982. These rivers, which within Mozambique comprise a single river basin, supply the Sabie

and Incomati irrigation schemes and the Corumana hydro-electric station. Terms of reference for the Tripartite Permanent Technical Commission were signed in 1981, but no agreement on the division of resources has been reached.

The Limpopo River supplies water for the main irrigation area in Mozambique. Previously this was a perennial river. It is now dry for up to 8 months per year. In 1982, Botswana, Zimbabwe, and Mozambique convened a series of meetings on the Limpopo River. Later South Africa joined these meetings. The last was held in 1986, when the Terms of Reference of the Limpopo Basin Permanent Technical Committee were signed. At the time, no discussions were held concerning the Elephants River from which the Massingir Dam provides water for the Limpopo irrigation areas. In 1994, a technical meeting with South Africa revealed that this river is highly polluted with sediment and total dissolved solids. A water sharing agreement is necessary for this river basin to guarantee at least minimum ecological flow.

In 1995, formal conversation started with Zimbabwe about the Pungue and Save River Basins. The main discussion item was the intended diversion of water from the Pungue River towards the Save River Basin for the water supply to the city of Harare and to irrigation schemes in the Save Basin. As the Pungue River is the only source for water supply to the city of Beira and during recent drought periods the city has been abstained from water. Mozambique has important reservations about this diversion.

In August 1995 the Protocol on the Shared Watercourse Systems in the SADC Region was signed by most of the member states. The actual version of the Protocol does not defend adequately the interest of Mozambique as the downstream country of most of the shared river basins, and for that reason Mozambique adhered to the Protocol under restriction.

No formal conversation has taken place with the upstream states on the Buzi, Zambezi, and Rovuma River Basins. Of these, the Zambezi Basin has the greatest development potential in Mozambique. The SADC/ZACPLAN programme includes several projects for development of the Zambezi Basin in upstream states, and Malawi is planning the construction of dams on the Chire, a tributary of the Zambezi.

4. PROVISION OF WATER RELATED SERVICES

4.1 URBAN WATER SUPPLY

A recent study of urban water supply, the "Provincial Town Study", was undertaken with World Bank finance. That study provides a detailed assessment of the twelve major urban water systems. Despite considerable investments in urban water supply, the coverage of supply to the urban areas has declined from 48% in 1980 to 33% in 1992 due to the rapid growth in the urban population.

Eight cities have full water treatment, flocculation/coagulation, decantation, rapid sand filtration, and chlorination. The rest are supplied by ground water which only requires chlorination. The systems of only three cities are operating satisfactorily, Maputo, Beira, and Nacala. However, the supply to Beira is interrupted during drought periods due to the intrusion of salt-water in the Pungue Estuary, and in Maputo water is only supplied for six hours per day. All the other treatment plants operate below capacity, and often safe drinking water cannot be guaranteed.

Many factories have their own ground water sources; only in Maputo and Beira are significant numbers connected to the municipal supply.

Lost or unaccounted-for-water is estimated to be on average about 60% of the total supplied, a very high level, a level of 25% being more acceptable. All aluminum sulphate and chlorine for water treatment have to be imported.

The responsibility for urban rainwater drainage systems lies with municipal authorities. Only in Maputo and Nacala has significant investment been made in drainage. In Maputo, a city drainage authority has been established to maintain the new structures. Other city councils have had limited capacity to maintain or extend their systems. They are therefore generally in a poor state of repair and inadequately sized. The rapid urban spread has resulted in severe erosion problems especially in Nampula and Nacala.

5. LEGAL AND INSTITUTIONAL FRAMEWORK

5.1 LEGAL FRAMEWORK

The first colonial legislation concerning inland waters specifically for Mozambique was enacted in 1901. This was based on the Portuguese Civil Code and established a due regime of water ownership. All water originating on private land was considered private property as long as it was confined to that land. All other water was considered public. The administration of public water was undertaken by the Public Works Department. However, the most important water use concessions were authorized only in Lisbon.

This law was effectively revoked in 1975 under the first Constitution of Mozambique, which defined all water as public property. As a result much of the existing regulations proved to be inadequate, and new legislation had to be redrafted. This took considerable time; the draft then had to be revised to account for the constitutional changes made in 1990. These established new democratic principles, the rights of citizens, and the role of the free market as the economic driving force. The second Constitution maintains all inland waters as public property in order to facilitate the planning of scarce water resources shared with riparian neighbors and dependent on erratic climatic conditions.

The new Water Law, adopted in 1991, defines the objectives of the legislation, its ambit, and lays down guiding principles to be followed by the various executive agencies. Legal responsibilities have been defined for all levels in the administrative structures.

Under this legislation the state has three basic functions:

- i. to maintain an updated inventory of surface and ground water resources and uses to assist planning and management activities;
- ii. to approve river basin master plans, register water use, and define water allocations and measures to be taken to promote economic and social development in an environmentally sustainable manner;
- iii. to establish a National Water Registry responsible for recording all water rights granted as concessions, licenses, or traditional uses to be legally recognized and protected by the state.

The law distinguishes two types of water use, common and private, and establishes guidelines for specific uses such as potable supplies, irrigation, and energy generation. These guidelines have yet to be detailed in specific regulations.

The law recognizes waste water discharge as a use which requires special regulation and should be subject to charges in order to protect water quality. The right to discharge can be revoked for reasons of public or environmental protection. Existing polluters are not able to claim acquired rights, but the law recognizes that such polluters must be given time to reduce or eliminate their discharges. Polluters are required to rehabilitate receiving waters to their natural condition and pay fines established by law.

Ground water investigations and abstractions are not subject to the water rights regime unless intended for public consumption or a ministerial decree rules to the contrary for specific areas to protect ground water resources or to guarantee their optimal use. In rural areas individuals may construct wells for domestic supply without limitation, but if problems arise the government may introduce controls. Specific regulations for ground water activities have yet to be drawn up.

The law also creates procedures for control of drinking water quality, the protection of water sources, sanitation, and soil protection.

The present levels of poverty in Mozambique make the application of environmental measures difficult. Other than some general statements, there is as yet no national environmental policy.

5.2 INSTITUTIONAL FRAMEWORK

The institutional framework is in transition between the old structures and the new ones established under the Water Law. The Ministry of Public Works and Housing (MOPH) is the cabinet authority responsible for planning and supervising water resource activities. It coordinates inter-ministerial policy through the National Water Council, created in 1991 as a consultative organ to the Council of Ministers.

MOPH has the following responsibilities which are implemented by the National Directorate for Water (DNA):

- i. to maintain current inventories of water resources and their uses at national, regional, and river basin levels and to establish a water information system;
- ii. to establish funding for major water control works; such as dams, water transfer schemes, and river regulation; and to ensure their proper use and maintenance;
- iii. to draw up water related legislation, to supervise its implementation and enforcement, and to give due attention to matters related to international rivers;
- iv. to undertake investments in water supplies and sanitation systems and to oversee their correct operation;
- v. to promote self-sufficiency and sustainable development in water supply and sanitation;

Revised regulations governing the functioning of the DNA were approved in 1992. They established the Departments of Water Resources (DRH); Studies, Planning, and Investment (DEPI); Water Supply and Sanitation (DAS); and the National Rural Water Programme (PRONAR), as well as a Division of Administration and Finance (RAF). Five Regional Water Authorities (of which only one, ARA-Sul has been established) and the Water Training Center report to the National Directorate.

At present, DNA directly supervises the activities of the city water supply companies which manage, operate, and maintain the urban water supply systems. Only the Maputo Water Company is established as a legal entity. Other smaller water supply systems are the responsibility of the local authorities. The "Provincial Towns Study" has recommended a more decentralized system in accordance with the ongoing local government reform.

PRONAR plans, implements, and supervises rural water supply activities through the Provincial Directorates for Public Works and Housing Construction (DPOPHs). Works are undertaken by Provincial Rural Water Brigades (EPARs) on a contract basis, supervised by the DPOPHs. The legal status of the EPARs has not yet been established.

The two commercial companies reporting to DNA, Hidromoc E.E. and Geomoc E.E., are currently in the process of privatization.

5.3 INSTITUTIONAL CAPACITY

The capacity of the water sector is limited by poor finance, the lack of up-to-date regulations, poor definition of the status of the water companies and EPARs, and the low educational level of most of the work force.

Of approximately 5000 employees in the public sector organizations, only 1.1% are graduates, 4.4% are technician grade, and over 50% have less than 5 years of schooling. Most of the graduates and technicians are to be found in Maputo or in local government. The sector lacks a training policy both at national and local levels.

6. PROBLEMS TO BE ADDRESSED

There are many problems to be addressed in the water sector. These include the state of infrastructure damaged during the war through over-use and lack of maintenance; the centralization of institutional arrangements; and the lack of financial, technical, and organizational capacity.

6.1 LEGAL AND INSTITUTIONAL MATTERS

The implementation of the institutional and regulatory system for water resource management, initiated by the Water Law of 1991, has lost impetus. The National Water Council no longer convenes, and the establishment of the first of the regional water administration is not yet complete.

For the provision of services, the transition from a centrally planned system with government-directed implementation agencies to one of autonomous implementing agencies with government regulation is far from complete. The legal framework of the new organization is not fully defined, and the legal and financial regulating mechanisms are few and not yet effective.

6.2 ENVIRONMENTAL CONCERNS

Saline intrusion occurs in a significant number of coastal rivers and aquifers, restricting the availability of freshwater for irrigation and industrial and public consumption. In the south,

important sections of international rivers are dry for many months of the year. In some areas of high population, water tables are falling, and ground water contamination has been observed.

The water resources inventory is inadequate for satisfactory water resources planning, and this is further impeded by the lack of data on geology, soils, land use, and population. There is no legislation to regulate the discharge of waste waters.

6.3 URBAN WATER SUPPLY AND SANITATION

The state still directly manages the provision of water supply and sanitation services in urban areas, although decentralization of these services is recognized as being more appropriate. There is as yet no institutional or legal framework for such autonomous local agencies. Prices for these services are set by national government and do not reflect the real costs of production.

There is little coordination between the provision of sanitation and the construction of roads and housing, community health services, and environmental protection.

6.4 RURAL WATER SUPPLY AND SANITATION

The state has a dominant role in construction and maintenance of rural water supplies but is dependent on international financial support. However, at the national level the relative roles of INDER and PRONAR are not well defined. At the local level, the legal status of the EPARs has not yet been determined.

There are a large number of NGOs working with local authorities in this sector, and there is little control over the impact or sustainability of the systems installed due to the lack of supervisory or regulatory capacity.

The water supply systems in the smaller towns and larger villages are largely inoperational and need rehabilitation. Without operational water supplies the economic development of these urban centers will be set back.

6.5 IMPLEMENTATION CAPACITY

The DNA itself has insufficient capacity to carry out either its technical or its new regulatory functions, and the sector as a whole demonstrably lacks qualified staff. The lack of a clear policy for the sector and its organizational requirements prevents adequate human resource planning. This is exacerbated by the centralized human resource planning system, which functions administratively. The capacity of the Water Training Center is underutilized.

7. NATIONAL WATER POLICY

7.1 BACKGROUND

Water is a vital resource that has to be used in a rational and sustainable way, focusing on the promotion of national development and the well-being of the population.

Since the proclamation of the Independence, a priority objective of the government is to increase the level of service of water supply and sanitation in the rural and urban zones aiming at the improvement of the living conditions of the population. Despite the many advances made in the water sector, the level of service and the degree of coverage are still far from adequate.

With the intention to create more dynamism in the materialization of the objectives drawn by the government, the elaboration of the National Water Policy has been of great importance for giving guidance to integrated water resources management by spelling out action fields and principal activities.

In this light, on the 8th of August 1995, the National Water Policy was been approved by the Council of Ministers.

7.2 PRINCIPAL POLICIES

a. Basic needs

The satisfaction of basic needs is a high priority and will require an increased coverage of water supply and sanitation, in particular to rural, low income groups.

b. Participation of beneficiaries

Effective use of resources and the provision of appropriate service levels is facilitated by the participation of beneficiaries at relevant stages of planning and implementation, and management of operation and maintenance. The objective is to provide services in accordance with the desires and economic capacity of the users and thus to improve the sustainability of the systems. The degree and form of participation will depend on the local conditions and the type of service.

c. The value of water

Water is seen to have an economic as well as a social value. It is important for economic development and poverty reduction. To permit services to be financially viable, the price of water should come to reflect its economic value, eventually covering the cost of supply.

d. Institutional arrangements

The operational water resources management will be decentralized to autonomous catchment authorities. The provision of water supply and sanitation services should be decentralized to autonomous local agencies. These should become financially self-sufficient. These agencies will require a strong management capable of harnessing local financial resources to strengthen their human resource capacity and physical assets. They should be empowered to determine their own tariff structures within simple guidelines laid down by Government.

e. The role of government

In the future the government is likely to withdraw from direct implementation of services. Instead, its role will be one of setting priorities, direction, definition of minimum levels of service, the collection and provision of information, and both stimulation and regulation of the activities of the service providers.

The state will have a role in direct investment in the short term and in evaluating the demanded commitment of the beneficiaries in the medium term. In carrying out these changes, the lessons learned over the past years should not be lost through unplanned or precipitous actions. A pilot project for a provincial plan integrating urban water supply and sanitation will be established.

f. Integrated water resource management

The allocation of bulk raw water through integrated river basin management should optimize the benefits to the community, balancing the interests of both present and future users. It should take into account environmental impacts and conserve water resources for the future.

No single action will provide an adequate improvement in water services. Many of the actions required are interrelated, and their implementation will need to be coordinated through a well directed sector policy which is integrated with those being prepared for local administration, health, agriculture, industry, and finances.

g. Investment

The investment policy should balance economic development with poverty alleviation and improvement in public health. The most critical weaknesses will be rectified to maintain existing systems in operation, and greater coverage will be provided to the more vulnerable sectors of the community. Investment will be concentrated so that it is possible to improve the quality of services, which in turn can lead to raising sufficient income to maintain and extend those services. New sources of investment finance should be investigated, with the possible establishment of development funds.

h. Capacity building

The capacity of the sector needs expanding in order to improve and broaden the reach of the services it provides. This will require actions related to human resources, the definition and implementation of new institutional arrangements, the active involvement of beneficiaries, and new roles for governmental, non-governmental, and private organizations.

Decentralization of decision taking to local managers close to the water users and clients should improve the quality of the services provided. The schedule adopted by central government to create the regulatory conditions for this decentralization is likely to determine how long this process will take. Local managers will also have to learn their new roles and responsibilities and will need to adapt their organizations to the new work methods. Past experience in Mozambique has shown that significant external support can accelerate this process.

The low level of education of the vast majority of participants in the water sector severely limits its capacity to attain the objectives outlined. Local organizations will need to accept responsibility for developing their own capacities through recruitment of trained staff, use of existing training facilities, and the provision of improved conditions of employment. The Government will encourage decentralized training initiatives and human resource planning, combined with adequate career structures and reward packages for staff within the sector.

i. The private sector

Many of the functions required for the provision of water and sanitation services can be undertaken by the private sector. At present the use of the capacity of the formal private sector is restricted to engineering services and construction. At the same time, the informal sector provides water to sectors of the population not presently served by the existing systems, such as in peri-urban and rural areas. Better use of this existing capacity through formal agreements could improve the levels and quality of service. The resources of the private sector may also be tapped in providing managerial and financial capacity. This would require both a politically and financially stable environment to provide conditions for adequate returns.

The dynamism of the private sector may be used to accelerate the rate of implementation of these policies and to establish the close relationship between the quality of a service and its financial viability. Models for involving the private sector include contracting-out, management concessions, and direct investment. To facilitate this involvement the central government will address the question of regulation.

The government will provide private sector participation in order to obtain full benefit from existing irrigation and hydroelectric schemes, which are essential for economic development.

7.3 URBAN WATER SUPPLY

The situation of urban water supply in Mozambique is precarious, and only about 35% of population is served with a decreasing trend in coverage to be contained. The government intends to serve at least 50% of urban and peri-urban population by the year 2000.

Despite tariff structures which attempt to provide water at low cost, the result has been the opposite. The more vulnerable sectors of the population, especially those in peri-urban areas, in fact pay more than the well off. Beneficiaries have demonstrated their willingness and capacity to pay for the services provided by water sector, provided that the service is regular and reliable and that the appropriate level of service is provided.

Local service providers will be established as autonomous entities, not to be part of the public administration structure. Although central government will create the necessary legal conditions for this to take place, local government ought to take an important part in the decision to establish these companies. The government will establish a mechanism to support this transformation process.

A gradual, but timely, tariff reform will firstly permit the recovery of operational and maintenance costs and later contribute to future investment. This will require a change to the present method of setting water prices and revision of existing legislation. The rate of increase should take into account the ability and willingness of customers to pay. Each company should establish its own tariff structure, but the government has a role in developing a methodology, establishing regulations, and supervising the process. It is recommended that social tariff for those with low consumption be maintained, with cross subsidies from others consumers.

The investment policy will balance economic development with alleviation of poverty. Principal investments should be aimed at conserving the existing infrastructures and reducing water losses, and to maximize the use of water by extending the coverage of services to peri-urban areas. In some cases, additional capacity will have to be installed. There is need to invest in the

commercial capacity of the water companies as well as their technical capacity. Whenever possible the wishes of the consumers should be taken into account when planning investment priorities.

Infrastructure development for the extension of service coverage and the corresponding investments will remain the responsibility of the state for the foreseeable future. On the other hand, management or operation of the water supply systems will, in principle, be carried out in a financially viable way and will be independent of the civil service.

A basic principle is that the management of urban water utilities, either public or private, should follow commercial orientation and generate profits for the operator, whenever possible. In exchange Government has to assure that the service is improved and reliable and allow for extensions to serve more people.

Possible methods for independent municipal services should be developed to overcome the problems of constituting autonomous companies, either as public-companies or through management contracts to a private operator. This last option would free the State from involvement in the development of management potential and would permit the participation of more flexible private operational know-how and investment.

Measures and actions to rationalize the water consumption and promote efficient distribution are given very high priority. The government has set targets to diminish drastically the rate of unaccounted for water by year 2000. Water tariffs will penalize excessive consumption.

To assure the availability of water sources is another matter of great concern. Raw water abstraction is to be charged and paid by the water companies to the basin authorities to promote basin management cost recovery and to promote water conservation. Major cities in Mozambique are located on the coast facing serious problems of saline intrusion on rivers and ground water fields due to draught situation and due to flows reduction caused by increased use of water sources by upstream countries. That is the case of Maputo City which is heavily dependent from Umbeluzi and Incomati Rivers and the City of Beira to which the only source available is the Pungue River.

7.4 RURAL WATER SUPPLY

A principal objective of the water policy will be the provision of basic water supply needs to low income groups in rural areas. Special attention will also be given to the rehabilitation of small water supply systems of urbanized centers in the rural areas as part of the process of reactivating social and economic infrastructures and activities such as hospitals, schools, and commerce.

A standardization of handpumps to VLOM (village-level operation and maintenance) type has been introduced. However, water point maintenance teams need to be well trained and must have the support of the other users. Community participation activities (PEC) need strengthening to ensure effective maintenance.

The rural population is willing to pay for a reliable and safe source of water at an appropriate level of service.

The future role of government should be in the provision of an adequate political and legal environment and to facilitate the provision of services by the allocation of suitably supervised investment funds.

The government will encourage the participation of the private sector in the construction and drilling of improved water sources. However, the state will retain a certain implementation capacity to intervene in the areas where private participation is shown to be non-viable.

7.5 INTEGRATED WATER RESOURCE MANAGEMENT

Water is a rare resource. Its allocation on a rational and sustainable basis requires an integrated management approach to maximize the benefits to the community both now and in the future.

The private sector can contribute to most areas of water resource management. However, the state should retain its planning, regulatory, and monitoring functions. The involvement of the private sector will be limited until finance is generated from tariffs approximating the real cost of providing raw water.

River basin management has to be executed both on a national and a basin wide (regions) level. The importance of joint water resources development studies are more and more acknowledged by the riparian countries. The signing of the Protocol on Shared Watercourse in the SADC Region by most of the member states confirms this evolution.

Mozambique has adhered to the Protocol under restriction. The main reason for this is the fact that comments forwarded by Mozambique have not been taken into consideration in the actual version of the Protocol.

For Mozambique, as the downstream country of most of the international river basins, it is essential that it be recognized that "drainage basins" (river basins) are integral systems of water that will flow into a natural lake or sea.

The actual definition states that: "drainage basin" means a geographical area determined by the watershed limits of a system of waters including underground waters flowing into a common terminus. This definition can lead to a situation in which the upstream countries can abstract or pollute water without consulting downstream countries.

7.6 SHORT TERM TARGETS AND THEIR COSTS

Urban and peri-urban water supplies

On average only 35% of the total urban population now has access to improved water supplies. In 1980 the coverage was estimated to be about 48%. The objective is to increase the coverage so that 50-80% of the population is supplied by 2002. If these targets are achieved an extra 1 million people will be served.

Most of the expansion will be in the peri-urban areas, where the proposed quality of service is one standpost with 2 taps per 500 persons. The target coverage for the various levels of service is 30% by standpipes, 25% with yard connection, and 20% with house connections. To achieve these targets water losses will have to be reduced from about 40% to less than 25%.

The works required to achieve these targets is estimated to require an annual investment of 30 to 35 million US dollars, a value higher than the 20 to 25 million US dollars invested annually during the last few years.

Rural water supplies

Sufficient water sources have been constructed to increase the coverage of supply to the rural population from 6% in 1980 to 30% by 1993. However, the real level of use and the quality of service provided by the installed infrastructure have not yet been determined. A survey of the existing sources in use is likely to show that a significant number have been abandoned due to migration or lack of maintenance.

The prime target for the rural water sector is to increase the present level of coverage to 40% of the rural population by the year 2000, at a level of service where a shallow well or borehole equipped with an operational hand-pump will serve 500 people in a radius of not more than 500m. In addition, up to 200 small water systems will be rehabilitated. These targets imply the construction of around 6000 new water sources to serve an additional three million people.

To carry out these activities an investment of about 15 to 20 million US dollars will be required every year until the end of the century. This is approximately 11 million US dollar more than the annual investment over the last two years.

Integrated water resource management

In the short term, a high priority will be to establish water sharing agreements on the Incomate, Limpopo, Pungue, Save, and Zambezi Rivers. These agreements should also guarantee minimum ecological flows. To assist with the establishment and monitoring of such agreements, the hydrological network will be reestablished to the level existing in 1973 and eventually extended to equal the current average standard within the SADC countries.

The licensing of borehole drilling companies will be regulated to ensure the collection of hydrogeological data.

The rehabilitation of the hydrological network will require an annual investment of over 2 million dollars per year.

River basin water development plans needs to be elaborated as soon as possible with special attention to international rivers.

Sanitation

In urban areas, the short term investment will be concentrated on the rehabilitation and conservation of existing sanitation infrastructures, especially those in cities with poor sanitary conditions such as Tete, Quelimane, Beira, and Maputo. In the short term, a Sanitation and Environmental Master Plan will be prepared to provide an inventory of existing drainage and sanitation infrastructures and to define a strategy for intervention.

Although precise values will depend on further study, the total cost of the investment works are likely to amount to between 5 and 10 million dollars per year. By the year 2000, urban sanitation taxes should be introduced in all the major cities to cover operation and maintenance costs.

At present approximately 100,000 peri-urban families own improved family latrines. The target is to increase this number to 200,000 families by the year 2000.

To promote the extension of the low-cost sanitation programme to rural areas, provincial sanitation teams will be established in all Provinces by the year 2000. The cost of these low-cost sanitation programmes will be about 3 million dollars per year.

7.7 STRATEGIC ACTIVITIES

The government intends to establish an implementation plan, taking into account the agreed policy, specifying investments, and defining more detailed targets. This will programme the changes to the legal and institutional arrangements and define the legal status of the local service organizations. Similar plans should also be established at the provincial level, identifying the principal activities to be undertaken, the institutional changes required, and the tasks and responsibilities of the various agencies involved.

Prioritized investments will be implemented in the short term to break the cycle of inadequate income and poor service and to build management capacity at the local level. Investments will meet priority needs and reactivate under-utilized systems. At the same time, a long-term investment plan will be prepared to coordinate sector activities at both provincial and national levels with the investment in other economic and social sectors. A related program will also identify sources of finance for these investments and will study the creation of water development funds.

NAMIBIA

1. INTRODUCTION

Namibia, located on the south-western coast of Southern Africa, is a country of contrasts in terms of socio-economic development and natural resources. A large land area of 823,000 square kilometers hosts a population of 1.4 million people of whom about 900,000 reside in a rural environment. Among these, there are the rich and those that are subject to extreme poverty.

As a result of the prevailing arid hydroclimate, a large area of the country is covered by deserts, the Namib and the Kalahari. The backbone of the economy is agriculture, mining, and sea fisheries, but both the communal and commercial farming activities are affected by the frequent droughts.

In some areas of the country, infrastructure development equals that of any developed country in the world, but in other areas there is very little as far as water and electricity supply, telecommunications, roads, clinics, schools, and other amenities are concerned.

Namibia has the potential for development in human resources, infrastructure, mining, agriculture, fishing, tourism, and many other areas which can lead to socioeconomic prosperity, but there is need for support to improve conditions for the benefit of the whole population.

2. WATER RESOURCES AND MANAGEMENT

2.1 AVAILABILITY OF WATER

As far as the hydroclimatic conditions in Namibia are concerned, there are distinct wet and dry seasons. Rainfall occurs during the summer months between October and April by means of very intense, but scattered thunderstorms. The mean annual precipitation in the country ranges from less than 50 millimeters (mm) in the west along the coastline to as high as 700 mm in the north-east Caprivi. The reliability of the expected rainfall is affected by high variability. This means that the rainfall is low, erratic, difficult to predict, and spatially unevenly distributed.

Low humidity and high temperatures exacerbate the climatic conditions. The potential average annual evaporation (A-pan evaporimeter) varies between 3,700 mm in the central-southern areas to 2,600 mm in the north. From this it is evident that in those areas where the rainfall is at a minimum, the evaporation is at a maximum. From a hydrological point of view, Namibia is a truly water deficient and certainly the most arid in the Southern African Region.

In Namibia a distinction can be made between four types of water resources. These are perennial surface water, ephemeral surface water, ground water, and unconventional water sources. The total assured yield of both surface and underground water resources, excluding the perennial rivers, is estimated at only 500 million cubic metres per annum (mm^3/a). The contribution made by the utilization of unconventional water resources is already significant at the local level and will become extremely important in future.

The only perennial river water sources available to Namibia are the Cunene, the Okavango, the Kwando-Linyanti-Chobe, and the Zambezi on the northern border and the Orange on the southern border. However, this water must be shared with other basin states, and the equitable and beneficial allocation of these international water sources is subject to agreement between the basin states.

Due to the erratic rainfall conditions, the flow in the rivers in the interior of the country is ephemeral, irregular, and unreliable. The potential of the surface water sources is therefore very limited, and the water can only be used when harnessed in storage impoundments. It is estimated that the sustainable safe yield from surface water reservoirs which could be developed on the ephemeral rivers is at least 200 mm³/a, and the Department of Water Affairs has constructed nine major dams in those rivers in Namibia to utilize some of this potential. The storage capacity of those impoundments is about 600 mm³, but the 95% assured safe yield is only 80 mm³/a which is an indication of the low efficiency of surface water storage facilities in the arid environment of Namibia.

The occurrence of ground water in Namibia is associated with six types of hydrogeological environments. These are alluvial aquifers, porous sediments, carbonate rocks, secondary structures in sedimentary or crystalline rocks, and volcanic intrusions. The magnitude, recharge potential, and supply capacity of the ground water sources depend on rainfall and favorable hydrogeological conditions while the quality of the water is affected by the geology and the age of the water.

The adverse climatic conditions make ground water a very scarce resource. More than 150,000 boreholes have been drilled in Namibia to find water and to understand the hydrogeological environment. About 60% of the boreholes drilled are suitable for the purpose for which they have been drilled and can be considered successful. The number of boreholes in use in Namibia today is estimated at 40,000. It is estimated that the sustainable safe yield of the useable ground water sources in the country is at least 300 mm³/a.

The augmentation of existing water resources can be effected by the desalination of brackish ground water and sea water, the reuse of water for industrial or irrigation purposes, the reclamation of effluent to potable water quality standards, and the substitution of better quality (potable) water used in industrial processes with more brackish water. It is estimated that existing capacity to utilize unconventional water resources can yield at least 7.0 mm³/a, but there is much more potential still to be developed.

Other options which have been investigated in Namibia are rainwater harvesting, weather modification, and fog harvesting, but these have only limited applications and are generally considered to have no major economic value. Public water awareness, water conservation, and more efficient use of water are all seen as measures to stretch the available sources.

The potential yield from the different categories of water resources available in Namibia is shown in Table 1 below.

TABLE 1: Water Resources Potential

SOURCE	POTENTIAL YIELD (Mm ³ /a)
Ground water sources:	
Dams in ephemeral rivers	200
Ephemeral river sources:	
Estimated potential	300
Unconventional sources:	
Present potential	7
Perennial river sources:	
Cunene (at Ruacana)	5500
Okavango (at Rundu)	5000
Okavango (at Mukwe)	10000
Cuando (at Kongola)	1300
Zambezi (at Katima Mulilo)	40000
Orange (at Noordoewer)	11000

2.2 WATER QUALITY

The potability of water is determined by its aesthetic (taste, smell, turbidity), chemical, and bacteriological quality. River water is generally of excellent quality, and only requires conventional treatment and disinfection. Ground waters in arid areas tend to have elevated concentrations of total dissolved solids, and in Namibia this is no exception. In some areas significant water sources are available, but the quality of the water is unacceptable for human or animal consumption.

The required bacteriological quality for drinking water in Namibia is achieved by disinfecting the water with chlorine, and potable water supplied by the state conforms to the standards of the World Health Organization in 95% of all water samples examined for bacteriological quality.

2.3 WATER LAW

The Department of Water Affairs in the Ministry of Agriculture, Water and Rural Development is responsible for administering the Water Act, Act No 54 of 1956. A large number of regulations have been promulgated in terms of the provisions in the Water Act and serve to regulate water affairs in Namibia, specifically with regard to the exploitation of water resources, the allocation of water, water quality management, and pollution control.

However, the present Water Act does not meet the requirements of an independent nation facing severe water scarcity and is presently under revision, a process which will be concluded after

consultation with all relevant organizations representing public interests. The main aim is to draft a new Namibian Water Act in view of the special circumstances prevailing in such an arid country.

2.4 WATER POLICIES

In September 1993 the Government approved a Water Supply and Sanitation Policy for Namibia. The overall long-term sector policy adopted states that water supply and sanitation services should become available to all Namibians and should be accessible at a cost which is affordable to the country as a whole. The equitable improvement of services should be achieved by the combined efforts of the government and the beneficiaries, based on community involvement, community participation, and the acceptance of mutual responsibility.

Communities should have the right, with due regard for environmental needs and the resources available, to determine which solutions and service levels are acceptable to them. The beneficiaries should contribute towards the cost of services at an increasing rate, once a basic needs level has been satisfied while environmentally sustainable development and utilization of the country's water resources should be pursued in addressing the various needs.

The overall water sector objectives center around the provision of improved water supply, sanitation and the development of irrigation. Better water supply should contribute towards improved public health, reduce the burden of collecting water, promote community-based social development, support basic needs for subsistence, and promote economic development. Better sanitation should contribute to improved health, ensure a hygienic environment, protect water resources from pollution, conserve water use, and enhance socio-economic development. Irrigation should promote improved nutrition and surplus production at the household level, support sustainable national food self-sufficiency, and promote economic development.

In view of the limited water resources in the country, the priorities approved for the allocation of water to competing demands are:

- (a) First priority: Water for domestic purposes, including water for livestock watering for both subsistence and commercial farming.
- (b) Second priority: Water for economic activities such as mining, industries, and irrigation. Priorities for these activities will have to be determined in each case by their respective value in relation to the overall development objectives and plans for the country.

It was also accepted that the overall sustainability of the water sector will depend on its ability to become self-sufficient by at least covering running and maintenance costs and Also, the details of a tariff policy should be worked out by each of the institutions responsible for water supply and reticulation.

Basic principles to be taken into consideration for rural water supply include the existence of an agreement between the community and the authorities delineating respective responsibilities and commitments before government support is given and, as a general rule, payment by the community should cover operations and maintenance costs (although there may be cases where a subsidies are warranted). Due to the great variations in conditions throughout Namibia, a system should be worked out whereby the ability of each community to pay for services rendered can be assessed and evaluated, including quantification of the need for subsidization. Government support should be reconsidered if the stipulated conditions of agreement are not complied with.

As far as urban water supply is concerned, a low price should be charged for a defined minimum lifeline volume of water, and progressive rates for increased consumption should be considered. Rates for commercial enterprises and industries should recover the full financial cost of water supply, to the extent possible. Direct and immediate recovery of costs for the supply of water to individual houses should be considered as plot-related costs. Tariffs should be the subject of administrative approval by the Minister of Water Affairs in order to ensure that the government policy is complied with and that any adjustments in tariffs or tariff structures are warranted and reasonable. It would be appropriate to enforce payment for water. For the few who still cannot afford to pay, assistance should be given from a social security vote, to be provided for by the authority responsible for these social services in any given urban area, rather than to circumvent the water revenue collection system.

In all cases where irrigation water is supplied by the state, the economic rate should be charged which may be reduced through a special subsidy determined by the value of the produce relative to its socio-economic benefits.

2.5 INSTITUTIONS

The mission of the Department of Water Affairs is the overall management of water resources in the country. Specifically, its objectives are to ensure that the water resources base is properly investigated to determine its potential, that water is utilized in a sustainable way, that the water resources are protected from pollution, and that water is allocated to the consumers in such a way that maximum economic and social benefit can be achieved for the nation as a whole.

In December 1992, the government decided to proceed with an investigation to rationalize and restructure the Public Service. As a result of this decision, proposals were made for the rationalization of the Department of Water Affairs and the Department of Agriculture and Rural Development in the Ministry of Agriculture, Water and Rural Development. As a result of this, a new directorate, Rural Water Supply, was created in the Department of Water Affairs, and the rural water supply function in the Department of Agriculture and Rural Development was formally transferred to the Department of Water Affairs.

The rationalization study resulted in a proposal to examine the possibility to commercialize a portion of the water supply function, and the Government subsequently decided to call for an investigation into the commercialization of the bulk water supply function. The study indicated that commercialization would be practical, viable, and desirable. In August 1994, it was decided to continue with further studies to determine the details of commercializing the bulk water supply function and to restructure the remaining portion of the Department of Water Affairs so as to maintain responsibility for the control and conservation of the water resources in the country and to fulfill a social responsibility towards the establishment of rural water supply infrastructure.

The proposed establishment of the Namibia Water Corporation Limited (Namwater), which will be fully owned by the State, was approved in February 1996. The detailed preparatory work required to establish Namwater and to restructure the Department of Water Affairs is in progress. It is anticipated that Namwater may commence its business activities by 1 April 1996, subject to the promulgation of the required legislation.

As part of the water supply and sanitation policy recommendations, an investigation into the establishment of Water Supply and Sanitation Coordinating Committees (WASCO) was proposed. Its objective was to provide a forum for water sector coordination in Namibia. After

the required investigations were done, the establishment of WASCO was approved by Government in 25 January 1995.

3. ISSUES FACING WATER MANAGERS

3.1 WATER SCARCITY AND QUALITY

The future of Namibia depends on development in agriculture, fisheries, mining, manufacturing, and tourism in order to generate employment opportunities and economic growth. These objectives can only be achieved if adequate water can be supplied in time and at the right locations to support expected socio-economic development.

In order to meet the growing water demand, the government is actively engaged in the short-term (5 to 10 years), medium-term (5 to 10 years) and long-term (10 to 30 years) planning of water projects in the interest of the nation as a whole. The timely establishment of water supply schemes for cities, towns, planned growth points, and mines to cater to the domestic, industrial, and agricultural water needs in the country should take place according to national and regional water plans.

Droughts and the limited availability of the surface and ground water resources in the interior of Namibia are due to climatic conditions which are beyond the control of man. However, control over and judicious management of the water resources are attainable could extend resource capacity and delay major capital expenditure to develop more water supply infrastructure.

The integrated, combined use of water resources in a systemic manner allows more efficient water resources utilization. This is achieved by optimizing the use of water from the storage facilities on the ephemeral rivers through the transfer of water from dams with less favorable basin characteristics to more favorable ones and by utilizing surface water in conjunction with ground water supplies. Although water conservation and demand management will reduce demand, the available resources are finite and will eventually have to be augmented. This can be achieved by utilizing the perennial rivers to augment water supplies in the interior or by desalination of sea water at the coast.

The provision of sanitation facilities and the management of sewage is the responsibility of various ministries like Health and Social Services or Regional and Local Government and Housing, and institutions like municipalities and private bodies or individuals, depending on their areas of responsibility. All the formal villages and towns in Namibia have adequate sewage disposal facilities. In the larger towns water-borne sewage systems are used while French drains and bucket systems are used in smaller towns and villages. In the rural villages, pit latrines serve as the most common type of human waste disposal systems, but there is considerable room for improvement in this field. Health and educational authorities at national and regional levels are also responsible for extension services to create sanitation facilities for rural communities and to advise people about the health hazards of unhygienic practices.

In the larger urban areas, conventional sewage treatment facilities exist. However, in view of the high evaporation rates and an abundance of sunlight, extensive use is made of oxidation dams to dispose of sewage. In many of the larger towns with sewage works, treated sewage is used for watering parks, sports fields, and golf courses.

Much attention is also given to the re-use and recycling of effluent. In this regard, Windhoek City has a water reclamation plant which is presently being upgraded and will have the capacity to recover 14,000 m³ of potable water per month from sewage effluent. Under Namibian conditions, about 25% of the water supplied to towns and cities is available as effluent which can be re-used in some way. The mining sector also makes an excellent contribution to water re-use. The large Rössing Uranium Mine serves as a classic example of what can be achieved because the freshwater demand at the mine has been reduced from 30,000 m³/day to 7,000 m³/day.

The Department of Water Affairs does not operate sewage or effluent disposal works but is responsible for control over effluent discharge and water pollution. There are more than 200 institutions that have been issued effluent discharge permits and regular inspections take place at some 1,563 institutions with small-scale effluent discharge points.

3.2 POLICY AND REGULATION

The government, through the Department of Water Affairs, is committed to ensure that environmental management is carefully considered in the planning, design, and operation of water supply schemes so as to avoid unnecessary conflict between development and conservation objectives as well as to ensure well-balanced water infrastructure development in Namibia.

Water sources can be polluted by animal and human waste. The provision of acceptable sanitation facilities contributes towards improved public health by ensuring a hygienic environment and also protects all water resources. The department therefore issues permits for the establishment, operation, and maintenance of sewage and industrial effluent disposal works as well as the abstraction of ground water within ground water abstraction control areas.

Concerning the water supply, a very important function of the Department of Water Affairs is disinfection and control of the bacteriological and chemical quality.

Although the formal water supply infrastructure provides water which conforms to high quality standards, many traditional water sources in the rural areas are highly contaminated. The provision of a wholesome water supply clearly does not always produce the desired improvement in health because of contamination of the water during transportation from a potable source to storage at home and from the storage point to consumption. These conditions can be rectified by the application of simple standards of hygiene which are practical and attainable at reasonable costs, provided that full community participation can be achieved through effective extension work.

Although more of the ephemeral surface water sources can still be developed, the extent to which this can be done is limited. However, it remains an important resource, and the construction of dams to harness the potential of ephemeral rivers will depend on need and on technical, economical, and environmental feasibility.

Due to the arid environment and low recharge, ground water sources are vulnerable to exploitation and are exhaustible. When replenished by natural recharge, they can be utilized for almost unlimited periods, provided that abstraction does not exceed the long-term recharge potential. Efficient management and the protection of these renewable sources are therefore of vital importance to Namibia.

In the past there was little or no competition between different types of water users since each could be supplied independently to a large extent, but it is envisaged that with the increasing demand for water as the economy develops, real competition will evolve, particularly between

domestic, stock, and irrigation consumption in the rural environment, as well as between domestic, industrial, and mining consumption in the urbanized areas.

Some of the larger rural centers are already utilizing their water resources to the maximum. The improvement of the water supply infrastructure for isolated communities is difficult and expensive. Water conservation measures should therefore receive high priority to reduce excessive demand. This would call for an efficient water demand management strategy.

The judicious utilization of water is encouraged to ensure that such a scarce commodity is used on a sustainable basis for balanced development in all sectors of the economy. The limited water resources and high capital cost to establish the necessary water supply infrastructure require the implementation of a national water strategy to ensure a reasonable supply to all consumers, prevent water pollution, and manage waste water discharge.

An effective way to curtail water demand is a sound water tariff policy, and to this end the major objective of the national water tariff policy is that water tariffs should be directed at bringing home to the consumer the value of water as a scarce commodity in an arid country.

Although the affordability of water supplies for the various consumers is an important consideration for a healthy development program, recovery of the full, actual cost for the supply of water is a long-term objective. However, a realistic assessment of a variety of economic, social, and political considerations will always be necessary to achieve this within the framework of a community-orientated drive towards equity, efficiency, and affordability of water supplies. The participation of all beneficiaries at all levels in the identification of their reasonable needs, the planning and implementation of appropriate water schemes, as well as the operation and maintenance thereof in an economical way is a major requirement for success.

In cases where the full cost of supplying water cannot be recovered from the consumer, at least the operating cost component is recovered. An attempt is also made to recover some of the capital cost component. In the case of commercial undertakings such as mines, the full economic tariffs are levied because the water is a production input to generate profits. The water tariffs in Namibia are subject to annual revision and periodic adjustment.

3.3 INSTITUTIONAL AND HUMAN RESOURCES

In spite of the fact that appropriate institutional arrangements have been made to restructure the water sector into a government department, a water company, and a water supply and sanitation coordinating committee, there still remains the need for further institutional refinements and the development of human resources.

Some of the major constraints to the future development of the water supply infrastructure are likely to be the availability of skilled manpower. Care should therefore be taken to ensure that manpower is trained, and manpower development is therefore an important facet of the total strategy to ensure that water resources development meets the needs of the country. However, the manpower required is very specialized and not easily obtainable. Special incentives for the training of engineers, hydrologists, computer programmers, technicians, and artisans should be considered at government level, while on-the-job training of less skilled positions will be taken care of by the department.

Training of community water committees and rural scheme attendants to properly care for communal water schemes is equally important.

3.4 DATA AND INFORMATION

There are five main water consumer groups in Namibia, each with different demands on the available surface and underground water sources. The estimated total annual water demand of the various consumer categories is as follows:

CONSUMER GROUP	Mm ³ /annum
Domestic	86
Urban: 52 mm ³ /a	
Rural: 34 mm ³ /s:	
Livestock	67
Irrigation	130
Mining	15
Tourism	2
TOTAL	300

The estimated average domestic per capita water consumption for some of the primary water consumers is described below. Domestic water demand in the urban environment includes industrial water. The difference between average domestic per capita water consumption in the commercial area of the urban environment as opposed to the communal area is due to a higher degree of industrialization and higher living standards in the major towns in the commercial area.

Commercial Area	Urban	330 liters/capita/day
	Rural	85 liters/capita/day
Communal Area	Urban	165 liters/capita/day
	Rural	25 liters/capita/day

3.5 ACCESS TO TRANSBOUNDARY WATER

The estimated future water demands of various consumer groups in Namibia and water resources utilization for each of the major categories are illustrated in Table 2.

TABLE 2: Estimated Consumer Demand on the Water Resources

Consumer	DEMAND ON WATER RESOURCES (mm ³)							
	Perennial Rivers		Ephemeral Surface		Ground Water		TOTAL	
	1995	2020	1995	2020	1995	2020	1995	2020
Domestic	19.4	100	20.6	30	40.0	90	80	220
Stock	4.0	10	*	*	63.0	65	67	75
Mining	7.1	25	1.6	5	9.0	15	18	45
Irrigation	76.5	180	29.8	50	23.7	30	130	260
TOTAL	107.0	315	52.0	85	136.0	200	295	600

*Limited quantities of stock water are supplied from farm dams, and that water demand has been incorporated in the demand on ground water.

From Table 2, it can be calculated that at present 54% of the water demand in Namibia is supplied from surface water sources (36% perennial and 18% ephemeral) and 46% from ground water

sources. This distribution may change drastically if more projects are developed to utilize perennial water sources. By the year 2020, it is estimated that surface water sources will supply 66% of the demand (53% perennial and 14% ephemeral). About 40% of the total estimated ephemeral surface and ground water sources (500 mm³/a) within Namibia are utilized at present. By the year 2020, this figure will be 57%. It is anticipated that the demand for perennial water resources will increase 290%, from 107 mm³/a to 315 mm³/a, during the same period if the expected development takes place.

One of the main reasons why it would not be viable to develop more of the ephemeral surface water potential (200 mm³/a) is the distance between potential dam sites and development centers. Moreover, those dams could have adverse environmental impacts on the river ecosystem downstream. The same applies to the ground water sources (potential 300 mm³/a). In some cases the yield of boreholes may also be insufficient to meet the increased demand, or water quality may be unacceptable. This situation makes access to perennial water an important alternative.

4. ACTIVITIES IN THE WATER SECTOR

4.1 ACHIEVEMENTS

In order to meet estimated future water demand with the available water resources, the broad guidelines detailed in the 1974 Water Master Plan for Namibia and the 1993 Central Area Water Master Plan are being followed.

According to those guidelines, the areas immediately adjacent to perennial rivers must be supplied with water from those rivers. This also applies to the central northern area and the highly industrialized central area. In the first case, available local ground water in the ephemeral Cuvelai is too saline for domestic consumption, and the topography does not allow the development of dams. Water must therefore be imported from the Cunene to augment the supply of water. In the second case, available surface water and ground water sources in the central area cannot meet the expected demand. Furthermore, the master plan states that the central southern area must be supplied with water from the Fish River while the Central Namib coastal area should be supplied with ground water and desalinated sea water. The rest of the country will have to rely on ground water, unless a future need for the development of a surface water source arises and is met in a sustainable way.

The Department of Water Affairs operates 130 State water supply schemes which supplied a total of 78.43 mm³ of water during the 1992/93 financial year. Of this quantity, 44.37 mm³ of potable water were supplied for domestic and industrial purposes while stock drinking accounted for 6.4 mm³. Mining activities consumed 5.4 mm³ while 22.26 mm³ of raw water were supplied for irrigation purposes, mainly from state dams. Of the total volume, 64% was supplied for domestic consumption, stock watering, and industrial purposes; 7% for mining operations; and 29% for irrigation. About 50% of the potable water was supplied from ground water sources.

Just after the independence of Namibia, the establishment of rural water supply infrastructure became a major priority, and a rural water development program was initiated. During the bitter drought of 1991/92, which emphasized the need for more aggressive planning and programming, an Emergency Water Supply Unit and a Ground Water Supply Unit was formed to

accelerate the construction of new rural water supply pipelines and the establishment of borehole water installations.

Over the past five years the Department of Water Affairs has managed to improve the water supply service to at least 230,000 people by developing more than 400 borehole installations, constructing more than 600 kilometers of pipelines, and creating some 350 water points at an approximate capital cost in excess of N\$30 million.

The department is also responsible for assisting rural communities at about 4,000 water supply installations. The improvement and upgrading of about 3,500 existing rural water installations are major challenges for the future while the extension of piped rural water supply schemes is critical in areas where ground water is not suitable for human consumption. However, the Government remains committed to facilitate the establishment of such infrastructure in the future, while the rural communities will be assisted to take further responsibility for their own water supplies.

The largest single state water project in Namibia is the Eastern National Water Carrier. Once completed, the water carrier will eventually import 4 m³/s or 100 mm³ of water per annum from the international, perennial Okavango River on the north-eastern border of Namibia to augment water supplies in the central, eastern, and western areas of the country.

4.2 WATER AWARENESS

Creating water awareness and stimulating a national water culture are seen by the government as one way of improving efficiency in water utilization. In this regard, a National Water Awareness Campaign was launched in Namibia on 22 March 1995 to mark World Water Day. This also coincided with the water conservation theme selected for World Environment Day in June 1995. The creation of water awareness is based on four pillars, namely to:

1. inform the public about water availability, consumption, and misuse;
2. advise the public on water conservation measures;
3. encourage public participation in reducing water demand;
4. improve efficiency and financial accountability for water supplied.

4.3 PUBLIC PARTICIPATION

Droughts in Namibia are the norm rather than the exception. During recent droughts (1981/82 and 1991/92), the authorities were able to successfully implement measures to reduce water consumption by 30% after water conservation awareness campaigns were launched. It has therefore been shown that through public participation it is possible to reduce water consumption.

Rural areas and scattered settlements use small amounts of water which can continue to be withdrawn from local sources like ephemeral pans and wells or supplied from boreholes with handpumps or motor driven pumps. The major challenge seems to be the security of supply during drought conditions or when maintenance support services break down. Catering for such small and scattered rural communities is potentially and prohibitively expensive. It is therefore important to stimulate community involvement in the construction and maintenance of these schemes to ensure that the people and their livestock have enough water.

Based upon the principles of active consumer involvement in water supply and the performance of water supply functions at the lowest possible level of delegation, an approach has been adopted whereby community participation in the development of water supply infrastructure is an integral component in fostering responsibility for the operation and maintenance of the installations.

For this purpose, water committees are being formed to assist with the planning of new schemes and to mobilize the communities to provide labor for the construction of installations. It is expected that committees will eventually organize and manage the daily operations and maintenance of their water schemes, encourage the judicious utilization of water, and guard against pollution or wastage of water. The committees will also make recommendations on water tariff structures and the collection of money for water supply. The Government will train members of local communities to gradually take over the responsibility for operation, maintenance, and management of their water supply.

4.4 APPLIED WATER RESEARCH

The research policy of the Department of Water Affairs is to engage in applied water-related research. Current projects can be divided into three groups, namely ecological research projects, limnological studies, and technological studies.

Attention is also being given to the desalination of brackish water for supply by rural water schemes. Alternative processes, using technologies which are most appropriate to rural conditions, are presently being tested. A study of various water disinfection methods for small schemes has been completed, and corrosion and scaling problems are investigated as required.

An important aspect of applied water research activities is drafting the terms of reference for environmental assessment of future water projects to be undertaken by Department of Water Affairs and the review of environmental impact assessments in other sectors of development, particularly those which involve a water component.

Research staff are further involved in the biological control of aquatic weeds and environmental education and training for both departmental staff and scholars.

4.5 INTERNATIONAL WATER ISSUES

The Cunene River is an important supply source for the densely populated north while the Okavango River is an important source for the industrialized central area. The Cunene, Okavango, Zambezi, and Orange Rivers are also important to Namibia to support irrigated agriculture alongside the river.

It is therefore imperative that Namibia reach agreements with other states sharing the same international waters in order to secure equitable and beneficial utilization of the perennial rivers bordering Namibia. Future water demand in the country will result in an increasing need to use those sources.

Namibia's equitable and reasonable share of the border rivers is difficult to quantify, but these sources are of critical importance to nation, not only to supplement the available ephemeral water sources within the country in times of drought but also to sustain future agricultural, industrial, and socioeconomic development. The negotiation of agreements between riparian countries regarding the utilization of these international water resources must therefore be seen as a priority.

Agreements between the basin states are usually achieved within the framework of the internationally accepted Helsinki Rules which serve as a basis for negotiation. Presently, Namibia has access to an agreed 180 mm³ per annum from the Cunene River and indicated a future demand of at least 200 mm³ per annum from the Orange River. No formal or informal agreements have been reached on the utilization of water from the Okavango, the Kwando-Linyanti-Chobe, or the Zambezi Rivers although it is planned that the Eastern National Water Carrier will eventually draw at least 100 mm per annum from the Okavango River. A Permanent Okavango River Basin Commission was established in September 1994. At its first meeting in June 1995, an agreement was reached between the parties to do an environmental assessment of the Okavango River Basin.

5. RECOMMENDATIONS

From this report it is clear that much has been achieved in the water sector in Namibia, but there are still major challenges in the investigation of the potential of the water resources base, the establishment of water supply infrastructure, the development of human resources, the recovery of water supply costs, negotiations about access to international waters, and the assessment of environmental impacts.

Presented By Mr. P Heyns Pr Eng., Director
Investigations And Research At The Department Of Water Affairs In The Ministry Of
Agriculture, Water And Rural Development

RÉPUBLIQUE RWANDAISE

Monsieur le Président,
Excellences Messieurs les Ministres,
Distingués représentants des Bailleurs de fonds,
Distingués membres de délégations,

Permettez-moi de commencer ce petit exposé en exprimant, au nom de la délégation rwandaise, notre profonde gratitude au Gouvernement Kenyan pour son chaleureux accueil, son hospitalité et, ensuite, aux organisateurs de ce séminaire pour ce cadre et climat de travail on ne peut plus favorable.

Mon petit propos va s'articuler sur six (6) points:

1. La situation géographique;
2. Le contexte social, économique, politique actuel;
3. Une brève description des ressources en eau et de leur gestion;
4. Un bref aperçu sur la politique nationale en matière de gestion des ressources en eau;
5. Le plan d'activités de développement dans le secteur de l'eau;
6. Quelques recommandations.

LA SITUATION GEOGRAPHIQUE

Situé entre les parallèles 1°04' et 2°51' de latitude Sud et entre les méridiens 28°53' 30" de longitude Est, le Rwanda se localise aisément dans la région des Grands Lacs d'Afrique Centrale. Son territoire s'étend sur une superficie de 26.338 km. La République rwandaise a ses frontières avec l'Ouganda au Nord, le Zaïre à l'Ouest, le Burundi au Sud et la Tanzanie à l'Est.

Le Rwanda est un pays montagneux d'une inclinaison générale orientée d'Ouest à l'Est. D'environ 1.250 m d'altitude au sud-est, le relief s'élève progressivement vers le Nord et l'Ouest où il culmine en une chaîne de volcans au Nord avec une pente de 4.507m et une chaîne de montagnes formant la crête Zaïre-Nil à l'Ouest avec des altitudes de 2.000 à 2.500m.

Le climat est tropical tempéré avec des moyennes de température variant de 18° à 23°C et une pluviométrie de 800 à 2.000 mm comme moyennes annuelles.

CONTEXTE SOCIAL, ECONOMIQUE, POLITIQUE ACTUEL

Notre pays, le Rwanda, a connu en avril 1994 le génocide et des massacres qui ont causé plus d'un million de victimes innocentes dont beaucoup d'ingénieurs, de cadres supérieurs, moyens et d'agents qualifiés qui oeuvraient dans les secteurs de l'eau et de l'environnement.

Au début de Juillet 1994, le Gouvernement ("rwandais") génocidaire a pillé systématiquement le pays et a pris le chemin de l'exil entraînant derrière lui des centaines de milliers de rwandais et emportant l'avoir public monétaire alors disponible dans la Banque Nationale du Rwanda, disponible dans les banques commerciales, dans les caisses et les comptes des différents projets

de développement.... sans oublier le matériel spécialisé affecté alors au Ministère des travaux publics et de l'énergie pour ses interventions dans les secteurs de l'eau et de l'assainissement.

C'est dans ce contexte de dénuement multi-sectoriel que le Gouvernement d'Union Nationale (actuel) a saisi la gestion du pays, dès le 19 juillet 1994.

Devant l'ampleur des dégâts tant matériels qu'humains causés par le génocide et les massacres, ledit gouvernement s'est efforcé à redémarrer les activités et y parvient avec l'assistance et l'appui des pays amis, des bailleurs fonds, d'organismes et institutions internationales.

Avec la Décennie Internationale de l'Eau Potable (1980-1990), le Gouvernement rwandais a pris conscience de l'importance d'une gestion rationnelle de l'eau et a entrepris la refonte institutionnelle de la gestion des ressources en eau par la création d'une Direction générale de l'eau au sein du Ministère des travaux publics et de l'énergie en 1984.

UNE BREVE DESCRIPTION DES RESSOURCES EN EAU ET DE LEUR GESTION

Au cours de la période d'avant 1984, le secteur de l'eau dépendait de divers départements ministériels tels que:

- Le Ministère des ressources naturelles avec son service d'hydrologie;
- Le Ministère des travaux publics et de l'énergie par le biais de l'ELECTOGAZ (Société Parastatale de distribution d'eau, d'électricité et de gaz);
- Le Ministère de l'agriculture et de l'élevage, par le biais de la Direction du génie rural et de l'hydrologie;
- Le Ministère des transports et communications par le biais de la Direction de la météorologie;
- Le Ministère de la santé par son Service de l'hygiène et épidémiologie;
- Le Comité national de l'eau, Coordinateur de l'action de tous les intervenants;

Au niveau quantitatif, le Rwanda est un pays relativement bien arrosé mais avec des précipitations inégalement réparties dans l'espace et dans le temps: ces précipitations varient de 700 à 800 mm à l'Est, de 1.600 à 2.000 mm à l'Ouest.

Le pays connaît quatre saisons:

- Une petite saison sèche de décembre à mi-février avec à peu près 20% d'apport hydrique annuel;
- une grande saison des pluies de mi-février à mi-mai avec +45% d'apport hydrique annuel;
- une grande saison sèche de mi-mai à fin août avec 10% d'apport hydrique annuel;
- une petite saison des pluies de septembre à novembre avec +25% d'apport hydrique annuel.

La variation planimétrique dans l'espace est tributaire de la topographie des régions et c'est pourquoi en plus des pluies convectives s'ajoutent souvent celles orographiques (c'est-à-dire en fonction de l'altitude).

L'hydrographie du Rwanda est abondante et dense; elle est tributaire de la morphologie des régions considérées. On distingue deux grands bassins hydrographiques: le bassin du Haut-Nil qui occupe à peu près 80% de la superficie du Territoire national (21.070 km²) et le bassin du Zaïre-Nil (chaîne de montagnes qui bordent le fossé d'effondrement tectonique du quaternaire).

En général, la majeure partie du réseau hydrographique est drainé par trois principales rivières du bassin du Nil qui sont la Nyabarongo et l'Akanyaru, affluents de l'Akagera.

L'autre partie du réseau hydrographique, celle du bassin du Zaïre, draine le bassin du lac Kivu et déverse ses eaux dans le lac Tanganyika.

Il faut noter cependant que les eaux superficielles des lacs et cours d'eau du Rwanda sont en général chargées d'alluvions et de sédiments suite au phénomène d'érosion.

Transport solide dans les grandes rivières

Nom de la rivière	Débit (m ³ /s)	Débit solide (kgs/s)
Nyabarongo à Kigali	78	79,1
Nyabarongo à Kanzenze	101	59,5
Akagera à Rusumo	235	23,9

La pollution physico-chimique des eaux n'est pas fréquente suite au faible niveau d'activités industrielles et au faible niveau d'emploi des intrants agricoles. Par contre la pollution micro-biologique due à certaines activités et grandes concentrations humaines est souvent observée.

Les eaux souterraines restent quant à elles, un domaine encore inexploré, hormis quelques forages initiés par certains projets et un nombre limité à 22.000 sources inventoriées dans le pays jusqu'à présent.

Au niveau de la gestion des ressources en eau, il existe actuellement la loi forestière, la loi sur la conservation des sols et trois projets de loi sur:

- l'environnement;
- les marais;
- la gestion des ressources en eau.

Une fois promulguées, ces lois constitueront un instrument juridique pour la gestion du secteur.

Les grandes institutions qui s'occupent actuellement de la gestion des ressources en eau dans le pays sont:

- Le *Ministère des travaux publics et de l'énergie* par le biais de la Direction de l'eau et de l'assainissement chargée de l'hydraulique rurale, de la gestion des ressources en eau et de l'assainissement;
- L'*Etablissement public de distribution d'électricité, d'eau et de gaz (ELECTROGAZ)* qui s'occupe de la distribution de l'eau en milieu urbain et de la gestion des centrales hydroélectriques;
- Le *Ministère de l'agriculture et de l'élevage* par le biais de la Direction du génie rural et de la conservation des sols qui s'occupe de l'aménagement et de la conservation des Sols par le terrassement, le drainage et l'irrigation;

- Le *Ministère des transports et des communications* par le biais de la Direction de l'aéronautique et de la météorologie qui s'occupe de la coordination des activités météorologiques et des bulletins décennaires d'agro-météorologie à travers le pays.

UN BREF APERÇU SUR LA POLITIQUE NATIONALE EN MATIÈRE DE GESTION DES RESSOURCES EN EAU

Au cours de l'année 1984, le Gouvernement rwandais, dans le souci de restructurer le secteur de l'eau, a créé une Direction générale de l'eau au sein du Ministère des travaux publics et de l'énergie. Cette Direction générale de l'eau est devenue à l'heure actuelle la Direction de l'eau et de l'assainissement.

Elle a pour attributions principales:

- 1) la définition, l'actualisation permanente et la mise en application de la politique nationale en matière de l'eau et de l'assainissement;
- 2) l'élaboration des stratégies d'approvisionnement en eau potable, (AEP);
- 3) le Contrôle de la qualité de l'eau par l'analyse physico-chimique et bactériologique;
- 4) la sensibilisation de la population sur les problèmes de transport, de traitement et de conservation de l'eau à domicile.

Pour ce qui est de la production, du transport et de la distribution de l'eau aux usagers, ils sont assurés par la Direction de l'eau et de l'assainissement en milieu rural et en milieu urbain par l'Etablissement public de distribution d'électricité, d'eau et de gaz (ELECTROGAZ).

Il y a lieu ici de mentionner une pratique actuellement à l'épreuve dans cinquante six (56) communes (sur les cent quarante trois que compte le pays) à savoir la gestion, l'entretien, la maintenance des ouvrages hydrauliques par les bénéficiaires eux-mêmes regroupés en "régies associatives".

Le Ministère des transports et des communications s'occupe de la publication décennale d'agrométéorologie, du contrôle de la qualité et du traitement des données météorologiques et agro-météorologiques.

Le Ministère de l'agriculture et de l'élevage s'occupe de l'utilisation rationnelle des potentialités hydriques du pays à des fins agricoles. C'est dans ce cadre que 3.500 Ha ont été aménagés pour la culture du riz sous irrigation. Aussi le drainage des terres inondées a-t-il contribué à l'augmentation de la production théicole.

LE PLAN D'ACTIVITES DE DEVELOPPEMENT DANS LE SECTEUR DE L'EAU

Après les événements malheureux qu'a connus notre pays en 1994, les infrastructures en eau en milieu rural ont été si endommagées que le pourcentage de la population desservie est passé de 60% avant la guerre à 40% actuellement.

Pour sa réhabilitation et son développement, le secteur de l'eau prévoit un certain nombre d'actions telles que:

- 1) l'inventaire des dégâts afin de relancer les investissements de remise en état;
- 2) la sensibilisation de la population rurale pour une participation active à la gestion des infrastructures hydrauliques mises à sa disposition;

- 3) l'augmentation des investissements dans le secteur de l'eau en vue de l'amélioration du taux de couverture des besoins en eau et en énergie électrique;
- 4) la réforme envisagée pour une gestion commerciale des secteurs de l'eau et de l'électricité;
- 5) l'aménagement et l'irrigation de 2.000 ha dans la région naturelle du Mutara, au nord-est du pays pour la production de riz et de soja;
- 6) la préparation et la mise en oeuvre du plan directeur d'irrigation de 1.000 ha dans la région naturelle du Bugesera au sud-est du pays;
- 7) la finalisation des études de drainage et d'aménagement des marais des rivières Nyabarongo et Akanyaru;
- 8) le drainage et l'irrigation de tous les petits marais du pays;
- 9) la formation des cadres en techniques de planification et de gestion des activités du secteur de l'eau;
- 10) l'actualisation de l'inventaire des ressources en eau;
- 11) la finalisation du plan directeur de gestion des ressources en eau;
- 12) la mise en place d'instruments juridiques pour une meilleure gestion des ressources en eau.

QUELQUES RECOMMANDATIONS

Le Rwanda est doté de ressources abondantes en eau. En vue de l'utilisation optimale de cette ressource naturelle, la République rwandaise se doit de:

- 1) renforcer les activités menant à une connaissance systématique (quantitative et qualitative) des ressources en eau:
 - eau atmosphérique (météorologie);
 - eau superficielle (hydrologie);
 - eau souterraine (hydrogéologie);
- 2) renforcer les mécanismes de coordination des actions de différents intervenants dans le secteur de l'eau;
- 3) créer un service d'Hydrogéologie opérationnel au sein de la Direction de l'eau et de l'assainissement;
- 4) accélérer les procédures d'adoption et de promulgation des lois en matière de gestion des ressources en eau;
- 5) participer activement aux consultations régionales sur l'exploitation des eaux des bassins des fleuves Nil et Zaïre.

La Banque mondiale et d'autres partenaires du Rwanda sont appelés à l'appuyer en vue du redémarrage des projets arrêtés à cause de la guerre et de continuer à soutenir ses activités de réhabilitation des infrastructures et de développement dans le secteur de l'eau.

Je clôturerai cette présentation en vous affirmant, Monsieur le Président, distingués membres de délégations, que le Rwanda, ma patrie, après le génocide et le massacres qu'il vécu, reste malgré tout confiant en l'appui de la communauté internationale, en la solidarité des pays frères et ce

dans son inlassable effort de recouvrer et poursuivre (voir accélérer) son rythme de production dans les secteurs de l'eau et de l'assainissement.

Je vous remercie.

**Ministère Des Travaux Publics Et Ministère De L'énergie
Ministère De L'agriculture Et De L'élevage
Par: Niyongira Thomas
Ministère des travaux publics et de l'énergie**

SOMALIA

1. SOMALIA'S WATER RESOURCES: A COUNTRY PERSPECTIVE

BACKGROUND

Somalia has a land area of 627,300 sq. km, a population of 7.7 million that is growing at 3.1%, and a GDP per capita income of US\$170 (1990), i.e., prior to the destructive civil war. Between 1991 and 1992 estimates suggest that this conflict has resulted in about 300,000 people dying of starvation, the deaths of at least 100,000 people due to the hostilities, and the displacement of about 45% of the population in-country or outside as refugees.

In 1990¹ cropland was estimated to be about 1.1 million ha. of which 15% was irrigated and the remainder rainfed. Pastures cover about 43 million ha., while forests and woodlands cover approximately 9.6 million ha. About 70% of the population is rural. Of these, about 55% are pastoralist or agro-pastoralist, 24% are crop farmers, and 1% are fishermen. The remainder are urban dwellers.

Agriculture contributes about 65% of GDP in 1990 of which livestock was responsible for 51%, crops 38%, forestry 9.5%, and fisheries less than 1%.

The principal food crops are sorghum, maize, sesame, cowpeas, sugar cane, and rice. Commercial crops are banana, citrus (mainly grapefruits and lemons), vegetables, cotton, frankincense, and myrrh (a spontaneous species). Livestock and livestock products account for 80% of exports; bananas 10%; and fish, frankincense, and myrrh comprising the remainder.

EFFECTS OF THE CIVIL STRIFE ON AGRICULTURE

The impact of the civil strife on agricultural sector was almost the same in all regions of Somalia. Young farmers and pastoralists became gradually involved in the conflict, leaving behind old men, women, and small children to look after animals and till the land. Many farming communities succumbed under various militia pressure, followed by heavy faction fighting. Others fled from their land and sought refuge in neighboring countries. All agricultural activities were disrupted and halted. Widespread looting of agricultural machinery, water pumps, transport vehicles, and electrical generators were reported in the agricultural areas of Somalia. Underground grain pits, seed stock saved for the coming seasons, and thousands of animals were taken by force.

In the southern regions (from Middle Shabele down to the Kenyan border), the impact of civil strife on the agricultural sector was particularly devastating, mainly for two reasons:

- (i) Because of the existing fertile soils along and between the two rivers, irrigation facilities, relatively good roads, vicinity of the main and fast expanding local markets, etc., almost all national agricultural development and service projects were, in the past 30 years, concentrated in these regions. When law and order broke down, many armed gangs went throughout the area searching for something to loot.

¹ FAO, Production Year Book, Vol. 45. 1991.

- (ii) Even long after the previous regime had left the stage, well-armed gangs and infighting of several factions had reduced these regions into rubble. In fact, in the Lower and Middle Juba regions, real battles of tanks and artillery took place, destroying much of the crops such as grapefruits, coconuts, bananas, and sugar cane. Weed infestation and the lack of supplementary irrigation later reduced banana plantations, sugar cane, and citrus fields to wilderness.

There was partial recovery in crop production in 1993 and 1994 to about 70% to 80% of pre-war levels due to a combination of reduced fighting, good rains, and considerable effort by the NGOs, UN agencies, and the farming communities. Banana, grapefruits, and watermelon exports restarted. In addition, livestock export resumed from the North West and North East. However, renewed hostilities in 1995 in both the North and South have again reduced agricultural production and export.

CLIMATE

The climate is semi-arid, with an annual average rainfall ranging around 500-600 mm in isolated regions near the southern and northern coasts to 100-200 mm (and below) far inland and in the flatter regions in the north. Rain tends to fall in isolated storms; in the wettest regions, there are typically 40-60 days with rainfall each year, with daily rainfalls of the order 5-15 mm (Kammer 1986). Open water evaporation usually far exceeds the rainfall and is of the order 1600-2400 mm per annum in the south of the country (Henry 1979).

Somalia has two rainy seasons, known locally as the "Gu" (April to June) and the "Der" (October to November). These result from the northward and southward migration of the Inter-tropical Convergence Zone (ITCZ) and its associated frontal systems. These seasons are observed in all parts of the country but are less pronounced in the northern mountain region. Droughts have occurred at intervals of 2-3 years in the Der season and 8-10 years in both the Der and Gu seasons (UN 1987). The coastal region in the south also has an additional rainy season, the "Haggai" (July and August), in which isolated rain showers occur.

Mean monthly temperatures range from 15-25°C in the northern mountains to 25-35°C in the south.

SURFACE WATER RESOURCES

It is estimated (UN 1987) that approximately 65% of urban dwellers and 21% of rural dwellers have access to safe supplies of drinking water. Also, it is believed that over the country as a whole only 1% of the annual rainfall is productively captured. The major towns (including Muqdisho) generally obtain their water supplies from ground water sources. The nomadic peoples exploit a variety of sources, including ground water (wells and springs), natural pools, and temporary water sources such as wadis or tugs. Also, small ponds and reservoirs provide an important resource. Kammer (1986) describes the types:

- *Balli* (Variable size). Natural depression in silty soils. Sometimes improved by man (e.g., sealed flood diversion works).
- *War* (100-25,000+m³). Hand dug or mechanically dug ponds possibly with silt traps and flood diversion works. Possibly polythene lined. Possibly pumped or gravity fed draw-off.

- *Barkard* (30-400m³). Concrete lined ponds, roofed, or covered by bushes suspended on nets.

An aerial survey (Resource Management and Research 1979-1984) suggested that Somalia has some 30,000 Balli; 28,000 War; and 5,000 Barkard.

Somalia has only two perennial water courses of any significance; the Rivers Juba and Shebelli. The sources of the Juba and Shebelli are in the Ethiopian highlands. The Shebelli has a catchment area of about 300,000 km² of which about one third is situated in Somalia. It is estimated that, under normal conditions, only about 10% of the annual flow of the Shebelli originates in Somalia (Gemmel 1982). Similarly, the Juba has a catchment area of some 270,000 km², half of which lies in Ethiopia (Henry 1979).

THE SHEBELLI

The Shebelli enters Somalia near the border town of Belet Weyn and flows toward the coast until, near Moqdisho, it turns parallel to the coast. It then flows South West for a few hundred kilometers before petering out in a series of swamp basins. Most maps show the Shebelli to be a tributary of the Juba, but flow from the Shebelli is believed to reach the Juba only following exceptional rainfall.

The total length of the Shebelli is about 1800 km, of which about 1,000 km lies in Somalia (this estimate assumes that waters from the Shebelli reach the Indian Ocean). Between the border and Bullo Burti, the Shebelli flows over a narrow floodplain. Downstream of Bullo Burti, it reaches flat and featureless terrain, and then southwest of Moqdisho it flows in a network of canals, pools, and swamps. The channel capacity of the Shebelli is about 400 m³/s at Belet Weyn, dropping to less than 90 m³/s at the town of Audegle, west of Muqdisho. In a recent, exceptional year (1981), the river was observed to dry up completely in the dry season and then to have peak floods of several hundred m³/s the next wet season. The total annual flow in the Shebelli is about 200 mm³ (at Belet Weyan) (Gemmel 1982).

The water in the Shebelli is at most times suitable for irrigation. Turbidity measurements are typically in the range of 250-1800 g/m³ rising to a peak at the start of the Gu floods in April, and reaching a minimum in October (GTZ/WDA 1986). EC (electrical conductivity) measurements suggest that the salt content of the water reaches a maximum during exceptional low flow periods and in the floods immediately following these periods (EC 2000-4000 micromhos/cm approx.). Mean monthly values are typically in the range 500-2000 micromhos/cm. Depending on the season; sulfate, chloride, or bicarbonate ions may predominate (GTZ/WDA 1986). Note that these estimates apply to the Shebelli at Jowhar.

THE JUBA

The Juba enters Somalia near the town of Lugh Ganana and flows for 800 kms to the coast. Upstream of Lugh Ganana, the river channel is wide and steep-banked. It narrows downstream and becomes more incised with rocky banks and a stony bed. Several intermittent tributaries enter the river along this reach. These tributaries provide a significant (although, as yet, unquantified) contribution to flood flows into the river. Downstream of Dujuuma, the Juba again widens and starts to meander over a wide floodplain before, near the coast, it narrows and flows into the sea. The average annual flow in the Juba is about 200 m³/s, and the total annual flow is about 6000 × 10⁶ m³ (some three times that of the Shebelli) (Gemmel 1982). Flood peaks of over 2000 m³/s have been observed yet, on several occasions, the river has dried up along most of its length.

The water quality of the Juba is generally better than that of the Shebelle, with much lower values of sediment load and salinity. EC readings are typically of the order 100-250 micromhos/cm but may rise to over 4000 micromhos/cm during the Gu floods and in low flow periods. The main ions are chlorine, bicarbonate, sulfate, sodium, magnesium (Agrar and Hydrotechnik 1985).

IRRIGATED AGRICULTURE

Somalia is estimated to have about 1,075,000 ha. of cultivated land, which represents less than 2% of the total land area. Only 165,000 ha. or 15% of the cultivated land is irrigated (UN 1987). Most of the surface water irrigation schemes are concentrated along the Rivers Juba and Shebelle (slightly more than 85,000 ha. (Gemel 1982). The main crops include maize, sesame, bananas, cotton, sugar cane, paddy rice, citrus, sorghum, and pulses. The main export earning crop is bananas. It is generally acknowledged (e.g. Henry 1979) that:

- (i) Crop yields are low and could be substantially improved if optimum irrigation flows could be maintained.
- (ii) There is considerable spare irrigation capacity on the Juba, and there is little available on the Shebelle given the current production techniques.
- (iii) The efficiency of irrigation is very low averaging about 30%.

Several types of irrigation are used along the Juba and Shebelle including pumped irrigation, gravity fed irrigation, and controlled and uncontrolled flood inundation. Rainfed agriculture is also practiced although irrigation is required for high yield crops. Both rivers are susceptible to flooding during the rainy seasons, and severe floods occur every few years.

Several major irrigation schemes have been constructed along the Shebelle and Juba in recent years, mostly with the aid of international funding. On the Lower Juba, two of the largest schemes are the Fanole irrigation and hydroelectric scheme (USSR and China) and the Juba sugar project at Mareerey (UK). On the Shebelle, in addition to four colonial barrages, several barrages have been constructed in recent years, notably the Sabuun barrage at Jowhar. This barrage services the Jowhar offstream storage reservoir (Saudi Fund) which with a capacity of 200 mm³ is currently the largest reservoir in Somalia. A similar reservoir had been proposed for a site near Duduble (FDR), further upstream on the Shebelle, although this second reservoir would only impound flood flows, leaving dry season flows unaltered. On the Juba, the main proposal is for the massive Baardheere dam, which was planned for the early 1990s. If built, this dam would impound some 5,000 mm³ of water, irrigating 200,000 ha., and generating 105 MW of hydroelectric power (UN 1987). It is unlikely that this project will be constructed any time soon given the state of the country and the need for massive rehabilitation of existing irrigation systems once peace is established.

2. HYDROLOGY IN SOMALIA

HISTORY

The hydrological network in Somalia has been operated intermittently from the early 1900s to the present day. Climatic data have been obtained throughout the country but, until recently, surface water data have been obtained only on the rivers and Shebelle.

Data collection (rainfall and river level) is believed to have started early in this century, during the British and Italian occupation. Some rainfall data remains, but the river level measurements, if they still exist, have not been located in any of the recent studies (listed below). The first reliable surface water records were started in 1951 and consist of daily river levels for the border towns of Lugh Gahaha and Belet Weyn on the Juba and Shebelli.

The present day hydrological network was started in 1963 in the course of an FAO funded project carried out by Lockwood Survey Corporation. Staff gauges and some automatic water level recorders were positioned at several sites on the Juba and the Shebelli, as described below:

Shebelli:	Belet Weyn	Afgoi
	Bulo Burti	Audegle
	Mahaddey Weyn	
	Balad	
Juba:	Lugh Ganana	Jamaame
	Baardheere	

The stations are all natural rated sections with mobile beds. This necessitates regular gauging by current meter in order to maintain the rating curves.

The first river gauging ever was also performed at these sites. This network was maintained up until 1969 by Lockwood and then, until 1972, by a hydrologist, Mr. M. Morgan, after which a slow decline began in the quality and availability of data.

During the 1960s and 1970s several other studies were performed by various foreign companies in connection with specific projects on the Juba and Shebelli. In some cases, new gauging stations were set up for the duration of the project.

- (i) The Russian Selchozpromexport project (1963-1965) on the Juba, which carried out similar work to that of Lockwood, and whose results were included in the Lockwood/FAO report.
- (ii) In the late 1960s, the UK companies Hunting Technical Services and Sir M. MacDonald and Partners prepared a water management plan the Shebelli, producing a report "*The Water Control and Management of the Shebelli River.*"
- (iii) The Russian team returned in the early 1970s and continued their work on the Juba, this time in connection with the Fanole Irrigation and Hydroelectric Power Project (now taken over by China).

Limited amounts of data remain from these and other foreign aid funded projects during this period.

Work toward a national hydrological network resumed in 1980 when a further FAO funded hydrometry project was started under the direction of Brian Gemmel. Gemmel achieved a great deal, including re-establishing the Lockwood network, obtaining stage-discharged ratings at most of the stations, and training counterpart staff. He also obtained much useful low and highflow information since his visit coincided with both an extreme drought and an extreme flood period. Gemmel also measured some flood flows on wadis draining into the Juba.

After Gemmel's departure in 1981, the hydrological network again began to decline. Recognizing this, the Somalia government and the UK ODA funded an interim Hydrometry project designed

to help maintain hydrological services in Somalia until the work could be supported entirely from local resources. This work, which started in late 1983, was carried out by Sir M. MacDonald and Partners and the UK's Institute of Hydrology. This project was currently in its third and final phase when the civil strife began.

Several other projects have also been in operation during the 1980s. A comprehensive list is not available, but these have included:

- Preparation of water resources and management plan for the Juba valley (Agrar and Hydrotechnik GmbH, GTZ funded, 1983-1990)
- Irrigation studies in Fanole, Mogambo, Genale, Afgoi, and Baardheere regions (various projects, funded by China, FRG, Kuwait, ADF, and others).
- Feasibility study for the Duduble barrage and offstream reservoir (Lahmeyer FRG, 1985-1989).
- Feasibility studies for the Baardheere dam (EEC/Arab/IDA/GOS funded 1981-1993).

GROUND WATER

The quality and the quantity of ground water in Somali are not well studied. The limited data available on ground water was lost as a result of the civil war.

CURRENT ISSUES

The national hydrological network in Somalia consisted of rain gauging stations which have been abandoned over the last five years with many of the instruments destroyed. Therefore, there is no functioning network. In addition, all the institutional capacity and memory resources in the Ministry of Agriculture, the Meteorological Section of the Ministry of Air and Land Transport, and the National Water Center of the Ministry of Mineral and Water are all lost with the exception of some records that might be available abroad in donor agencies and consulting firms that worked in Somalia. Therefore, what was already a weak system no longer exists.

RECOMMENDATIONS

1. An attempt must be made to collect water resource information on Somalia from sources outside the country.
2. It would be desirable to allocate some resources to the Hydrological Institute in Ethiopia to establish river gauging stations on the Juba and Shabelle to collect hydrological data. These could be shared with their counterpart Somali institution once peace is re-established.
3. The USAID financed Famine Early Warning System (FEWS), which had field presence in Somalia, could establish a limited number of meteorological and hydrological stations staffed by Somali professionals.
4. The continuation of the use of satellite cold cloud data to estimate rainfall by the USAID funded FEWS.
5. Assistance to communities where there is relative peace to rehabilitate water resources infrastructure such as wells, barrages, irrigation canals, reservoirs, etc.

6. **Rehabilitation and reconstruction of major irrigation structures once peace is re-established.**

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REFERENCES

- Agrar and Hydrotechnik. "Hydrology of the Juba River," Main Report and Annexes 1-4, (Ministry of Juba Valley Development/GTZ, 1985)
- B. Gemmel. *Hydrological Data Collection and Upgrading of the National Hydrometric Network on the Juba and Shebelle Rivers*, also in-service training of the field operational staff, (FAO: Rome, Italy, 1982)
- BCI Geonetics Int. Laconia. "Groundwater Exploration in Northwest Somalia," Technical Report 1, (New Hampshire, USA, 1985)
- C. Faillace and E. R. Faillace. *Water Quality Data Book of Somalia - Hydrogeology and Water Quality of Southern Somalia*, (Water Development Agency, WDA, Somalia/GTZ, GTZ Project No. 80.2193.3 - 09.112, 1986)
- Chinese Well Drilling Team. *Completion Report on the Water Well Drilling Project in the Northern Four Regions of the Democratic Republic of Somalia*. 1986
- Consiglio Nazionale Delle Ricerche. "Geological Map of Somalia and Ethiopia 1:2000000", (Florence, Italy, 1973)
- Sir Alexander Gibb and Partners (Africa). *Source Investigation for Muqdisho Water Supply Expansion*, (Institute of Hydrology: Wallingford, Muqdisho Water Agency, Moqdisho, Somalia, 1980)
- D. Kammer. *Proposal for the Establishment of a Monitoring System at Selected Surface Water Reservoirs in Somalia*, (FAO: Rome, Italy, 1986)
- J. C. Henry. *Present and Future Irrigated Agriculture in the Shebelle and Juba River Basins*, (FAO: Rome, Italy, 1979)
- J. W. Finch. *Data Processing and Management Using Personal Computers*, (National Water Centre: Somalia, 1987)
- Lahmeyer International "Shebelle Water Strategy Study", *Durable Feasibility Study/Hydrologic Data Report/Appendix B Water Resources Studies (Surface Water)*, 1986
- Sir M. MacDonald and Partners. *Jowhar Offstream Storage Project. Operation and Maintenance Manual*, 1981.
- Sir M. MacDonald and Partners/Institute of Hydrology. "Hydrometry Project - Somalia" Inception Report Phase 3, 1988
- Sir M. MacDonald and Partners/Institute of Hydrology. "Hydrometry Project - Somalia", Final Report Stage 1, (ODA 1985)
- P. Hutchinson and O. Polishchouk. *The Agroclimatology of Somalia*, (Food Early Warning Department of the Ministry of Agriculture: Moqdisho, Somalia, 1988)
- Sogreah Grenoble. "Northwest Region Agricultural Development Project", Technical Report 16, 1982
- UNDP/FAO. "Monthly/Annual Rainfall Data for Somalia (provisional)" (National Water Center: Somalia, SOM/85/008. Field Document 1, 1987)
- United Nations Development Programme (UNDP). "Somalia Annual Development Report 1986," (UNDP: Moqdisho, Somalia, 1987)
- Wallingford. *Groundwater Information Processing System (GRIPS)*, (Institute of Hydrology, 1987)
- World Bank/UNDP. "Sub-Saharan Africa Hydrological Assessment, Group 1 Countries." Final Report: Somalia. Prepared by Sir Alexander Gibbs & Partners, (British Geological Survey and Institute of Hydrology, 1989)

SOUTH AFRICA

1. SOUTH AFRICA'S WATER RESOURCES AND THEIR MANAGEMENT

WATER QUANTITY AND QUALITY

The greater part of South Africa is semi-arid. Its mean annual rainfall is only 500 mm, which is 60 per cent of the world average. Rainfall is poorly distributed relative to areas of economic growth. From east to west the rainfall decreases rapidly and becomes increasingly variable while the potential evaporation trebles. Sixty-five per cent of the country averages less than 500 mm, which is usually regarded as the minimum for successful dryland farming. Twenty-one per cent in the west receives less than 200 mm. Surface runoff is South Africa's main water source, notwithstanding that on average only about nine per cent of the total rainfall reaches the rivers. The economically usable mean annual runoff is estimated at 31,000 million cubic meters. The variability of the runoff is even more erratic than that of the rainfall, particularly in the west. Snow melt is occasional, ephemeral, and insignificant. Hydrological extremes, in the form of droughts and floods, are common. Only one-quarter of South Africa has perennial rivers. They occur mainly in the south, the south-west, and the east. They flow irregularly, and they are often strongly seasonal. Rivers with periodic flow are found in a further quarter of the country. Over the western interior, rivers are episodic and flow only after infrequent storms.

South Africa's geological formations are predominantly composed of hard rock. They store insufficient ground water to stabilize the base flow of the rivers. As ground water is sparse, only about 5400 million cubic metres per year may be obtainable. Over large areas, the ground water is saline.

Storage is generally necessary to be able to make the best use of runoff. The major dams in South Africa have a combined capacity of 50 per cent of the total mean annual runoff and command virtually all the runoff from the interior of the country. South Africa suffers from serious erosion of its soil and the consequent sedimentation of its reservoirs. The average loss in the capacity of large reservoirs is just under 10 per cent per decade in high erosion hazard regions. In many areas, natural geological erosion has been accelerated by inappropriate land use.

With increasing urbanization, industrialization, irrigation, and the use of artificial fertilizers and pesticides, the quality of many water sources in South Africa is declining, mainly through salination, eutrophication, and pollution by trace-metals, micro-pollutants, and bacteria, particularly as it is a requirement to return all effluent to the rivers. The quantity and quality of water in South Africa are inextricably linked, and downstream users are becoming more vulnerable to diminished flow and quality.

South Africa's poor water supply situation may worsen if unfavorable climatic changes should arise from global warming.

WATER LAWS

South Africa has never recognized the concept of ownership of water, only rights to its beneficial use. In the 19th Century, the Roman law principle of *dominus fluminis* (according to which the right to use public water could be exercised only on the authority of the State) was replaced by the riparian principle (according to which the owners of properties adjoining a river had the exclusive right to use its water). Subsequently a fusion of the two principles has been effected, in which an increasing measure of centralized State control has been re-introduced with the intention of achieving the optimum utilization of what has since become a scarce resource, which must also be shared with other countries according to accepted requirements for international watercourse management.

The main legal instrument is the Water Act of 1956. Unfortunately its elementary water allocation mechanisms, which were derived from an inadequate understanding of South African hydrological conditions in the previous century, are becoming less and less suitable for equitable and lasting solutions to the growing intricacy of aquatic and land resource problems. Initiatives related to interbasin sharing to enable water and other resources to be managed to best national advantage, endeavors towards achieving the best joint use of water by all user sectors, the need to supplant rigid or simplistic allocations by continuous intelligent optimization and re-accommodation amongst the parties, and the movement from fixed standards to dynamic standards in managing water quality are not well catered for. Water-related legislation contained in many other acts has also to be taken into account, while for some purposes, such as adequate provision for the natural environment, legislation is deficient or lacking altogether.

Water will need to be administered in a manner which recognizes the entire hydrological cycle as an indivisible continuum, with an increasing appreciation of the role of atmospheric precipitation, evaporation, infiltration, seepage, runoff, and erosion, as well as of the value of each alternative use of water, and the detriment in not being able to meet it. South African water law is accordingly undergoing a complete review, aimed at a totally independent determination from fundamental scientific and socioeconomic principles, unencumbered by established precedents and values, of the type of legislation that would be the most suitable for present and future conditions. For openness in the process, it is anticipated that all documentation will be available on the Internet, which will hopefully encourage worldwide interest and participation.

WATER MANAGEMENT POLICIES

Under increasingly challenging conditions, South African water managers have to aim at ensuring an equitable provision of adequate quantities of water of satisfactory quality to a widening spectrum of competing users at reasonable cost and acceptable assurance of supply. As various legitimate aspirations for development and conservation must be met concurrently, practical compromises have to aim at achieving the best joint utilization by users at different levels of development with different aspirations. This will have to be achieved not only by judicious management and conservation of available resources in consultation with all user groups, but also by striving to promote a climate of understanding in which each group can be induced to recognize and accommodate the changing needs of others. As a priority, the government is committed to ensuring that all citizens have access to water and sanitation services to meet basic human needs.

South African water management strategies are focusing primarily on water supply, water demand, water quality, and conflict resolution. *Water Supply Management* implies the creation of the best combination of affordable infrastructure elements for supplying water from the available resources, which will meet determinable requirements with appropriate degrees of assurance.

Water Demand Management is intended to optimize the allocation of the supplies available at any time to the various competing consumptive and nonconsumptive user groups. These include towns, power generation, industry, mining, agriculture, forestry, recreation, and ecological requirements. Allocations must be based on priority criteria derived from scientific, economic, and socioeconomic studies, which are seen to be fair. These studies must be undertaken with the active involvement of users who must be kept well informed about opportunities, limitations and viable trade-offs. *Water Quality Management* strategies relate to the maintenance of the fitness for use of the available water by controlling harmfulness arising from diffuse and point sources through the enforcement of standards and, more recently, the employment of receiving-water quality objectives.

Considering the national pool of water, the river basin is usually the best sub-unit for managing water and associated land resources to gain the full benefits of multipurpose use and to coordinate the activities of various agencies and other bodies interested in resource utilization for their own purposes. Integrated overall water management requires the simultaneous assessment of all relevant factors in local, adjacent and possibly remote catchments, which can be managed together as water systems.

Serious conflicts are escalating among competing users as the demand for water outstrips its natural geographic availability. For the effective dynamic allocation of the available water, impartial central orchestration will have to lay strong emphasis on the national optimization of water use and on inter-jurisdictional conflict resolution, for instance between provinces. The possibility of developing water markets under some circumstances is also being examined.

WATER INSTITUTIONS

South Africa has been fortunate in that, since 1912, the management of its water has been characterized by centralized control, whereas many other countries have been disadvantaged by fragmentation of this function. The Department of Water Affairs and Forestry is the main Central Government Agency. It administers the Water Act and acts as the custodian of the nation's water resources, which require equitable territorial redistribution. Several other central government departments also administer acts that relate to water management, such as the departments of Agriculture, Health, Environment Affairs and Tourism, Constitutional Development and Provincial Affairs.

In terms of Schedule 6 of South Africa's Interim Constitution, legislative competence over matters which depend on water, such as agriculture and nature conservation, is granted to the nine provinces. Local government is charged with the responsibility of making provision for all persons residing within its area of jurisdiction for water, sanitation, and other services and providing that such services and amenities are rendered in an environmentally sustainable manner and are financially and physically practicable. Accordingly, liaison structures have been instituted to maintain the closest cooperation between the central government and the provinces for all water management purposes, particularly given their joint interest in the development of the capacity of local government to provide water and sanitation services on an equitable and efficient basis.

About 20 percent of irrigation is undertaken on State irrigation schemes which were developed earlier in the century. A further 60 percent is undertaken by private individuals and the remaining 20 percent by Irrigation Boards, which are statutory bodies formed to cater to communal irrigation under private initiative. In some areas of the country, industrial and domestic water is supplied by Water Boards, which are Statutory Bodies formed to meet the needs of various user groups within their boundaries, such as industries, mines, and

municipalities. Within this three tier system, depending on geographical location and other circumstances, the ultimate user is catered for himself or is supplied by a local authority through its own waterworks. The local authority's supply may originate or be supplemented from the works of an intermediary such as a Water Board or Irrigation Board, which may obtain its water in bulk from the State's water works. Hydropower generation is undertaken by Eskom, the national electricity authority, on a very small-scale.

A hierarchical National Disaster Management Structure is being created to deal in a pre-emptive as well as a reactionary way with water related disasters, particularly floods.

2. WATER MANAGEMENT ISSUES IN SOUTH AFRICA

SCARCITY AND POLLUTION ISSUES

Relative to the growing demand, water is scarce in some areas of the country, and it is expected to become scarce in most areas. Unexpectedly, it can become scarce anywhere during droughts.

Demands for water range from those which cater for the material needs of people by supporting life, hygiene, domestic use, agriculture, and industry to those which provide spiritual gratification by conserving and beautifying the environment and supporting recreation. Most of the water in South Africa is used consumptively for irrigation. While the water needs of the large developing sector are increasing rapidly, the developed economy is becoming more reliant on an improved assurance of supply and the maintenance of an adequate water quality. The proportion of the total required by users who need a high assurance of supply, such as the power-generating, municipal, domestic, and industrial sectors, is also increasing. To be viable, modern power stations, mines, industries, sanitation systems, and capital-intensive irrigation equipment cannot conveniently accommodate cutbacks. Unfortunately the substitution of other factors of production, such as capital, to compensate for the relative scarcity of water, is only viable if the assurance of the water supply can be improved. Therefore, getting to understand the implications of supply risks which depend on the vagaries of the weather is becoming very important for the operation of schemes and as a basis for investment decisions.

In the past the quantity of water available for use within the country was increased by rescheduling its availability through the building of conventional waterworks which, where possible, are judiciously placed to reduce evaporation losses from storage sites. While additional sites remain to be developed, they are being utilized with special care, particularly noting environmental requirements.

Further augmentation of supplies will require unconventional means which are being monitored. These include desalination, rainfall stimulation, and the possible use of icebergs. A most effective way for South Africa to access more water is through the importation of commodities which require a great deal of water for their production. Applying the principle of best joint utilization across the Southern African region, it would be in the interest of South Africa as a semi-arid territory to encourage the growth of water intensive production such as irrigation, afforestation, and hydro-power generation in the well-watered countries to the north. By importing such commodities, the water destined for increasing their production within South Africa can be allocated to other higher-value purposes. Such a policy should strengthen the economies of the other countries and encourage greater regional prosperity. Collaboration with countries to the

north to import water is also possible. Large water projects involving collaboration can provide a powerful vehicle to stimulate regional development.

Purposeful management of the water quality is aimed at ensuring its continued fitness for human, agricultural, industrial and recreational use, as well as for the propagation of the fish, wildlife, and plant species that could reasonably be expected in a particular environment. As effluents have to be purified and returned to the watercourses, in time, poor quality may become more critical than reduced availability in some areas, particularly in the interior of the country. South Africa therefore requires the polluter to pay.

Strict controls are imposed on point source pollution. Methods are also being devised to deal with diffuse pollution, so as to reduce the presence of contaminants in water, in sediment, and in the biota of aquatic ecosystems. In addition, stringent operating rules are being developed for river systems to deal with residual pollution that cannot be controlled directly. These include blending techniques employing precisely-timed reservoir releases. The traditional requirement for effluent producers to conform to standards is being extended by the development of receiving-water quality objectives for non-toxic effluents in suitable river trajectories.

POLICY AND REGULATORY ISSUES

A sustainable water management strategy must aim at ensuring the indefinite availability of adequate quantities and qualities of water for all competing groups of users at acceptable costs and assurances of supply under changing conditions. In this respect the government is giving the highest priority to meeting basic human needs in the rural areas and in the rapidly growing informal urban settlements. To maintain an optimum dynamic balance between the management of supply, demand, and quality requires good catchment, ground water, and effluent management using integrated controls over water allocation, use, and disposal, as well as the expansion of an affordable bulk supply infrastructure consisting of regional, inter-regional, and international waterworks. This relies on the evolution of comprehensive systems of dams and distribution works, which have to be operated with state-of-the-art techniques. It also requires an improved comprehension of all the hydrological processes that occur in drainage basins, so that they may be taken into account in the context of integrated watershed and environmental management. In consequence, streamflow hydrology is now also being evaluated in terms of its role in nature, noting the effect of seasonal variations and periodic events such as floods and droughts on natural processes.

Increasing financial, economic, and socioeconomic efficiency is being demanded in construction programs for water works. For financing and tariffing, refined forms of financial and economic management are being developed, both for cost recovery as well as for use as instruments for managing demand, while unwarranted subsidies are being eliminated as water assumes the role of an economic good under increasing scarcity. In addition, the timing of construction phases is being determined by sophisticated statistical monitoring of the likelihood of shortfalls of supply from existing systems and the implications of rationing on the various user sectors.

INSTITUTIONAL AND HUMAN RESOURCES ISSUES

In the past, when water was more abundant and problems localized, South African water managers could rely on technocratic skills alone. Problems were solved merely by building more waterworks. This elementary phase is over. With the increasing need to solve conflicts arising from increasing water scarcity and degradation of the environment, resource management will have to rely increasingly on public participation and negotiation at a level needing public conceptions which are noble enough to support the achievement of superordinate goals which no

single group could create or sustain in isolation. However, in many other countries greater democratic participation has fostered obstructionism. A burning issue, therefore, is to ensure, while encouraging the democratic involvement of the public, that, within the requirement of public accountability, professional water managers at the leading edge of technology are able to retain a high, ethical level of command over the situation in the public interest. Unfortunately, professional water managers in South Africa represent a very small, largely unrecognized, and poorly rewarded sector of a society comprising some 43 million people. To ensure that a fair share of the nation's best talent continues to be deployed in this vital activity, it is necessary to raise the esteem in which the sector is held. Accordingly, the issues at stake, the trade-offs possible, and the advances being made in the field of water management need to be well publicized.

A suitable balance between a centralized and a community-based approach to managing water resources is central to achieving integrated water resource management. While a provision for government coercion is necessary, integrated river basin management cannot and should not be handled by government alone. It must be undertaken in partnership with the people living in the geographic sub-units which make up the basin. It must represent the sum of the efforts of individuals and local institutions. Institutions must therefore be able to facilitate group decisions and collective action. As the boundaries of river basins do not generally coincide with those of other important administrative units, attempts are being made to foster sound cooperative links between all levels of government.

DATA AND INFORMATION ISSUES

As the growing water demand will have to be reconciled indefinitely with a limited water supply, increasing attention will have to be given to comprehending the complex water demand situation in South Africa. Educating the public and assisting it to agree on what represents the greatest communal good with the least individual detriment at any time necessitates the development and maintenance of information systems capable of digesting vast databases and portraying complex trade-offs simply and convincingly. The acquisition of large volumes of data by methods such as remote sensing and the rapid development of techniques to portray spatial relationships are acting as enabling technologies. A key trend is the intensive development of new mathematical models to portray the choices implicit in alternative scenarios and the development of multidisciplinary allocation criteria for supporting these models. Electronic technologies such as database management, computerized geographic information systems, remote sensing, and digital terrain modeling are being used extensively in South Africa to assist in reaching agreement at regional, national, and international levels. Together, they offer the promise of conveniently maintaining a simultaneous, continuous, overall temporal and spatial appreciation of changing conditions in a local area, in a whole drainage basin, or over an entire sub-continent to supplement technical solutions.

South Africa has reached the stage where it will be necessary to rely on real-time information systems to maintain adequate water quality in the Vaal River system (on which the economic heartland of the country depends). Adequate quality will have to be maintained by continuous blending with water from controlled releases from dams, which requires the installation of data loggers along critical trajectories of the river to monitor the quality continuously via satellite transmissions.

TRANSBOUNDARY ISSUES

South African water management is becoming more international in character. At this level, there is a growing realization of the need to manage water ethically on a subcontinental basis. The

simple, rigid abstraction allocations which sufficed in the past under conditions of relative abundance cannot be sustained under increasing scarcity. The relative contributions and requirements of different portions of the watercourse system, based on a good understanding of the associated climate, are becoming important parameters for international negotiation. As regions of South Africa share international watercourses, the joint use of water is subject to demanding international requirements as well as to the laws and institutional arrangements of each country.

A provision has existed for a number of years for water commissions between South Africa and its neighboring countries to monitor development and to advise the respective governments on how to achieve the best joint advantage. Negotiations on the joint use of water have recognized principles contained in rules drawn up by the International Law Association in Helsinki in 1966, and treaties have been drawn up with neighboring countries. While monitoring relevant factors has been difficult in the past, modern electronic methods will make it easier.

The protocol on shared watercourse systems in the SADC region, which has been signed by most SADC member states, constitutes an appropriate instrument for addressing rational, sustainable, and efficient regional utilization of shared watercourse systems in the SADC region. Once all states have ratified the protocol, mechanisms to implement it will be established.

3. SUMMARY OF ACTIVITIES

ACHIEVEMENTS IN WATER MANAGEMENT

Despite its semi-arid conditions, the growth of the South African economy during this century has been well supported by the effective rescheduling of the availability of its limited water resources. In the earlier years this was achieved mainly by building dams and waterworks. In later years there has been an increasing concentration on comprehensive water management.

Mathematical modeling and optimization techniques are being applied with increasing success. These include the successful development and employment of probabilistic methods, incorporating stochastic models, to manage water resource systems to best advantage. A proven technique was developed during the late 1980's to optimize the yield of the Vaal River System which encompasses eight drainage basins and links 50 reservoirs. This methodology is now being extended to other water systems and is assisting in fine-tuning public expenditure programs on expensive new waterworks such as the Lesotho Highlands Project.

In addition to various runoff and watershed models, a model has also been developed to manage salinity problems which arise from the use of a river channel both to supply freshwater for irrigation and as a drain for return-flows. It can enable farmers to develop a greater appreciation of the impacts of abstraction and return-flows and hence of the need to collaborate in accommodating the needs of other users and of the environment downstream. A scenario gaming tool is also under development to assist stakeholders in a catchment to experiment with finding optimal solutions to alternative water uses as seen from economic, social, and environmental viewpoints, which are likely to differ.

The satisfaction of divergent public interests also requires readily understood methods for comparing economic consequences with intangible consequences without resorting to oversimplification, emotive advocacy, and visceral appeal. To meet the need for a systematic,

justifiable, and credible means of achieving an equitable balance, a new scenario-based policy planning approach is being developed under the auspices of the South African Water Research Commission. It is intended to guide concerned parties towards a compromise which achieves in some sense the greatest overall satisfaction of conflicting goals and interests. It can help to provide a logical justification for preferring unlike things. Stakeholders can express value judgments by directly comparing specific policies having consequences which are only partially known. It can help them to formulate preferences and rank options meaningfully. It can assist individuals as well as groups to deepen their insights in searching for consensus.

PLANS TO RESOLVE WATER MANAGEMENT ISSUES

The size of the South African population has outgrown the possibility of making water available to all by traditional methods from local resources. This is well illustrated not only by the urgency with which a national water and sanitation program is being undertaken, but by the fact that the elementary phase of water management that was able to rely entirely on the construction of waterworks has been superseded for some time. For several years the country has had to develop increasingly complex management systems which have included the substitution of other factors of production and the optimization of the joint use of multiple resources to solve water-related problems.

Moving beyond the technological solutions, South African water management is now in the phase of increasing public participation and negotiation which will intensify and become more controversial as water becomes scarcer. The setting of standards, the placing of limitations on use, the control over the siting of industries, and disposal of effluents all tend to be viewed as violations of rights, inviting resistance. Equitable water apportionment strategies at a national level will have to assess the value of each alternative use of water and the detriment in not being able to meet it in a manner which gains widespread public acceptance.

OTHER OPPORTUNITIES

Regarding the more effective use of water, the public of South Africa is debating the concept of regarding water as an economic good which should be priced according to its scarcity value. Although much of the water used is not paid for at present (such as rainfed cultivation, diversions from rivers by riparian owners, and the use of ground water), the concept holds promise for moving towards a better allocation of water as a scarce resource. In this respect it is necessary to examine externalities such as social equity and environmental requirements particularly carefully. A reduction in the rate of population growth will also ease the pressure on South Africa's water resources. In addition, an economic alliance to generate prosperity between the countries of Southern Africa which is in the offing could involve important cooperation in the fields of water and power.

4. RECOMMENDATIONS

As water is essential for all forms of life and socioeconomic prosperity, this scarce national asset needs to be well-managed at central government level. It is recommended that this be achieved by ensuring that a well-resourced organization is equipped with the best available technology to interpret the workings of the entire hydrological cycle and is supported by a sound legal and

fiscal framework to ensure that water is allocated so as to ensure the maximum collective benefit in a manner which is above reproach.

Sustainable development depends on appreciating the limits to which the country's aquatic and terrestrial systems are resilient to human activities. Successful development requires foresight and skill in their management so that these limits are not exceeded. Therefore, public attitudes to the use and conservation of water need to be elevated from the confines of narrow sectoral interests towards the development of a responsible national ethic. As no government can enforce an ethic by law, it is recommended that the need for the use and conservation of water be fostered at the level of the individual and of the community through extensive conservation-based education programs, beginning at the schools. It is also recommended that water be brought to prominence on the political agenda at international, national, regional, and local levels if it is to receive the attention and resources which its importance deserves.

It is further recommended that a good partnership between water managers and a well-informed public be formed as conflicts increase. Spokesmen must be identified to champion the cause of each user group and to mobilize its insights under informed peer pressure, to justify the allocation of water for consumptive and non-consumptive uses. For this purpose, the development of communication forums is being encouraged, inside the country as well as in Africa.

As the excellence of reconciliation of demand, supply, and quality that can be achieved will depend on the caliber and currency of information and the successful development of techniques to reliably portray the merits of trade-offs, decision-support systems in the region must also be strengthened.

A.H. Conley, Department Of Water Affairs And Forestry

SUDAN

1. WATER RESOURCES AND THEIR MANAGEMENT

1.1 WATER RESOURCES QUANTITY AND QUALITY

There are four water sources in the Sudan: rainfall, the Nile Basin System, Non-Nilotic streams, and ground water, to meet mainly the needs of irrigation and hydropower.

a. Rainfall:

The annual rainfall ranges from less than 75 mm in the far north to between 800 to 1200 mm in the equatorial forests in the far South. The total volume of the country's annual rainfall is characterized by its variability and low reliability for rainfed agriculture.

b. Nile Basin System

The supplies from the Nile and its tributaries can be summarized as follows:

Tributaries	Annual Average Supply	Flow Fluctuation
Blue Nile	50.7 mm ³	Daily discharge falls from 800 mm ³ /day in August to only 7 mm ³ /day in April
Rahad	10.0 mm ³	Flow from July to November
Dinder	3 mm ³	Flow from June to November
White Nile	30.9 mm ³	Daily flow falls from 114 mm ³ in November to 54 mm ³ in April
Bahr El Gazal	14 mm ³	Only 0.5 mm ³ reaches Malakal (swamps)
Bahr El Jebel	29 mm ³ at Mongalla	Only 14.7 mm ³ reaches Malakal (swamps)
Sobat	13.7 mm ³ reaches Malakal	Losses in Baro and Machar reaches 8 mm ³ . Flows 8 mm ³ /day in April to 66 mm ³ /day in November
Atbara	12 mm ³	Flow confined from June to February

It can be noticed that there are remarkable fluctuations between flood and low season discharges. Also, huge losses in the swampy region of the Upper Nile Basin can be noticed. Not all the Nile water is at the disposal of Sudan since its share, according to the 1959 agreement with Egypt, is confined to 18.5 mm³ measured at Aswan, Egypt, not neglecting the rights of other riparian countries.

c. **Non-Nilotic Basins:**

The main non-nilotic streams are the Gash, Baraka, and Jebel Marra. The flow in these streams is seasonal and intermittent. The total annual flow for each of the Gash and Baraka range from 200 to 800 mm³, while it is only 350 mm³ in Jebel Marra. Other seasonal streams are found in the Red Sea region, the Savannah Belt, Darfur, Kordofan, Blue Nile, and Kassala regions. The total annual discharge of the streams in the central clay plains of the Sudan is estimated at about 4 million cubic meters.

d. **Ground Water:**

The annual ground water recharge is below 4.8 mm³. Ground water is mainly used for drinking and irrigating limited areas, and expansion in ground water use is subject to further studies.

1.2 WATER LAWS

The following legal systems relevant to water laws and regulation exist in Sudan.

1.2.1 River Control Regulation Rules:

To operate dams in Sudan, to ensure downstream rights and minimum acceptable flow, and to avoid environmental degradation.

1.2.2 Reservoir Compensation Ordinance:

To compensate for damage to property caused by filling the reservoir and displacing people and property.

1.2.3 Irrigation Ordinance and Regulations:

To deal with distribution of irrigation water, clearance of silt and aquatic weeds, and drainage.

1.2.4 The Nile Pumps Control Ordinance:

Issued in 1939 to equitably distribute water among river users, taking into account the requirements of environmental health.

1.2.5 Freshwater Fisheries Ordinance:

To regulate fishing in rivers.

1.2.6 River Transport in the Nile and Inland Waters Ordinance

Enacted in 1907 to deal with river navigation regulations.

1.2.7 Water Pollution Control Ordinance

Issued in 1975 to prevent addition of wastes to rivers, canals, wells, and water supply sources. Forms part of the environmental health ordinance

1.2.8 Water Hyacinth Ordinance

Enacted in 1960 to combat water hyacinth in Sudanese rivers and waterways and includes measures to be taken by owners of vessels and pump schemes.

1.2.9 Water Resources Law

Passed in 1995 by the Transitional National Council, Sudan's highest legislative body, and endorsed by the President of the Republic. According to this law, a national council for water resources was formed to:

1. Plan for optimum water resources use by evaluating quantities and quality and by taking measures to alleviate effects of droughts and floods;
2. Program and set priorities for better use of water resources;
3. Set a basis for coordination with other countries who share Sudan's water sources;
4. Revise water legislation or enact new legislation for water resources use and development;
5. Encourage scientific research.

1.3 WATER RESOURCES MANAGEMENT POLICY

Twenty percent of Sudan is desert and 29% semi-desert. In other parts of the country where it rains, rainfall is characterized by its variability and low reliability. Recent studies have shown decreasing trends of rainfall all over the country and indicate that rainfall cannot be depended on for sufficient food production, especially with the high rate of population growth. Therefore, the Sudan advocates a strategy of development, conservation, and use of the Nile Basin and other local and shared water resources in an integrated, sustainable, and environmentally sound manner through basin-wide cooperation.

1.4 WATER INSTITUTION

The Ministry of Irrigation and Water Resources is the unique body responsible for water resources management and development all over the country. Although Sudan is now applying a system of decentralization, the Ministry of Irrigation remains a federal body as planning, development, and management of water resources need to be integrated to obtain the maximum possible benefits.

Since the Sudan has adopted a free market policy, the Ministry is witnessing radical changes. Until very recently, the Ministry of Irrigation and Water Resources relied entirely on the Ministry of Finance for its budget regardless of whether the water users had fulfilled their obligations or not. Now many companies and corporations have been formed within the Ministry. Although most of these newly formed corporations are non-profitable, the water users are obliged to pay these corporations directly to cover part of the cost of the services they receive. The remaining cost is covered by the Ministry of Finance. The contribution of the Ministry of Finance is only transitional, to guarantee the successful implementation of the newly adopted policy.

The adoption of a free market policy and real water pricing has a transitional set-back due to the unavailability of financing. This has caused a reduction in total irrigated area. We expect a rising trend to occur in the near future.

2. ISSUES THAT FACE SUDAN IN WATER RESOURCES MANAGEMENT

2.1 WATER QUANTITY ISSUES AND RELATED TRANSBOUNDARY ISSUES

As discussed in 1.3 above, the rapidly increasing population, the recurrence of droughts, and the unreliability of rainfall in the Sudan have made it evident that the country has become heavily dependent on the scarce Nile Waters. If this happens to other riparian countries, this will lead to conflicts among Nile Basin countries. This matter requires a the search for an appropriate mechanism to harmonize future water uses at different locations. Such a mechanism could be facilitated by joint efforts involving concerned co-basin countries. Much work was done towards this end, and an action plan was endorsed through the regional organization TECCONILE (Technical Cooperation Committee for the Promotion of the Development and Environmental Protection of the Nile Basin).

2.2 WATER LOSSES

In the swampy region in Southern Sudan, large amounts of water are lost due to evaporation since rivers flood large areas. About 14 mm³ are lost in the Bahr El Jebel swampy area, in addition to 8 mm³ lost in Mashar and Baro swamps. River diversion works are essential to decrease these losses. Jonglei Canal is expected to save about 4 mm³ annually.

2.3 WATER QUALITY AND POLLUTION

2.3.1 Aquatic Weeds

The White Nile and its tributaries have been infested with aquatic weeds such as papyrus, um souf, and other species. Since 1957, the water hyacinth infested the White Nile, Bahr El Jebel, Bahr El Zaraf, and Sobat causing negative impacts such as water losses due to evapotranspiration, impeding navigation, and blocking the inlets or irrigation canals. Aquatic weeds of various species spread in irrigation canals causing interruption of irrigation water supplies.

2.3.2 Sedimentation Problems

Reservoir Sedimentation Problems

The majority of the irrigated area in the Sudan is served by three dams, Roseires and Sennar on the Blue Nile and Khashm El Girba on the Atbara River. The large amount of sediment transported by the Blue Nile (120 million tons annually) and Atbara River (about 40 million tons annually) has accelerated reservoir sedimentation rates. As a consequence, Roseires, Khashm El Girba, and Sennar have lost 40%, 60%, and 56% of their total capacities, respectively. This has lead to a reduction in irrigable areas, interruption in irrigation supplies, crop damage, and a reduction in hydropower generation.

Sedimentation in Irrigation Canals

Sudan possesses a large network of irrigation canals that exceed 10,000 km in length. The main single problem that faces the Ministry of Irrigation in operating these canals is sediment

deposition which leads to reduced and interrupted irrigation supplies, reduced crop yields, increased incidence of overflowing due to high water levels, and increased maintenance costs.

3. A BRIEF SUMMARY OF ACTIVITIES

3.1 ACHIEVEMENT IN WATER MANAGEMENT

Sudan has a well-established Ministry of Irrigation and Water Resources which is responsible for diverse water resources activities, commencing from planning, designing, and implementation or supervision of newly constructed projects and ending with operation and maintenance of these projects. Some outstanding achievements of this Ministry are:

- a. Operation and maintenance of the world's largest irrigation scheme under one management, with very high efficiency;
- b. Control of reservoir sedimentation;
Sudan relies on controlling sedimentation in the dams' reservoirs through operational measures. These measures have proved to be successful in some reservoirs. Sennar Dam, which has been in operation for about 70 years (exceeding its life time), has lost only 56% of its total capacity.
- c. Adoption of water pricing mechanisms which are implemented concurrently with a free market policy;
- d. Stakeholder participation in water management in small-size irrigation projects (pumping irrigation schemes).

4. PLANS TO RESOLVE WATER MANAGEMENT ISSUES

According to the Sudan's strategy for the period 1992-2002, it intends to make use of the expected available 32.65 mm³ of water as follows:

- a. Concentration on gravitational irrigation to expand irrigated land;
- b. Rehabilitation of the existing dams, heightening of the Roseires Dam, and construction of other new dams;
- c. Maximum use of seasonal streams and ground water;
- d. Sediment control in existing dams and reliance on previous experience to avoid future problems of this nature.

The expected 32.65 mm³ will be available from the following sources:

- a. Sudan's share from Sennar Dam, according to 1959 Agreement with Egypt: 20.55 mm³;
- b. reclaimed water from swampy areas: 4.4 mm³;
- c. non-nilotic rivers and streams: 2.8 mm³;
- d. ground water investment: 4.9 mm³.

5. RECOMMENDATIONS

The country's annual rainfall is characterized by its variability and low reliability. Thus the country depends on the scarce and seasonally fluctuating flows of the River Nile and its tributaries. Sudan therefore calls for cooperation with other Nile Basin countries to develop and use the Nile Basin in an integrated, sustainable, and environmentally sound manner.

Large amounts of water are lost in the swampy regions of Southern Sudan which need to be reclaimed by reducing the evaporation losses, thereby increasing River Nile yield.

Water hyacinth has infested long reaches of rivers, causing serious environmental problems. To combat this aquatic weed, joint efforts on the part of the concerned countries are needed.

Sedimentation problems can be mitigated by controlling soil degradation in catchments. Such work is beyond the ability of an individual country. Therefore, the cooperation of concerned countries is recommended.

SWAZILAND

1. WATER QUANTITY AND QUALITY

All of Swaziland's rivers are shared with the Republics of Mozambique and South Africa where the rivers originate. Only one basin is shared with Mozambique.

- Surface water availability has been decreasing since 1962 when South Africa embarked on the Interbasin Transfer Scheme. At present, there is insufficient river flow to support Swazi runoff river irrigation projects located in the lower reaches of the common river basins. The situation is worse during the dry season (April-October) of each year. There is little potential for ground water exploitation.
- Increasing migration to urban centers also results in demand on the available resources.
- The recent drought resulted in below normal flows, in some cases as much as 60% below normal. Irrigation water had to be drastically reduced. Water management and policing of abstractions fell into disarray.
- Water quality is generally good except for occasional industrial spills. Drought conditions cause poor water quality, mainly from non-point sources at the beginning of each wet season (October-March).

Water laws:

- The 1967 Water Act is in operation. It is felt to be outdated, and a New Act is being formulated. The 1967 Act is in conflict with recently established and older laws, e.g. the Water Services Corporation and the 1950 Swazi Administration Acts, respectively.

Management policies:

- Policies are in disarray, e.g. ground water abstractions are governed by the Water Services Corporation and the Department of Geological Survey and Mines.
- The Ministry of Agriculture has been allocated a budget for water planning and development although the portfolio is statutorily allocated to the Ministry of Natural Resources and Energy.

Institutions:

- The Ministry of Natural Resources and Energy is mandated, under the 1967 Water Act, with the responsibility for planning, development, management, and control of surface water, including monitoring of pollution.
- There is a Water Apportionment Board (WAB) that issues user permits under the act.
- The act allows for establishment of irrigation boards.
- The Water Services Corporation is responsible for water supply to urban areas and is parastatal.
- The Rural Water Supply Branch supplies rural settlements and therefore exploits ground water.

- The Department of Geological Survey and Mines undertakes ground water research; its boreholes are used by the Rural Water Branch.
- The Water Resources Branch is responsible for surface water territorially.

Only the water services corporation is self-accounting, independent of the government; all the other agencies are part of the Ministry of Natural Resources and Energy.

2. ISSUES ON WATER MANAGEMENT

- Present water resources are increasingly over-allocated, especially with regard to irrigated agriculture.
- Urban migration is the source of increasing demand as well.
- Further development can only be take place if water storage is available. The quality of water is generally good but threatened by mining and industrialization.
- Policy/regulatory issues.
- Mozambique, South Africa, and Swaziland have jointly established a Tripartite (TPTC) Permanent Technical Committee to address issues on planning and development of common lives.
- Water is free except on rivers with storage where users are charged in order to achieve cost recovery.
- Various controls via the Water Act are in place to effect water conservation, e.g. via land use controls. A permit is required for afforestation.
- Water use/abstractions require a permit for any commercial undertaking.

INSTITUTIONAL/HUMAN RESOURCES:

- At present, institutional and human resources are grossly inadequate.
- A draft act proposes the establishment of a national water commission to be responsible for planning and execution of water related development plans.
- A draft act will rationalize or bring under one department all the different water agencies.
- A commission will have a technical and administrative executive arm under a government ministry. Human resources and presently inadequate staff capacity will be addressed here.

DATA/INFORMATION ISSUES:

- An adequate River Flow Monitoring Network exists for monitoring in and outflows, territorial accruals, and abstractions.
- A computerized database is in place.
- A water use registry is also computerized.

- Data publications and information dissemination are inadequate due to staff limitations. Data are only available in raw form on floppy discs.

TRANSBOUNDARY ISSUES:

- A Joint Water Commission (IWC) exists between South Africa and Swaziland, established under treaty.
- A Tripartite Permanent Technical Committee (TPTC) exists between three countries: Mozambique, South Africa, and Swaziland.
- A JWC has been proposed between Mozambique and Swaziland but has yet to be finalized.
- The TPTC can be expected to emerge as the dominant organization in water matters among the riparian states in the long-term.

3. SUMMARY OF ACTIVITIES

Achievements:

- There is now adequately trained local professional and supporting technical staff.
- An adequate river flow network is in place.
- Ground water investigations have been on-going during the past 8 years, and the boreholes are used for water supply to rural communities.
- One river basin planning has been completed and is now being implemented through the JWC with South Africa.
- River abstraction policing structures are in place and are implemented by the irrigation boards. Water rationing during the dry season is being implemented.
- Moderate success in water conservation is has been achieved via land use controls. Construction of small dams and flood irrigation are on the decline in favour of sprinkles.
- Ground water research and mapping are continuing.

Plans to resolve water management issues:

- The proposed draft act is considered comprehensive and satisfactory in terms of addressing the planning and control of water management issues, including addressing staff limitations and the reorganization of all water agencies into a single department.

Recommendations:

- Timely enactment of the proposed draft water act is imperative.
- Staff positions need to be expanded to establish an adequately staffed executive arm for the proposed National Water Commission.
- Further training of locals is essential to man the department once it is established.

- **It is imperative for the country to construct reservoirs to meet the increasing demand for water on the part of industry and agriculture.**

TANZANIA

1. INTRODUCTION

Tanzania, covering an area of about 940,000 km², is hydrologically divided into five major drainage systems. These are:

- the Indian Ocean Drainage System;
- the Internal Drainage System of Lakes Eyas, Natron, and Bubu depression complex;
- the Internal Drainage System of Lake Rukwa;
- the Atlantic Ocean Drainage System; and
- the Mediterranean Sea Drainage System.

Each of these drainage basins comprises a network of rivers and lakes of various sizes. The country has a narrow coastal plain occupying the eastern seaboard of about 800 km long stretching from 4° 7' to 10° 5' south of the equator. Otherwise most of it lies on the Great African Plateau with altitudes ranging between 1000 m and 2000 m above mean sea level.

The economy of Tanzania is mainly based on agricultural production, livestock keeping, fisheries, hydropower production, and to a small extent, commerce and industry. In all the above activities, water plays a central role in the production processes, necessitating proper management of water resources.

2. AVAILABILITY, USE, AND MANAGEMENT OF WATER RESOURCES

2.1 AVAILABILITY OF WATER RESOURCES

Surface Water

Surface water in the country consists of lakes, rivers, man-made reservoirs, and natural ponds or springs. Major lakes include Lakes Victoria, Tanganyika, Nyasa, and Rukwa. Major rivers include Rufiji, Ruvuma, Kagera, Pangani, Ruvu, Wami, and Malagarasi.

Total available average flow in rivers is estimated to be 450 MCM per day.

For the purpose of proper analysis and balancing of the country's surface water resource, the country's drainage system is further divided into nine river basins as also declared in the national water legislation. The nine river basins are:

- (i) Pangani River Basin;
- (ii) Ruvu/Wami River Basin;
- (iii) Rufiji River Basin;

- (iv) Ruvuma River and the Southern Coast Basin;
- (v) Lake Nyasa Basin;
- (vi) Internal Drainage Basin (Lakes Eyasi, Manyara, Natron, and the Bubu depression);
- (vii) Lake Rukwa Basin;
- (viii) Lake Tanganyika Basin;
- (ix) Lake Victoria Basin.

Ground Water

Ground water sources are found in shallow and deep water aquifers. However, the potential is not uniform over the whole country. Exploration reveals that the Pangani and the Internal Drainage Basins have high potential for deep ground water. The actual potential, however, is not known. There are about 5000 deep boreholes already drilled throughout the country as shown in Table 1. A number of shallow wells have also been drilled ranging from hand-dug to auger drilled wells.

Ground water recharge is mainly from rainfall. It has been established that the recharge rate in the Internal Drainage Basin, particularly in Makutupora area, is about 10 to 12 MCM per year. This area is the main source of water supply for Dodoma town.

Table 1. Distribution of deep boreholes in the country

Name of basin	Wells drilled	Wells with yield >900 l/h	Cumulative yield (l/h)
Pangani	325	292	4217.599
Ravu/Wami	892	522	5084.294
Rufiji	440	268	2123.047
Southern Coast/Ruvuma	334	188	2654.689
Inland drainage	1594	562	6117.555
Lake Victoria	672	316	1523.429
Lake Tanganyika	380	132	790.700
Lake Rukwa	263	128	561.618
Lake Nyasa	63	4	27.458

Water Quality and Pollution

High turbidity, particularly during the rainy season, is the main ambient water quality problem in all river basins. Another overriding problem is high concentrations of fluorides in both surface and ground water sources particularly in the Internal Drainage Basin and part of Pangani Basin. Concentrations in excess of 32 mg/l have been recorded where significant health problems ranging from mottled teeth to dental and skeletal fluorosis have resulted.

The problem of water pollution, meanwhile, needs serious attention before it gets out of hand. Major contributors to pollution of water sources include municipal and industrial wastes and agricultural and mining activities.

In addition, indiscriminate clearing of forests and poor land use practices in catchment areas have resulted in soil erosion which is responsible for high turbidity in many surface water sources.

2.2 WATER USE

The main water uses in the country are domestic, agriculture, hydropower generation, industry, and livestock.

Irrigated agriculture is the largest consumptive user, using about 97% of all uses put together. This is being aggravated by usually low irrigation efficiency, ranging from 15 - 25%.

Hydropower generation, though non-consumptive, has appeared to be a strong competing water user against farmers. All of the current hydropower generating plants are situated downstream while the irrigation activities are upstream. Thus, the only way to increase the power plants is to reduce the amount of water used for irrigation. The situation has proved to be a potential and sensitive source of conflicts. About 80% of electric energy in the country is hydropower-generated.

2.3 WATER RESOURCES MANAGEMENT POLICY AND LEGISLATION

Water Resources Management Policy

The Water Policy currently in place was launched in 1991 and focuses more on the cost-sharing and participatory aspects of domestic water supply, particularly rural water supply. It does not adequately deal with cross sectoral aspects of water, watershed protection, or with the sustainability of river basin management. Efforts to re-dress this situation are under way as discussed in the subsequent paragraphs.

Water Legislation

The primary legislation governing the water resources management is the Water Utilization (Control and Regulation) Act No. 42 of 1974, amended by Act No. 10 of 1981 and Written Laws (Miscellaneous) Amendments Act No. 17 of 1989 and General (Regulations) Amendments. Steps are being taken to improve water legislation so as to accommodate the participation of the private sector and the community in general in the planning, implementation, and funding of projects aimed at the harnessing, development, and efficient use of water resources.

Water Resources Management Institutions

The current National Water Legislation relates to the administration of granting water right to the use of water as well as controlling the pollution of water bodies. The legislation establishes central and regional water boards as principal advisory organs on matters pertaining to the utilization of water at national and regional levels, respectively.

The minister responsible for water affairs is also empowered to declare any area of land to be a water basin in relation to any river under section 7 (c) and (2) of Act No. 10 of 1981 and to appoint a basin water board therein. This is more appropriate than regional water boards where water use from the same source of water may be considered differently in the nearby region.

To date, two river basin water offices and boards have been established (Pancrani and Rufiji River Basins) out of 9 declared river basins in the whole country. The establishment of more river basin water offices and boards will follow a priority list drawn up based on prevailing water resources management issues as recommended by the Tanzania Rapid Water Resources

Assessment carried out in 1995. The next basins on the priority list are Lake Victoria and Ruvu/Wami River Basins.

3. WATER RESOURCES MANAGEMENT ISSUES AND CONSTRAINTS

Main issues which affect proper development and management of the country's water resources include the following:

Water Resources Information Data Base

The hydrometric data collection system is weak due to the inadequate flow of resources, resulting in a lack of accurate and timely information essential for water resources planning and management decision-making.

In Tanzania and most of SSA, there is a need to strengthen the capacity for systematic water quality monitoring and the enforcement of natural and efficient water use and pollution control. Information flows and strong data bases need to be established. We need to estimate or calculate and to establish fairly accurately the amount of water we need for different uses at different stages of development. For shared waters, this is an urgent imperative in order to assure fair and equitable sharing of the water resources.

Sectoral Coordination

A comprehensive policy addressing water resources in a holistic way, including delineating priorities, needs to be formulated in order to guarantee coordination among the sectors.

4. DEVELOPMENT OF TANZANIA WATER RESOURCES MANAGEMENT STRATEGY

In 1993, the Government of Tanzania carried out a water and sanitation sector review and a parallel Rapid Water Resources Assessment (RWRA).

The overall objectives of the RWRA were:

- to integrate hydrological considerations, cross-sectoral water uses, land use, water quality, and environmental and public health aspects in water and sanitation sector planning;
- to establish national and basin-wide priority issues on river basin management and the formulation of strategies which will address those issues.

This step was considered to constitute the first phase for putting in place a strategy towards water resources management. The strategy has aimed at progressively moving towards basin-based management of water resources. The Pangani and Rufiji Basins have been targeted first because of the intensity and urgency of problems concerning water usage conflicts, conservation, and development.

Achievements in Water Resources Management

A series of activities which have been undertaken or are in progress towards achieving a comprehensive Water Resources Management Strategy are as summarized below:

Water Sector Review: The Water Sector Review was carried out by a team of Tanzanian experts and funded by UNDP. Its objective was to build on-going initiatives, identify constraints, propose necessary interventions, and seek the commitment of external support agencies to support specific activities.

Rapid Water Resources Assessment: The Rapid Water Resources Assessment was conducted by an Inter-Ministerial Task Force and was supported by the World Bank and DANIDA. It builds on and was an input into the water sector review to address the gap between supply and water resources management issues.

The Seminar on Water Resources Management in Tanzania: The EDI-funded seminar was jointly organized by the Tanzanian Government and the World Bank. Held in Tanga, Tanzania in September 1994, the seminar provided a forum for discussing the findings of the Water Sector Review, the Rapid Water Resources Assessment, and various topics related to river basin management. It also assisted in building consensus among the various sectoral actors needed to manage water resources in a more integrated manner. It identified elements relating to human resources and capacity building.

River Basin Management and Small-Holder Irrigation Improvement Project: These are parallel initiatives in already identified priority basins (Pangani and Rufiji) aimed at establishing management tools for integrated water resources management. Basin water boards and offices are already operational but will be strengthened under the project. The project also recommends revising the existing water policy and legislation.

National Water Resources Assessment: This on-going, joint task between the World Bank and the Government of Tanzania is aimed at identifying crucial issues and constraints for preparing a coherent water resources management policy and strategy. The study will also help in identifying areas for further detailed work in the sector.

5. CONCLUSIONS

Tanzania is pursuing a phased approach towards developing a water resources management strategy, a process which has to involve all related sectors and stakeholders. In all activities which have been undertaken in the process, a collaborative and participatory approach has been adopted. Local institutions have been taking the lead role in implementing the activities summarized in paragraph 4.0 with support and backstopping provided by various support agencies.

This approach departs from the traditional "top-down" approach which was largely externally/centrally driven. It is an approach which is bound to lead to a sustainable development of our water resources.

REFERENCES

1. United Republic of Tanzania, 1995, Rapid Water Resources Assessment, Vol. I, World Bank/DANIDA.
2. United Republic of Tanzania, 1995, Water and Sanitation Sector Review, URT/UNDP.
3. Management of the Pangani and Rufiji River Basins in Tanzania, Dr. Rafik Hirji; A paper presented at the World Bank Annual WRM Seminar, December 1995.
4. Towards a Water Resource Management Strategy in Tanzania, A phased Approach, Mr. F. Z. Njau et al; A paper presented at the World Bank Seminar, December, 1995.

UGANDA

1. WATER RESOURCES ISSUES

1.1 WATER AVAILABILITY

Uganda has an equatorial climate with small regional variations in annual temperature and humidity. The southern part of the country is generally well watered with two rainfall peaks occurring in March-May and August-November without any pronounced dry season in between, whereas in the north there is a marked dry season from November to March.

Although Uganda is usually considered as being well endowed with water resources, seasonal and spatial variability causes specific problems as the country encompasses both humid and semi-arid areas. There are not only differences between distinct wet and dry years, but there are also considerable variations in the timing of the onset of seasons and in the amount of rainfall and streamflow.

(a) Surface water

The main hydrological feature of the country is the extensive interconnected system of the Equatorial Lakes forming the upper part of the White Nile. Lake Victoria, which drains a total area of about 190,00 km² in Rwanda, Burundi, Tanzania, Kenya, and the entire southern part of Uganda, has its outlet close to Jinja.

Passing the Owen Falls Dam, the water flows through the Victoria Nile into Lake Kyoga and subsequently into the northern end of Lake Albert. The other branch of the lake system, i.e., Lake George and Lake Edward, is connected via the Semliki River which flows into Lake Albert in the southern end. From Lake Albert, the Albert Nile flows north towards the Sudan.

The Ugandan territory is situated entirely within the Nile Basin and is for operational purposes divided into a total of eight sub-basins. These sub-basins are relatively small contributors to the Nile flow, but their yields dominate the water resources potential within Uganda. While the Nile and its flow characteristics are important from both an international and national point of view, the Ugandan catchments are important from a district and local point of view.

The flows in the main branches of the Upper Nile are, to a great extent, determined by the water levels of the lakes. In this respect the lake system provides a significant storage which helps to smoothen out the effects of seasonal as well as inter-annual variations in rainfall and tributary inflows. In general, lake levels and hence outflows vary periodically around fairly stable levels.

(b) Ground water

Ground water represents the main source of domestic water supply for the rural population of Uganda. It is also important for livestock use particularly in the drier regions. Ground water extraction takes place from springs, boreholes, and to a lesser extent from dug wells.

The productive aquifers occur mainly in the crystalline basement rock zones underlying more than 90% of Uganda. Aquifers are also present in the Western Rift Valley sediments found in an

area around Lake Edward and from Lake Albert towards the north. These aquifers are alluvial infills of gravel, sands, and clay. In the northern part of the zone, these infills are predominantly sandy and provide comparatively good water yields.

Aquifers in volcanic formations are found around Mount Elgon at the eastern border and at Mfumbira in the extreme south west of the country. The volcanic rocks are thus found in areas of high relief, and the ground water occurrence is often as springs.

(c) Wetlands

The wetlands constitute a very important natural resource in Uganda. Externally, they reduce the effects of both floods and drought, provide fish resources, and support cropping and grazing along their margins. Internally, they are centres of high biodiversity and productivity as well as valuable refuge and sources of food for fish, in particular the young. Furthermore, they are active biological filters in treatment of effluents, but due to this function they are also sensitive to accumulation of pollution.

1.2 WATER QUALITY ASPECTS

At present, the general quality of Uganda's water resources is satisfactory to meet demands. However, distressing cases of quality degradation are emerging, caused by both natural and human factors - such as pollution, degradation of wetlands, infestation of the water hyacinth, deforestation, and poor land use practices. The changes in the ecology and deterioration in water quality of Lake Victoria will also have significant effect on the economic activities of the countries in the region.

Corrosiveness and high iron content are widespread problems affecting ground water quality. High fluoride concentrations and bacteriological pollution, due to poor sanitation, also occur in parts of the country.

The major sources of water pollution in Uganda today can be categorized as follows:

- siltation from deforested areas and overstocked and degraded rangelands;
- chemical and biological contamination from untreated industrial effluents;
- acidification due to drainage of wetlands;
- salinity from application of agricultural chemicals and fertilizers; and
- biological pollution from improper management of human and animal wastes.

Land degradation has been identified as one of the major environmental problems. Examples include inappropriate farming practices, bush burning, deforestation, removal of vegetative cover, and overgrazing. All these have the effect of disnuding the land and enhancing soil erosion by wind and water. They also affect the hydrological regime (evapotranspiration, runoff, infiltration, etc.), inducing unfavorable climatic changes (droughts) and desertification trends.

In general, water quality and existing pollution loads in the region are not being monitored sufficiently to make adequate assessments of existing water quality or cause/effect relationships. However, it is apparent that the most striking international issue at present is the dramatic deterioration of the water quality and ecology of Lake Victoria over the last two decades, which in turn has affected water quality in the Nile River and downstream lakes.

2. FRAMEWORK FOR WATER RESOURCES MANAGEMENT

The aspirations of a rising population, the need for sustained economic growth, the increasing demand for wholesome water supply, the need to safely dispose of increasing volumes of industrial effluent, and the requirement for increased agricultural and hydropower production inevitably exert high pressure both on water resources and the environment.

Viewed within this context, a clear need has become evident for developing a comprehensive framework for proper water resources management, through which priorities can be established and optimal use of the nation's water resources planned. To meet this challenge, the Government of Uganda has over the past few years earnestly initiated activities aimed at building major pillars for such a framework.

The framework has been molded within the government's general policies of democratic decentralization and its commitment to the privatization process in many spheres of the national development efforts.

The framework within which the water sector is now set to function consists of three main codes:

- a Water Action Plan;
- a new Water Statute;
- a National Water Policy;
- NEMA;
- NWSC Statute.

2.1 UGANDA WATER ACTION PLAN

Water resources issues were high on the international agenda during preparation of the UN Conference on Environment and Development (UNCED) in Rio de Janeiro, June 1992. The guiding principles for water resources management and development which emanated from the UNCED's Agenda 21's Freshwater Chapter were adopted and operationalized under the Uganda Water Action Plan. These guiding principles recognize:

- freshwater as a finite and vulnerable resource, essential to sustain life, development, and the environment;
- management of water resources at the lowest appropriate levels;
- the role of the government as an enabler in a participatory, demand-driven approach to development;
- the recognition of water as a social and economic good;
- the integration of water and land use management;
- the essential role of women in water management; and
- the important role of the private sector.

The Water Action Plan (WAP), which was prepared during the period 1993-95, provides guidelines and strategies for the protection and development of Uganda's water resources and a structure for their management at national, district, and local levels. It is intended to be an

evolutionary and dynamic framework rather than a traditional, prescriptive (“topdown”) master plan.

Preparation of the Water Action Plan has been a process of identifying and analyzing water resources issues that need attention, assessing potentials and constraints, as well as identifying necessary short, medium, and long-term management needs and functions.

The outcome of the Water Action Plan are policy statements; institutional arrangements; procedures, regulations and guidelines; an action programme and databases - all part of creating an enabling environment and a series of tools needed for the effective management of water resources in a sustainable and integrated manner.

2.2 NEW WATER STATUTE

For many years legislation for the regulation of the water sector was inadequate, outmoded, and scattered under different statutes and acts. The government, therefore, initiated a water sector legislation study which led to preparation of a new comprehensive Water Statute which was enacted by Parliament in November 1995.

The Water Statute (1995) is the fundamental code from which all aspects of water resources management are derived: administration; water resources planning, and role of the Water Action Plan; authorization of hydraulic works and uses of water; waste discharge permits; water abstraction permits; variation and cancellation of water rights; financial provisions; powers and duties; and appeals and offenses.

It is designed to be a flexible, adaptable, and comprehensive legislation which also maintains its intention to promote regional cooperation and observe international obligations.

Appropriate regulations to operationalize the new Water Statute have also been drafted.

2.3 NATIONAL WATER POLICY

The National Water Policy, emanating from the process of preparing the Water Action Plan and the Water Statute, is still subject to further discussions before it can be finalized.

The policy has been guided by the government’s overall goals and strategies for social and economic development. Furthermore, the policy is in full harmony with the objectives contained in the National Environment Management Policy (1994) and the subsequent National Environment Statute (1995).

The overall Ugandan water policy objective is:

“to manage and develop the water resources of Uganda in an integrated and sustainable manner, so as to secure and provide water of adequate quantity and quality for all social and economic needs.”

The water resources management strategies, which have evolved from the overall policy objective, are grouped according to (a) those which support an enabling environment, (b) those which guide institutional development, and (c) those which support an upgrading of planning and prioritization capacities.

- (a) The key strategies within the support for an enabling environment are in brief:
- the government as an enabler;
 - legislation to support the policy;
 - regulatory control only in response to need and at enforceable levels;
 - regulatory controls combined with economic incentives;
 - a Water Action Plan process to provide dynamic management framework.
- (b) The key strategies within institutional development comprise in brief:
- cross sectoral coordination mechanisms (Water Policy Committee);
 - integrated approaches to project development;
 - management functions delegated to the lowest appropriate level;
 - private sector involvement;
 - women's participation;
 - water resources management capacities developed at all levels.
- (c) The key strategies within planning and prioritization comprise in brief:
- first priority to domestic demands;
 - allocation to other purposes other than domestic use should be based on economic, social, and environmental values of the water;
 - sustainable use;
 - recognition of water quality and land use links;
 - environmental impact assessment as a planning tool;
 - recognition of the "polluter pays" principle;
 - economic incentives to avoid water wastage;
 - regional cooperation;
 - recognition of wetlands as an integral part of the water resources system.

The strategies are intended to assist decision makers and resource users in determining priorities at the national and local levels as well as at the sectoral, private sector, and individual levels. It is also intended that the policy and its strategies should facilitate improvement in the efficiency of the sector by deriving maximum benefits from the available resources as well as enhancing cooperation and collaboration among the many sector stakeholders.

3. WATER RESOURCES DATA AND INFORMATION

Water is a major factor in the socio-economic fabric of Uganda as well as a determining factor in the country's development potential. However, the present data on Uganda's water resources, including Lake Victoria, are outdated and unsatisfactory in coverage. Any water resources development decision risks of being wrong, and conflicts between users and expensive overdesigns can be among the adverse effects. Opinions, instead of field based knowledge, are often used as the foundation on which Uganda's water resources development and international cooperation are based. A data collection network, which has been out of operation since 1978, is today essentially non-existing.

Seen in the international context, Uganda needs information on its contribution to the water resources of the Upper Nile and knowledge of impacts of water resource development projects. Uganda cannot participate on an equal footing in discussions with other riparians on coordinated

approaches to the use of the Upper Nile resources without being able to describe its own situation adequately.

The most urgent needs for water resources data and information have been identified regarding surface water quantity and quality. Thus, the rehabilitation of the hydrometric network and the establishment of water quality monitoring stations, including associated laboratory upgrading, are to be undertaken. The networks and supporting facilities must represent a balance between factors such as data requirements, technical capabilities, and financial requirements for running and maintenance of the networks. Capacity building and training programmes as well as logistic arrangements will be essential in this context.

Projects both at the regional level (Lake Victoria Environment Management Programme - GEF/World Bank supported) and at the national level (Strengthening of Uganda's Water Resources Monitoring and Assessment Services - DANIDA supported) are about to be implemented to address these shortcomings and rectify the prevailing situation.

4. REGULATORY MECHANISMS

As recommended in the Water Action Plan, the new Water Statute sets requirements for issuing of water permits related to two main activities: (i) extraction of surface water and ground water, and (ii) discharge of waste.

The Directorate of Water Development (DWD) under the Ministry of Natural Resources will - as the central authority - administer the water extraction permit system, at least initially. It is not the intention to regulate small-scale water extractions if they do not adversely affect the possible use of the resource by others. Therefore, although there will be an obligation to report all ground water drilling, only large-scale extractors will need to apply for a permit and be subject to subsequent monitoring.

The long-term strategy is that districts will receive permission from DWD to allocate a specified volume of water from streams and rivers. On this basis, the districts will then decide how the permitted volume of water will be divided among the competing users.

At district level, in cases where monitoring reveals that permits, by-laws, or regulations are not followed, the district authorities will have to impose sanctions, either administratively or through the local councils and magistrate courts.

In view of the technical complexities - and due to the fact that waste discharges affect water resources across district and even national boundaries - the processing and issuing of waste discharge permits will be a permanent national function of the central authority, i.e. DWD.

5. ACHIEVEMENTS

- increased coverage
- legislation (WPC)
- Water Action Plan

- decentralization
- institutional upgrading/restructuring
- NEAP/NEMA
- water resources databases (GW/SW)
- improved sector performance, i.e., NWSC
 - (a) monthly revenue collection (1988-94)
 - (b) income increase from <\$1.0m - \$16 m/year, 1988-94
 - (c) service level increase from initial 15% to between 85% and 100%
 - (d) increased involvement of private sector in service provision

6. CONSTRAINTS

- (a) Shared nature of Ugandan water resources and inadequate cooperation.
- (b) Inadequate capacity, especially at district level.
- (c) Inadequate water resources data (demand/supply).
- (d) Decentralization process.
- (e) Inadequate planning, monitoring, and evaluation capacity and systems.

7. RECOMMENDATIONS

- (a) Reactivate WR monitoring and assessment service.
- (b) Capacity building.
- (c) Implement and enforce legislation/regulations.
- (d) Develop sub-sectoral laws, e.g, irrigation, power generation, and transport.
- (e) Eradicate water hyacinth in lakes and the River Nile.

RÉPUBLIQUE DU ZAÏRE

RESSOURCES EN EAU AU ZAÏRE

L'adhésion du Zaïre aux objectifs de la Décennie Internationale de l'Eau Potable et de l'Assainissement "DIEPA" (1981-1990) a permis la mise en place des mécanismes de gestion des ressources en eau dont les plans d'action retenus visent à la fois:

- à assurer aux populations la fourniture d'une eau de bonne qualité respectant un minimum des normes d'une eau potable;
- à les mettre à l'abri de la contamination directe ou indirecte par des eaux souillées de pollutions diverses.

Chaque pays a, en fonction de ses besoins, préparé des stratégies et politiques. Le Zaïre, pour sa part, a inscrit le développement de ce sous-secteur dans un cadre plus global marqué par une planification rigoureuse et une coordination active.

Cette volonté a été concrétisée par l'élaboration d'un Plan Directeur Bi-Décennal qui, dans sa préparation, a réalisé une synthèse des études hydrauliques et hydrogéologiques menée suivant une approche normative suite à l'absence des données de base reconnues.

DESCRIPTION DES RESSOURCES EN EAU ET LEUR GESTION

Problèmes sur la quantité et la qualité

Le Zaïre est un vaste pays aux potentialités en eaux très variées. Près des deux-tiers de son territoire sont occupés par des terrains sédimentaires d'âge primaire à quaternaire; ces derniers recouvrent les terrains les plus anciens dans tout le centre du pays. Les formations d'âge précambrien affleurent à la périphérie, celles de moindre envergure se sont déposées d'une part sur la zone littorale, d'autre part dans les fossés tectoniques de l'Est du pays.

La pluviosité importante, estimée à plus ou moins 1200 mm en moyenne par an a fait du Zaïre le pays le mieux arrosé de l'Afrique Sub-Saharienne. La pluie efficace atteint 7000mm dans la cuvette centrale et reste élevée sur une grande partie du pays. Globalement, la recharge annuelle des nappes représente des volumes d'eau considérables sans commune mesure avec les besoins.

Eaux souterraines

Les nappes d'eau souterraines sont nombreuses. Les nappes les plus facilement exploitables sont dans les alluvions mais on en trouve également dans des formations gréseuses et calcaires. La profondeur des captages est de l'ordre de 40 à 60 m en général, mais peut atteindre 80 m dans certaines régions.

L'analyse des aquifères conduit à distinguer dans l'ensemble plusieurs zones ou provinces hydrogéologiques dans lesquels les conditions d'exploitation sont similaires. Six provinces ont pu être individualisées:

- Province I: Alluvions du fleuve Zaïre et de ses principaux affluents;

- Province II: Comprend le territoire de la cuvette centrale qui est recouvert par des sédiments sableux récents;
- Province III: Sable, grès néogène et paléogène formant des dépôts tabulaires d'une centaine de mètres d'épaisseur sur des formations moins perméables;
- Province IV: Terrains d'âge primaire à crétacé, formant de très grandes étendues au sud de la cuvette centrale;
- Province V: Formations du précambrien supérieur, schisto-calcaires ou schisto-gréseuses; pouvant présenter une importante perméabilité de fracture;
- Province VI: Terrains plus anciens, cristallins ou métamorphoriques.

Ces potentialités doivent être jugées différemment selon que leur exploitation est destinée à l'AEP ou l'AEPR. Dans le premier cas, on recherche généralement des débits importants et le volume élevé d'eau produite permet d'amortir des ouvrages relativement coûteux. Dans le 2ème cas, on recherche des ouvrages de petit débit, dans des aquifères accessibles facilement et avec une eau pas trop profonde.

Eaux de surface

Le Zaïre est très bien pourvu en eau de surface. La presque totalité de son territoire est situé sur le bassin versant du fleuve Zaïre qui, au voisinage de son embouchure, est remarquable aussi bien par son débit que par sa régularité. Seule la région du nord-est (bassin du Nil) et le littoral ne sont pas dans le bassin du Zaïre.

L'abondance du réseau hydrographique fait qu'il y a probablement peu de villes qui ne soient pas à distance acceptable d'un cours d'eau exploitable pour l'alimentation en eau. Les eaux sont pour la plupart douces et propices à l'AEP, sauf cas de pollution.

Évaluées dans leur ensemble, les ressources en eau du Zaïre sont très importantes dans toute l'étendue du pays, mais elles présentent plusieurs handicaps notamment la difficulté d'accès, les coûts prohibitifs de mobilisation...

Les données disponibles sur la qualité des eaux au Zaïre sont en nombre relativement limitées, sauf en ce qui concerne les analyses chimiques et bactériologiques. Les quelques analyses pratiquées sur les eaux de source (nappes profondes) à plusieurs endroits dénotent la présence d'une eau acide dont le Ph varie entre 4, 5 et 6 parfois extrêmement chargées en nitrates, et beaucoup plus rarement en nitrite.

Les eaux de surface ont:

- une teneur forte en matière organique;
- une très faible dureté;
- de titres alcalimétriques très faibles;
- une faible teneur en chlorure;
- une faible teneur en nitrates, nitrites et ammoniacque;
- une faible teneur en fer et manganèse.

Les minéralisations totales sont donc très faibles. De plus, les caractéristiques chimiques sont, sauf cas de pollution (surtout dans les grandes villes), tout à fait propre à la consommation.

Législation des eaux

La législation actuelle en matière de l'eau au Zaïre s'appuie principalement sur des textes anciens qui accusent certaine caducité.

A l'issue du premier "Symposium pour la Définition des normes nationales de la qualité des eaux" organisé en 1988, il a été relevé le caractère parcellaire de la législation des eaux, son inadaptation face aux divers usages en évolution, l'insuffisance des infrastructures de protection de l'environnement.

C'est ainsi que face aux exigences actuelles de développement économique et social du pays qui nécessite une gestion rationnelle et équilibrée du patrimoine hydrique selon une approche multi-sectorielle tenant compte des besoins (présents et futurs), un texte de loi portant "code de l'eau" a été élaboré et sera promulgué incessamment. Ce texte sera complété par la loi en matière de la protection de l'environnement qui est en élaboration.

Politique de gestion des ressources en eau

Les connaissances exactes sur les ressources en eau au Zaïre sont quelque peu limitées compte tenu de l'étendue du pays. Cette limitation est due essentiellement à la disparition des données recueillies avant la colonisation, l'étendue très restreinte des recherches depuis 1960 jusqu'à une époque récente et l'absence d'un support documentaire adéquat pour recueillir et conserver les données sur les travaux réalisés.

L'adhésion du Zaïre aux objectifs de la DIEPA a permis la mise en place du Comité National d'Action de l'Eau et de l'Assainissement "CNAEA", organe qui regroupe en son sein plusieurs départements et organismes tant gouvernementaux (nationaux) qu'internationaux intervenants dans le secteur.

L'une des tâches dévolues à ce Comité est de réaliser des études rétrospectives et prospectives qui permettent à partir d'un diagnostic de l'existant, à proposer des recommandations en vue d'une gestion adéquate des ressources en eau.

C'est dans ce cadre qu'ont été initiés une évaluation hydrogéologique en Afrique Sub-Saharienne réunissant les pays de la CEPGL ainsi qu'un Plan de Développement du secteur AEPA à l'horizon 2010 et qui, grâce à l'outil informatique mis en place, permet de gérer les données sectorielles en rapport avec l'eau.

Institutions chargées de la gestion des ressources en eau

Durant les décennies qui ont vu le développement du Zaïre, beaucoup d'organismes ont été concernés par la gestion des ressources en eau. Ces organismes se répartissent suivant les activités menées telles que décrites ci-après:

- Contrôle et utilisation des données météoriques et superficielles:
 - * régie des voies maritimes;
 - * régie des voies fluviales;

- * régie des voies aériennes;
 - * Institut national de la météorologie;
 - * Institut national d'études et de la recherche agronomique.
- Utilisation et exécution des ouvrages (donnés hydrologiques):
 - * REGIDESO;
 - * Service national d'hydraulique rural "SNHR", SANRU;
 - * CRGM;
 - * ONG nombreuses.
 - Coordination et gestion des ressources en eau:
 - * Comité national d'action de l'eau et de l'assainissement "CNNEA";
 - * Ministère ayant l'eau dans les attributions (énergie, environnement).

PROBLEMES MAJEURS DANS LA GESTION DES RESSOURCES EN EAU

Les problèmes importants qui y sont posés sont les suivants:

- (1) Insuffisance des données mobilisées.
 Cette insuffisance est due surtout à la dispersion des informations provenant des rapports d'exécution d'ouvrages, absence d'inventaire général des points d'eau et d'une synthèse hydrogéologique – aide à la décision, manque d'actualisation des fiches d'enquête des points d'eau, grande dispersion des intervenants...
- (2) Faible densité des points d'observation.
 Le pays n'a pas pu mettre en place un réseau standardisé de points de mesure hydrométrique suffisants, pas de suivi de l'exploitation mais seulement un contrôle se fait en case de défaillance de l'ouvrage (pas de coordonnées géographiques, données sur la qualité des eaux, évaluation des débits et cartographie non assurées).
- (3) Qualité des données disponibles discutables car elles comportent plusieurs erreurs liées souvent à l'incohérence des appareils de mesures et à la compétence des agents chargés de la tâche.
- (4) Le manque d'un texte réglementaire sur les usages tant au niveau national que régional des points d'eau. La plupart des textes sont en élaboration et ceux qui existent sont caduques.

RESUME DES ACTIVITES

Les données hydrauliques concernent essentiellement les sources, les forages inventoriés et contrôlés par la REGIDESO (hydraulique urbaine) et le SNHR (hydraulique rurale).

En 1990, la desserte en eau potable en milieu urbain était évaluée à 64% et 24% en AEPR. En ce qui concerne le type d'ouvrage, pour des raisons de qualité de l'eau, la préférence est donnée aux ressources en eaux souterraines en hydraulique villageoise. Les ouvrages concernent alors soit

des puits soit des forages dans les zones de socle ou en zone sédimentaire soit des captages des sources dans les zones humides.

En hydraulique urbaine, à l'exception de petits centres où on recourt quelques fois aux eaux souterraines, la mobilisation des eaux se fait à partir des eaux de surface pour alimenter les grandes villes. Les réseaux de distribution d'eau sont souvent orientés vers les branchements particuliers. Les aménagements comprennent les stations de pompage et de traitement des eaux.

D'autres usages de l'eau sont l'hydroélectricité et la navigation. L'agriculture profite seulement de la pluviométrie abondante mais l'irrigation n'est pas développée.

RECOMMANDATIONS

Dans les perspectives de développement du secteur des ressources en eau, les recommandations portent sur:

- (1) établissement d'une législation du régime des eaux;**
- (2) renforcement de la Commission des Etudes Hydrologiques du CNAEA qui serait responsable du réseau d'information sur l'eau;**
- (3) renforcement des réseaux de mesures hydrométriques et établissement de synthèses périodiques;**
- (4) conception de technologies innovatrices.**

A cet effet, les grandes orientations pour une gestion optimale des ressources en eau viseraient à relever les grands défis auxquels le pays fait face notamment:

- (1) l'accroissement de la population sans commune mesure avec les efforts de maîtrise de l'espace environnemental;**
- (2) la limitation des risques de pollution des eaux surtout dans les grandes villes et dans les zones industrielles;**
- (3) le renforcement institutionnel qui faciliterait les capacités de gestion de sous-secteur.**

Voilà, en quelques mots, la situation des ressources en eau relevée à travers quelques études réalisées dans le pays.

**Régie De Distribution D'eau Du Zaïre
Regideso**

ZAMBIA

1. INTRODUCTION

Zambia covers an area of about 753 thousand square kilometers and had an estimated population of 9.1 million people in 1995. Administratively, the country is divided into nine provinces of Central, Copperbelt, Eastern, Luapula, Lusaka, Northern, North-Western, Southern, and Western. Its water resources potential is estimated at 135 mm annual runoff and 160.08 million cubic meters as annual recharge for ground water.

Considering the size and population of the country, the water resources of Zambia are considered in normal years to be sufficient to meet both short and long-term requirements of the nation. However, water is a limited resource based on the realization that the qualities of water available for exploitation and use at costs that are affordable by many are limited by various factors. These include unfavorable climatic conditions in some regions, uneven geographic distribution in relation to areas of demand, declining quality in some basins such as the Kafue, and the obligation to share the available water resources with the other countries in a common river basin.

Since water is a critical resource which supports the natural environment, food, and agriculture, health, industry, energy, transport, and tourism, its management therefore needs a holistic approach in which comprehensive spectrum of demands are recognized and evaluated to assess their priority. There is also need to put in place adequate institutional and legal framework which will support rational utilization of the water resources in order to benefit all sectors of the economy and the natural environment.

2. WATER RESOURCES OF ZAMBIA

Zambia is blessed with abundant water resources in comparison to other neighboring countries in the Southern African region. The country has a well distributed system of perennial rivers, streams, lakes, and swamps throughout its territory. There are five river basins of Zambezi, Kafue, Luangwa, Chambeshi/Luapula, and Tanganyika. In all, the surface water resources are estimated to cover 45,000 square kilometers of the total land area.

Apart from surface water resources, Zambia enjoys favorable ground water conditions compared to most countries in the Southern African region with regard to depth, storage capacity, available yields, and exploitation potential. The most productive aquifers are the limestones. Other productive aquifers are the alluvial formations, the Kalahari sands, and Karroo formations.

2.1 WATER RESOURCES POTENTIAL

Zambia has a mean annual rainfall which varies from 1,400 mm in the north to 700 mm in the south along the shores of Lake Kariba. The total runoff is of the order of 4,000 cumecs when runoff from Angola is included. The runoff generated locally is 3,200 cumecs or 100,000 mcm annually (MacDonald 1990 Sub-Saharan Hydrological Assessment Report).

The Zambesi Basin represents by far the largest water resource for Zambia and is currently used for hydro-power generation at Victoria Falls (108 mw) and Kariba Dam (1,266 mw). The mean annual runoff of the river as it enters Lake Kariba is 1900 cumecs.

The Kafue River is part of the Zambezi Basin but is completely inside Zambian territory and has a mean annual runoff of 350 cumecs. By virtue of its location and course, the Kafue River has become the most important and most utilized river basin in the country as all the major industrial towns and centers are located within its basin.

The Luangwa River is also part of the Zambezi Basin and contributes an estimated 500 cumecs as mean annual runoff to the Zambezi. The Luangwa has less or no potential for demanding due to high turbidity and high sediment loads.

The Chambeshi and Luapula Rivers are part of the Congo Basin and discharge their flow through Lake Mweru into the Congo River. The estimated mean annual runoff of the two rivers at Lake Maweru is 690 cumecs.

In addition to rivers, Zambia has large natural lakes such as Bangweulu, Mweru-Wantipa Mweru, and Tanganyika.

Ground water resources of Zambia have favorable conditions as regards to depth, storage capacity, available yields, and exploitation potential. The total estimated ground water storage is 1740.4 mcm with recharge of 160.08 mcm per annum.

According to the studies carried out by Chenov, ground water resources of Zambia are divided into four major drainage basins of Luapula/Tanganyika, Luangwa, Kafue, and Zambezi (see Table 1). The aquifers are classified into three types as follows:

- (a) Aquifers where inter-granular ground water flow is dominant.
This category includes the alluvial formations, the Kalahari Group, and the Karroo Group.
- (b) Aquifers where ground water flow is mainly in fissures, channels, or discontinuities.
This category includes the highly productive aquifers of the roan dolomites and kundelungu limestones, and the locally productive aquifers of the lower Roan Quartzites, Muva Sediments, granites, and undifferentiated Kundelungu formations.
- (c) Low yielding aquifers with limited potential.
These include the major part of the argillaceous formations, Karroo basalt, and the older Basement Complex.

Table 1. Ground Water Potential In Zambia (All values in million cubic meters)

	Drainage Basin	Luapula-Tanganyika	Luangwa	Kafue	Zambezi	Total
1	Basin Area (km ²)	194,000	147,500	155,000	256,000	752,000
2	Total Mean Annual Rainfall (mm)	214.1	122.3	149.72	228.69	714.85
3	Ground water through flow	0.83	1.634	0.96	0.22	3.65
4	Vertical recharge	41.5	33.02	24.45	64.03	160.08
5	Ground water storage	377.7	242.76	252.06	86.82	1,740.4

2.2 WATER QUALITY

The quality of water in most of the rivers in Zambia is generally good. The most comprehensive results were gathered during the National Water Resources Master Plan Study by JICA Study Team in 1990-1994. However, there are issues of some concern regarding the quality of water in some rivers and streams. These are:

- (a) high turbidity in the Luangwa River throughout the year;
- (b) high copper content in most streams;
- (c) high nutrient loading in many streams that probably warrant special investigations given the example of nuisance need problem already evident in middle Kafue.

For drinking purposes, the quality of ground water is considered to be good. Its suitability for other purposes is not yet determined due to lack of adequate data. In most cases ground water is considered to be good for any use even if no analysis has been conducted.

It is generally observed that ground water in the Kalahari Sands and the Karroo formation has poor quality due to high contents of iron and fluoride respectively.

2.3 WATER LAWS AND INSTITUTIONS

Among the legal enactments in Zambia that are related to water, the Water Act is Supreme Law. The Act stipulates the state ownership of surface water resources and procedures of authorization and invalidation of water rights. Under this Act, the Water Development Board has been established as the authorizing entity.

Other important laws on water resources management are the Natural Resources Conservation Act, Environment Protection and Pollution Control Act, the Local Government Act, and the Lands Acquisition Act. The Natural Resources Conservation Act is the law for conservation and rational use of natural resources, while the Environment Protection and Pollution Control Act covers environmental protection and pollution control. The Lands Acquisition Act makes provisions for compulsory land acquisition in the national interest, including those for dam and reservoir development. The roles and responsibilities of the local governments, the city, municipal and district councils are stipulated in the Local Government Act.

The Department of Water Affairs in the present Ministry of Energy and Water Development and the Water Development Board are the major organizations responsible for the management and

development of water resources, while resource conservation is discharged mainly by the Ministry of Environment and Natural Resources and the Environment Council of Zambia.

There are a number of organizations which use and regulate the usage of water. The major ones are:

- (a) Zambia Electricity Supply Corporation which supplies electricity and maintains a number of hydro power stations.
- (b) Kariba North Bank which maintains the Kariba Hydro power station.
- (c) Zambezi River Authority which regulates the use of water in the Zambezi River. The organization is jointly owned by Zambia and Zimbabwe.
- (d) The Lusaka Water Sewerage Company and city, municipal and district councils supply water and sanitary services in urban areas.

2.4 WATER RESOURCES MANAGEMENT POLICIES

Zambia previously had no coherent Water Policy for planning, management, and development of its water resources. In recognition of the important role water plays not only in the ordinary lives of the people but also in the economic development of the Country, the Government of the Republic of Zambia through the Ministry of Energy and Water Development, in November 1994 evolved the National Water Policy.

The water policy put in place measures and strategies in order to achieve long-term sustainability of the water resources. The measures put in place are stipulated below:

- (a) Recognizing the important role of the water sector in the overall socio-economic development of the country.
- (b) Vesting ownership of water resources in the country under state control.
- (c) Promoting water resources development through an integrated management approach.
- (d) Defining clear institutional responsibilities of all stakeholders in the water sector for effective management and coordination.
- (e) Developing an appropriate institutional and legal framework for effective management of water resources.
- (f) Promoting a state of disaster preparedness to mitigate impacts of extreme occurrence of water (flood and drought).
- (g) Recognizing water as an economic good.

3. MAJOR ISSUES IN WATER RESOURCES MANAGEMENT

Although Zambia is endowed with abundant water resources, there are factors that limit the exploitation and use of these resources. These factors include unfavorable climatic conditions in some regions, uneven geographic distribution in relation to areas of demand, declining quality in some basins, and the obligation to share the available water resources with other countries in a common river basin. Other factors that affect effective management of water resources are issues related to water laws and regulations, institutions responsible for water, human resources

development in water institutions, and provision and acquisition of reliable data on water resources.

3.1 WATER QUANTITY AND QUALITY

The quantity and quality of available water in Zambia is affected by many factors some of which are given below:

- (a) Uneven geographic distribution in relation to demand.

High water demand is in the Kafue Basin and the southern half of the country. The Kafue Basin has potential for irrigated agriculture, tourism, fisheries, and hydropower generation. It also houses all the major industrial towns and centers and is the home of 40% of Zambia's population. However, its contribution to national water resources is only 14%.

The southern half of Zambia which includes some parts of the Kafue Basin has high agricultural potential, but it only receives half the amount of rainfall as the northern part, and the total annual runoff produced by the south is five times less than that of the North.

- (b) Unfavorable climatic conditions in some regions.

As earlier stated, the southern half of the country has high demand of water due to its agricultural potential. This potential is difficult to utilize due to the persistent droughts year after year. Furthermore, the south has few perennial rivers and streams.

- (c) Lack of laws and regulations to protect ground water resources.

Presently ground water is regarded as private, and therefore there exist no laws and regulations governing the use of ground water. In some areas, i.e. Lusaka, ground water is being mined due to unregulated drilling of boreholes and abstraction of ground water.

- (d) Inadequate monitoring mechanisms for water conservation and pollution control.

Although there exist laws and regulations on the conservation and protection of water resources, the monitoring capacity of the relevant institutions is very low. For example, currently the registration of industrial discharge to the environment is proceeding on a voluntary basis with industries otherwise already registered with the Ministry of Commerce, Trade and Industry.

3.2 POLICY AND REGULATIONS

The water policy has put in place all the necessary measures and strategies, but what now is required is the support of legal instruments which make the policy objectives on water resources management attainable. The fundamental legislation is well stipulated, but is often not followed by detailed statutory instruments or regulations containing the necessary technical standards or norms and prescribed procedure.

In the Water Act, ground water is currently classified as private water. Such water can be used free of charge without license from the Water Development Board. Effective control of ground water does not appear in the legislation. Technical and managerial standards, regulations, or norms for planning, design, operation, and maintenance of water resources facilities are not well established in the legislation.

3.3 INSTITUTIONS AND HUMAN RESOURCES

The major institutions responsible for the development, conservation, and management of water resources are the Ministry of Energy and Water Development through the Department of Water Affairs, the Ministry of Environment and Natural Resources, the Water Development Board, and the Environmental Council of Zambia.

The Water Development Board is both under-staffed and under-equipped. Although legally the Water Board belongs to the Ministry, its budgetary allocation is made through the Department of Water Affairs.

The Water Board lacks adequate technical as well administrative and clerical staff resulting in the inappropriate implementation of its duties. This has made it dependent on the department of Water Affairs especially for technical support.

Even though the Department of Water Affairs is staffed by over 1,800 personnel, more than 60% are daily employees, and only 13% are permanent. Out of the 177 professionals and technicians, the Water Supply Section accounts for 71%, and only 29% work for water resources management.

The Ministry of Environment and Natural Resources, and the Environmental Council of Zambia have some duplications in the allocation of regulatory and operational functions. Both the Ministry and the Council suffer from a general lack of professional and technical staff.

3.4 DATA AND INFORMATION

Data and information on water resources are very scanty. However, data on surface water resources do exist though mostly in raw form. As regards ground water, due to inadequate legislation for ground water resources regulation by the government, most of the data are not of much use.

A little information on water resources exists through publications by the Department of Meteorology in the Ministry of Transport and Communications mainly for weather forecast. Before 1977, the Department of Water Affairs used to publish hydrological yearbooks, though only on surface water resources. Since then no publication has been done.

3.5 SHARED WATERS

The Zambezi River Basin is shared by many countries. These include Angola, Namibia, Botswana, Zambia, Zimbabwe, Tanzania, Malawi, and Mozambique. It is evident from the above that in order to utilize the water resources of the Zambezi River, some form of agreement among these countries need to be signed. There already exists a protocol on shared waters of which Zambia is to be one of the signatories.

The Zambezi River Authority Act of 1987 ratified the agreement between Zambia and Zimbabwe for the development of the Zambezi water along the common boundary. The Act provides 50/50 sharing of benefits and costs principally for hydropower and calls for consent before substantial quantities of water are abstracted for other uses such as irrigation. No agreements exist for other river basins, e.g. Luapula and Tanganyika.

4. MAJOR ACTIVITIES IN THE WATER SECTOR

There are a number of ongoing projects in the water sector. They include the following:

- (a) Rehabilitation of some urban and township water supplies (Kafue, Monze, Choma, and Livingstone).
- (b) Rehabilitation of dams and weirs in drought prone Southern, Lusaka, Central, and Eastern Provinces.
- (c) Construction of peri-urban water supplies in Lusaka.
- (d) Construction and rehabilitation of rural water supplies through donor funding in Central, Northern, North-Western, Lusaka, Copperbelt, Eastern, and Southern Provinces.
- (c) Development of the National Water Resources Master Plan.

4.1 ACHIEVEMENTS IN WATER MANAGEMENT

Some of the major achievements in water resources management are the formulation of the National Water Resources Master Plan funded by the government of Japan and the evolution of the National Water Policy.

The objectives of the Water Resources Master Plan Study were to formulate a national water resources master plan through the year 2015 and to propose an action plan through the year 2005, outlining the implementation of priority projects. The proposals for the master plan include plans for the construction of multipurpose dams, developments of public water supply systems, and many others. Improvements to laws and institutions are also recommended.

The National Water Policy has already identified measures and strategies necessary to achieve long-term sustainability of the water resources. What is now left is the implementation of this policy on the basis of the strategies already identified.

Other achievements have been the recognition of the need to involve the community in the management of water facilities. Water, Sanitation, Health, and Education (WASHE) committees have been formed in rural areas.

4.2 PLANS TO RESOLVE WATER MANAGEMENT ISSUES

In order to resolve water resources management issues, the Water Policy identified necessary strategies which need to be implemented. These include the following:

- (a) According high priority to water sector in view of its parameter role to all socio-economic activities.
- (b) Adequately supporting and promoting all developmental programs in the water sector in order to improve the level of service delivery to other sources.
- (c) Identifying weakness in the present Water Act with due regard to water resources that are currently under private ownership.
- (d) Revising the Water Act to incorporate water bodies, such as ground water now under private control, under state control.

- (e) Developing conventions and protocols in the case of internationally shared water resources in accordance with international legal principles known as the Helsinki Rules which embody the concept of best joint utilization.
- (f) Assessing the water resource potential from both surface and ground water resources.
- (g) Building and strengthening the capacity of water resources management and monitoring in the Department of Water Affairs (DWA).
- (h) Undertaking public awareness campaigns on development and conservation of water resources.
- (i) Strengthening the water resources data bank in DWA to incorporate all developmental activities that have an impact on water resources.
- (j) Involving research institutions in the development of appropriate and environmentally sound technologies and ensuring their adaptability to local conditions.
- (k) Undertaking environmental impact assessments prior to implementation of any development project.
- (l) Developing up to date Water Master Plan.
- (m) Separating water resources management activities from those related to water supply.
- (n) Concentrating water resources management activities in one ministry.
- (o) Identifying weaknesses in the existing institutional structure regarding water resources management.
- (p) Recommending re-organization measures for water resources management.
- (q) Strengthening water resources management in DWA.
- (r) Enacting appropriate legislation to deal with water resources management at the national level as well as those dealing with internationally shared water resources.
- (s) Recognizing the Environmental Protection and Pollution Control Act and any other pieces of legislation relating to water resources quality aspects.
- (t) Establishing early warning system capabilities pertaining to floods and drought.
- (u) Providing financial resources to establish and strengthen research activities in climate variations related to flood and drought occurrence.
- (v) Promoting effective coordination links between various institutions during emergency situations.
- (w) Drafting water tariff legislation to cover provision and allocation of water resources for consumptive and non-consumptive use.

4.3 OTHER OPPORTUNITIES

The government is presently conducting a restructuring exercise in all public service institutions to enhance efficiency in their operations. This entails building institutional capacity and developing human resources.

After the restructuring exercise, the Department of Water Affairs shall be responsible for management of water resources while the water supply functions shall be the responsibility of the Ministry of Local Government and Housing.

It is also recommended that the Water Department Board shall be strengthened so as to enable the Board to administer its legal and monitoring functions.

As regards the Rural Water Supply and Sanitation, since this affects the vulnerable section of the society, the government is responsible for the provision of some facilities (boreholes and wells) with full participation of the community, while the management of these facilities is the responsibility of the beneficiaries through the WASHE Committees.

5. RECOMMENDATIONS

Water is a critical resource which sustains life. It is therefore prudent that the conservation and management of this very important resource should be given the highest priority by government in view of its paramount role in all socio-economic activities.

In order to achieve sustainable water resources development, the following recommendations are made:

- (a) Need for political commitment by the government in resource mobilization for the development, management, and conservation of the water resources.
- (b) Functions for development, management, and conservation of water resources should be in one ministry so as to avoid duplication of responsibilities and waste of resources.
- (c) Need to enact laws and regulations that govern the use of both national and international waters.
- (d) Need to enforce laws and regulations by the establishment of monitoring mechanisms for the management and conservation of water resources.
- (e) Need to fully involve local communities in all aspects of water resources management and conservation by conducting awareness campaigns.
- (f) Need to acquire data and disseminate information on water resources, development, and conservation.
- (g) Need to carry out research activities on climate variations related to flood and drought occurrence.
- (h) Need to protect the vulnerable section of the community by the provision of safe and adequate drinking water.
- (i) Need to implement the strategies outlined in the water policy on water resources management.

REFERENCES:

1. NATIONAL WATER POLICY OF ZAMBIA (1994).
2. NATIONAL WATER RESOURCES MASTER PLAN STUDY REPORT (JICA 1990-1994).

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ZIMBABWE

1. INTRODUCTION

In these days of persistent droughts in the Sub-Saharan African (SSA) region in general and in Zimbabwe in particular, the importance of sound water resources management (WRM) can never be over-emphasized. We are increasingly facing a shrinking water resources base. Our national economic development will depend, *inter alia*, on how well we manage the available water resources now and in the future. The complexity of the WRM problem is further compounded by the fact that WRM is a dynamic process. Any changes in the socio-economic, politico-cultural, and physical environments tend to trigger signals requiring appropriate responses to WRM from us. The challenge to us is how we can develop those appropriate strategies to guide WRM. Strategies themselves have to derive from a thorough analysis of the situation in the water sector and the enunciation of sound policies in WRM. This subject has attracted not only our attention but that of the international community as well. This is more so for the SSA sub-region where per capita food production is said to have generally fallen far below demand. While the need for sound WRM is a general thread running through the Sub-Saharan African region, there are always some specifics which are unique to each of the countries in this region. The following sections cover the specific WRM situation in Zimbabwe.

2. THE WATER SECTOR IN ZIMBABWE

In Zimbabwe, comprehensive surface water resources assessments have been made from available stream flow records which are of adequate duration and quality. At present these assessments have excluded water availability from such international rivers as the Limpopo and the Zambezi. For planning and development of the water resources, the country is broadly divided into 8 river basins. These include the following: 1) Gwayi-Shangani, 2) Sanyati, 3) Manyame-Dande, 4) Mazowe, 5) Ruwenya-Pungwe, 6) Save, 7) Bubi-Runde, and 8) Shashe.

2.1 WATER RESOURCES QUANTITY AND QUALITY

The water availability estimates of 1993 are the most recent using updated data. This study (Kabell et al 1993) estimates that, of the long-term mean annual rainfall of 674.5 mm (259.1 Billion Cubic Meters) only 7.7% or 51.8 mm (19.9 BCM) are available as runoff. In this assessment, the study assumed the availability of dam sites with sufficient storage capacity along river basins to enable full exploitation of the available water potential.

It was also assumed that the storage capacity would be twice the mean annual runoff (MAR) of each basin. This would enable the optimum yield to be developed. With these assumptions, the potential yield from the 8 river basins was estimated at 11.26 BCM. Exploitable yield was estimated at 75% of the potential at 8.5 BCM. This allows for constraints, e.g. topography and disparity between locations of storage sites and regions of water consumption. This is summarized as follows:

Total surface water resources potential available for development	11200 MCM based on 10% yield
Exploitable yield out of the total	8500 MCM
Committed yield out of exploitable yield	4890 MCM
Balance	3610 MCM
Amount reserved for irrigation (based on 80% of balance)	2888 MCM
Potential area irrigable at 12000m ³ /ha/annum	241000 ha

The above estimates do not include ground water resources which are estimated at 1000 MCM.

Generally speaking, Zimbabwe has had limited water quality problems. However, if unchecked, poor quality could easily build up to uncontrollable levels around the big cities of Harare and Bulawayo where industrial and municipal effluent is produced in large quantities. In 1993, these two cities produced about 70 Million Cubic Meters (MCM) of effluent. If this is allowed into the public streams and rivers, the results could be disastrous. Occasional signs of alkalinity in the water have been reported in ground water in the south-eastern lowveld of the country.

3. WATER LAWS

The water sector in Zimbabwe is governed by the Water Act of 1976 which has been reviewed recently so as to take account of the changed national socioeconomic environment. This has been found necessary in order to improve equity in the access to and use of water. Moreover, as the country reels under the spate of frequent droughts, water scarcity is beginning to have a grip on the nation. Water controls are common in cities and towns and the irrigation sub-sector. This law is administered by the Administrative Court of Zimbabwe which houses the Water Court. The old law is based on the Riparian Doctrine, and it recognizes the principle of the "Priority of Rights" and that, all other things being equal, the holder can have the granted water right in perpetuity.

The review sought to redress some of these aspects which are no longer useful in present day Zimbabwe. The Water Act (Law) recognizes the existence of public and private water and various uses of public water, e.g.:

- Primary uses, being those uses to cover rural domestic and stock watering.
- Secondary uses. This covers the use of water in the primary industries, e.g. agriculture and mining.
- Tertiary Uses. This covers the use of water for industrial, municipal, and institutional purposes.

The use of water for purposes other than primary requires users to secure a water right before they can have access to the resource. The water rights are free, save for the application fee of ZW\$10.50. However, users who get access to ministerial water in major government dams have to pay a water blend price of ZW\$47.00 per 1000m³. The law empowers the minister to regulate the use of water in times of scarcity, to deal with issues of water pollution, and to be the custodian of all public water.

4. WRM POLICIES

Zimbabwe is in the arduous process of preparing its water sector policy. The exercise is being spear-headed by a steering committee comprising government and private sector organs. This committee co-ordinates the efforts of three technical sub-committees. These are the Sub-committee on Urban, Industrial and Mining water uses (UIM), the Irrigation/ Agricultural Sub-committee, and the Sub-committee on Primary Water Supply. These sub-committees are at different stages of task completion, with the irrigation sub-committee having completed the "Draft Irrigation Policy and Strategy" for the country. Once all the sub-committees are done, the three sections will be collated into a comprehensive water sector policy and strategy document. This process recognizes the need for stakeholder participation. In the general policy direction, this will mean an increased role for stakeholders in WRM. They will have to shoulder more responsibility at local and regional levels, with government setting and monitoring the rules of the game.

The government will also have to create an enabling environment to ensure effective stakeholder participation in WRM. A study of options on water pricing is also under way. We need a water price which is not so high as to inhibit general economic development but also not so cheap as to promote inefficient use of this scarce resource. The policy will also recognize the need for reform in the legal framework which governs the allocation and administration of water in the country. Human resources development and institutional capacity building are very important tenets of the proposed water policy. Last but not least are those aspects relating to human health, environmental integrity, and over-all sustainability of our national development in the water sector. These should be addressed by the intended policy.

5. WATER SECTOR INSTITUTIONS

The mandate for WRM lies with the Department of Water Resources in the new ministry of Lands and Water Resources. The other collaborating Ministries are those of Agriculture and Local Government since they are the largest users of water resources. However, other organizations also collaborate when necessary. Agritex in the Ministry of Agriculture (MOA) has the mandate for irrigation development while DDF in Local Government will build small dams and drill boreholes for water supplies in the Communal and Resettlement Areas.

The Department of Water Resources (DWR) plans and implements all major national water schemes except where a local authority has the necessary skills to do so under the supervision of DWR. The Ministry of Environment and Tourism (MET) will look after the environmental impacts of any water development projects. The Ministry of Energy and Transport is responsible for hydro-power generation and distribution of electricity. The river boards manage water at the river catchment or regional level while the Irrigation Management Committees (IMCS) will manage water for the smallholder irrigators at irrigation scheme level. Regulatory activities in WRM are a joint responsibility among several institutions although DWR is the lead agency.

6. NATIONAL WRM ISSUES

The nation faces a number of contentious issues in water resources management. Some of these are as follows.

1. WATER QUANTITY AND QUALITY

The issues with regards to water quantity are both political and technical in nature. They are political in the sense that Zimbabwe is only one and a half decades into independence.

At Independence in 1980, Zimbabwe found itself confronted by both a moral and socio-economic contradiction in its midst. The water resources distribution was heavily skewed in favor of a few large-scale white commercial farmers. The majority of the communal, resettlement, small-scale commercial farmers and emergent large-scale black commercial farmers find themselves with very little or no access to the use of the national water resources today.

Obviously, the issue of equity in water distribution needs to be addressed squarely. On the technical front, the allocated water seems inefficiently used. People use too much water than needed due to either lack of sufficient training in water management or due to the relatively cheap water price.

2. POLICY AND REGULATORY ISSUES

Water sector policy is still under preparation. All stakeholders need to be involved. This poses an immediate problem on how to get all these people to agree on what are considered substantive issues of policy and how the policy statements should be cast. Sometimes there are disagreements as to the adequacy of any suggested policy thrust. Regulatory services in the water sector are governed by the Water Act of 1976 which is currently being reviewed. The issues of permanent water rights and priority of rights in water allocation and use are topical.

3. INSTITUTIONAL AND HUMAN RESOURCES ISSUES

WRM is by its very nature multi-disciplinary. However there is need for an apex body which has ultimate authority over all the other participating organizations. In Zimbabwe, several institutions will build dams for water storage, e.g. DWR, DDF, Agritex, and individual farmers. This is done with some fair amount of autonomy except for the size restrictions on the structure. Regarding human resources, the country is unable to retain the few well qualified ones due to poor conditions of service. They often find their way to some greener pastures in the sub-region or overseas. The farmers and municipal water users need training on water management.

4. DATA AND INFORMATION ISSUES

Data banks and information on the water resources of the country are needed. A comprehensive water resources inventory to cover both surface and ground water is needed. This should also cover supply and demand aspects.

5. TRANSBOUNDARY WATER ISSUES

Zimbabwe shares two major rivers as boundaries with its neighbors. The Zambezi to the north with Zambia and the Limpopo in the south with the Republic of South Africa (RSA). Since Zimbabwe is riparian to these rivers, it certainly will, in consultation with its neighbors, be interested in some of the water from these rivers. As of now, Zimbabwe is a participant in the Zambezi Action Plan (Zacplan) in which the countries in the Zambezi catchment area agree to co-operate in the planning for and sustainable use of the water resources in this basin.

7. SUMMARY OF ACTIVITIES IN WRM AND RECOMMENDATIONS

Zimbabwe is already working on a comprehensive WRM policy and strategy to guide the exploitation of the country's water resources. It is hoped that in this exercise, major water management issues will be resolved. The stakeholders will engage in dialogue between and among government and themselves. Issues will be raised and solutions suggested. This exercise has offered Zimbabweans an opportunity to redress the inequities of the past, an opportunity to bring to the fore technical issues such as inefficient water utilization, and the realization that this whole exercise will have to be a joint responsibility by both government and the other stakeholders within the spirit of national economic growth and sectoral sustainability.

Zimbabwe has already started to consider a WRM strategy based on the policy issues which are being widely discussed and are already available in draft form for some of the water sub-sectors. Broadly put, the strategy will, among other things, seek an integrated approach to water resources planning and implementation based on the principles of sustainable development. In order for the strategy to be achievable, the following reforms are being suggested for implementation as a matter of priority.

- Implementation of legal reforms, especially on the Water Act of 1976, so as to allow greater and more equitable water resources development;
- Institutional restructuring and strengthening of DWR in order to ensure capacity to execute an expanded program of action;
- Adoption of a river basin as a unit of water resources planning and development;
- Investment in human capital at professional, managerial, and technical levels, in order to manage the strategy;
- Involvement of all stakeholders in the planning and development process; and
- Investment in water resources research, technology development and testing, and information dissemination.

8. CONCLUSION

Zimbabwe is a drought prone country, and as such water resources development is an imperative. Any development drive which ignores the central role of stakeholder participation is bound to fail and should be avoided at all cost. WRM should be environmentally conscious.

It is essential that WRM be based on sound government policies which encourage individual initiative and ensure equity and human resources development.

REFERENCES

1. Chitsiko R. J. 1995, WRM policy review and reform: experience from Zimbabwe. In; FAO Water Reports NO. 6, Methodology for Water Policy Review and Reform. Proceedings of the Expert Consultation on water Policy Review and Reform, Rome, Italy.
2. Department of Water development (DWD), 1988. An assessment of the surface water resources of Zimbabwe and guidelines for development. Ministry of Water Resources, HARARE.
3. GOZ and FAO, 1994. "Unpublished" Draft Irrigation Policy and Strategy for Zimbabwe.
4. Kabell, T.C. 1984 An assessment of the surface water resources of Zimbabwe and guidelines for development planning. DWD, Zimbabwe.

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THEMATIC PRESENTATIONS

GROUP A: STRATEGIES AND INVESTMENT OPTIONS LONG TERM VISION OR SHORT TERM REALITY

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1. INTRODUCTION

The objective of this short paper is not to repeat sections of the Strategy Paper nor is it to provide different views. Rather, it is to stimulate discussion by highlighting and developing key themes of the Strategy Paper in a provocative way.

Is it important to have a *long-term, strategic vision* in managing a nation's - or a basin's - water resources, a vision which defines the overall challenge, informs policy, sets goals, creates incentives, and allows rational planning?

However, while a long-term vision can be defined, it is almost always distorted by *short-term reality*, which is often far from the vision. This reality is proscribed by political expediency, economic and social constraints, environmental diversity and complexity, and limited capacity. These are rarely minor factors that can be readily overcome or ignored - they are the driving forces that define what can and cannot be done.

How can the short-term realities in Africa be addressed while maintaining sight of a long-term vision? This is a challenge for the countries of the Region and a question at the heart of the Strategy Paper. In seeking to address this question, this paper briefly looks at five themes:

- the long-term, strategic vision
- short-term realities
- policy objectives
- strategy options
- investment choices and financing roles

2. A STRATEGIC VISION

A strategic vision for any country in the world (or group of countries) could be '*to develop and manage its water resources to meet the present objectives of society, without compromising the objectives of society in the future*'. This goal of integrated water resources management (expanded in Box 1) includes the notions of sustainability, equity, and efficiency and becomes a possible vision for the Africa Region, needing recognition and long-term advocacy and commitment. The vision is one of rational exploitation of water resources by individual nations and groups of nations, meeting social objectives by ensuring the extension of water and sanitation services to all the Region's inhabitants and enhancing food security through improved irrigated and dryland farming, achieving economic objectives by allocating water resources to different uses in the most efficient way, and accomplishing environmental objectives by effective stewardship of scarce water resources through conservation and protection.

Box 1. African Water Resources Management: Goals and Challenges

A *long-term strategic vision* for individual countries and groups of countries could be to develop and manage their water resources to meet the present objectives of society, which could include the following:

- ◇ human health
- ◇ equity
- ◇ economic efficiency and productivity
- ◇ environmental protection

without compromising the objectives of society in the future, to ensure long-term sustainability.

The overall vision is compounded by particular characteristics of the Region, each relevant in some countries more than others, creating *specific challenges*, which could include:

- ◇ meeting the demand for affordable water and sanitation services by the unreserved rural and urban poor;
- ◇ enhancing food production with efficient use of water;
- ◇ coping with the environmental impacts of rapidly growing cities;
- ◇ ameliorating the catastrophic effects of endemic drought;
- ◇ managing growing water scarcity through allocation policies which achieve a balance of economic efficiency and equity;
- ◇ achieving harmony in the development and management of numerous transboundary basins; and
- ◇ building institutions, policies, and regulations.

3. SHORT-TERM REALITIES

How well do others do? Visions and realities can be very different. Only some of the principles set out in the Strategy Paper are embraced by the world's most advanced nations, where the political dimensions of water time and again overshadow apparently rational approaches to water resources management, resulting in apparent compromises and conclusions which can rarely be understood without probing the cultural and constitutional heritage that engenders imperatives which, to a greater or lesser extent, drive the development and management of water resources. Despite the important principle advocated in this Strategy Paper, few industrial nations treat water as an economic good. If industrial nations were to be judged by the effectiveness of their management of water resources, few would score highly. Looking at the United Kingdom, for example:

- ◇ there is almost no stakeholder participation;
- ◇ privatization of *assets* into monopoly water companies has created perverse incentives and associated political problems;
- ◇ raw water pricing does not reflect opportunity (or environmental) costs;
- ◇ retail tariffs are at a flat rate which is generally not based on consumption, as only a small proportion of consumers are metered;
- ◇ regulation is introducing huge costs (US\$ billions) to achieve compliance;
- ◇ much of the water regulation is coming from the EC in Brussels - even further from consumers; and
- ◇ confidence in water quality and the water industry in general is low.

What about Africa? Nevertheless, the problem in Africa is different. At a continental scale, Africa is significantly disadvantaged in comparison with the other continents of the world with regard to its endowment of water resources. The Region has a highly variable climate with extremes of precipitation and temperature and considerable variability. Africa's water resources endowment is particularly difficult to manage effectively, adding a dimension of complexity; it is, however, an endowment that needs to be well managed, adding a special challenge. The water resources endowment is one causal factor in defining the economy of the Region. For example, rainfall has an extraordinary effect on the Zimbabwe stock exchange, which fell by 62% in 1992 due to drought and is now rising this wet season, in response to rain. While drought obviously affects crop and hydropower production, it also reduces the money in every one's pockets, thus having an economy-wide impact. Few economists consider the risks of climatic variability when undertaking macroeconomic projections - there is always an assumption of an 'average' year, yet recent drought across many parts of Africa has demonstrated how susceptible the economy of many nations is to water. In every country the management of water resources is fraught with political implications, tensions, and interference. Limited governance (in terms of accountability, rule of law, transparency...), characteristic of some countries in the Region, intensifies a problem which is anyway ubiquitous and is as entrenched in the industrial world as it is in the developing one.

A pragmatic approach. The long-term vision includes a mix of social, economic, and environmental objectives. These need to be blended in a way that reflects the scale of the issues in individual countries and the capacity to address those issues. In defining strategies for water resources management in the Region, there must be a degree of pragmatism in distinguishing between long-term goals and shorter-term realities. Both threats to water resources and the capacity to manage those threats need to be considered. Where threats are great and capacity is low, the challenge is greatest, as actions are unlikely to succeed without prior efforts to build capacity. An overarching priority is therefore to build capacity. However, a pre-requisite even for building capacity is likely to be the need to enhance awareness of water resources threats and the implications for social and economic development. In promoting the development of water resources management strategies, it is important to:

- ◇ recognize that there are few 'prescriptions', due to physical and cultural diversity, and that sustainable basin- and country-level solutions will need to evolve gradually, from different starting points and following different routes;
- ◇ promote change which results from conscious decisions by stakeholders, as a result of a process of awareness raising, consultation, debate, and adoption, and not as a result of imposed strategies and conditionalities; and
- ◇ be aware that building sustainable water resources management is always slow and difficult - there are unlikely to be many shortcuts; however, the sooner the process of strengthening the management of water resources is begun, the better.

4. POLICY OBJECTIVES

Social objectives or economic efficiency - or both? Perhaps the most intense debate over policy objectives is that which sets social objectives against economic efficiency. Is this necessarily a real choice? In many cities of the Region, high density (often informal) settlement is commonly very poorly served with water supplies - formally by standpipes or informally by vendors. Consumption levels are generally an order of magnitude lower than in the lower-density areas provided with piped services (15-20 liters against 150-200 liters per head per day), and unit costs

per cubic meter can also be an order of magnitude higher. Transient tenant populations in informal housing are perceived by suppliers as a high risk for billing and collection, and there are few incentives for formal utilities to extend services. There are, in fact, disincentives for such populations to pay bills, due to unreliable services in general and a common sense of disenfranchisement. Thus, subsidies in water prices target only those with formal services - and the more water you use, the greater the level of subsidy you receive. Economic pricing would recover costs, allowing wider service coverage and providing services to the poor at a fraction of the unit prices they typically pay for informal services. If subsidies for the poor are still needed, they must be highly targeted (through vouchers, for example) so that only the poor benefit. The same is also often true in rural areas - where large-scale irrigators pay much lower costs for water than the shadow prices paid by informal irrigators. It is clear that there is often convergence in striving to achieve both economic efficiency in water pricing and also social objectives.

Urban - rural linkages. The farther from perennial surface water, the higher the capital and operating costs of water supplies for domestic, agricultural, and other uses. Poorer people settled in such areas commonly have limited voice. Thus the characteristic remote rural situation: large numbers of people and livestock dependent on wells that are costly and therefore few and far between; water levels are deep, usage is high, and failure is frequent. Repairs are expensive and difficult and therefore infrequent. Health and economic livelihood are at the mercy of water supplies whose coverage is inadequate, reliability poor, and repair in the hands of remote agencies. At the same time, traditional coping strategies for managing the unpredictability of rainfall and a vulnerable landscape for food production are under increasing pressure, with population growth, growing demand for food and water, and inadequate farmer incentives (such as depressed farm-gate prices). Yet rural people are stewards of the landscape. Without their stewardship, the land upon which rain falls degrades, and silt and pollutants fill the rivers and dams that serve downstream cities, often resulting in rapidly rising costs of water supply. In looking at the rational management of the whole basin, the role of the rural poor cannot be overlooked. There is sound economic rationale for levying the cities to recompense the stewards of the landscape for fulfilling their essential task; in the long run, the main beneficiaries will be the city dwellers themselves.

Social objectives: priority and sustainability. There is no doubt that priority must be given to closing the services gap, ensuring that the very large number of rural and urban poor have access to at least a basic level of acceptable water and sanitation services, as well as water for food production. Without this, human health is severely compromised and economic development constrained. Integrated water resources management policies must have closing this gap as a central policy platform; broader policy objectives - such as treating water as an economic good - can be developed but are unlikely to be effectively implemented when a large proportion of the population lack even basic services. Water lies at the heart of the poverty trap.

5. STRATEGIES: A MENU OF OPTIONS

An uncharted journey. In identifying strategies for improving water resources management, it must be emphasized that there are no blueprints, no straight answers, no experts. The process of strategy development and adoption is necessarily politically charged, slow, and risky; as such it needs to be tackled slowly, with care and with widespread consultation. If the long term vision is kept in mind, solutions will evolve to suit the regulatory, economic, social, and political circumstances of the moment, and these solutions will be amended as these circumstances

change. Quite where the process will end up is unknown - the journey is always long and is uncharted, and course changes will come at many points along the way.

Participation - regulation - markets. In water resources management, a spectrum from participation to regulation can be described. Most industrialized countries manage water mostly through regulation, with little participation (e.g. the UK); those that do the opposite (e.g. France) are generally thought to manage water better. First and foremost, the political risks of allocation are taken by those stakeholders who will bear the consequences, not by central government. In Africa, limited governance and thus regulation capacity is often thought to lead to the participation end of the spectrum being adopted as a second best strategy for water management. Increasingly, it is being recognized that participatory approaches, involving stakeholders, are in fact the solutions of choice. Furthermore, they adapt themselves well to traditional practice and customary law in Africa. That is not to say that regulation is not needed, but that the balance is shifted along the spectrum towards participation. A similar spectrum could be perceived with the application of regulation or markets in water allocation. And, for similar reasons, a shift towards the market end of the spectrum, away from excess regulation, is advocated.

Poachers and gamekeepers. At the center of strategy choice is the question of institutions. If there is only one basic rule of water resources management, it is that the supply ('poacher') functions of water provision and wastewater discharge must be separated from the regulation ('gamekeeper') functions of abstraction licensing, standards monitoring, and discharge permitting. Obvious that this may seem, in many parts of the world this rule is broken, where one organization is trying to regulate itself, resulting in conflicts of interest. The regulating agency also needs an intersectoral perspective. As in many - if not most - parts of the world, in many African countries each category of water use is the responsibility of a different ministry or agency, which can often make water resources development decisions without coordinating their actions with others. This sectoral and fragmented approach is at the core of the problem of water resources management. That is not to imply that individual sectors should not continue to be free-standing users of water resources; they should and they will. It is, however, to imply that that water resources management strategies need to be coordinated by an apex institution to avoid sectoral conflicts of interest. For example, calculations of hydropower potential and irrigation potential often both assume exclusive use of available water resources. Intersectoral management implies rational allocation of available resources to the highest value uses, where value is ascribed in terms of meeting a range of objectives - economic, social, or political.

A long list of strategies. Chapter 4 of the Strategy Paper sets out a long list of strategic options and related actions, not as a prescription, but rather as a guide to the menu of choices. This list is summarized here as Table 1, representing a shorter, but relatively comprehensive menu.

6. INVESTMENT CHOICES AND FINANCING ROLES

Fiscal retrenchment. Investment choices between sectors will always be determined by a mix of economic and social objectives, coupled with political imperatives. To the extent possible, the use of price as an instrument of allocation and maximizing net present value in investment choice will generally result in wise investment, although the safety net for the Region's poor must always be a mitigating factor. However, across the Region there is widespread fiscal retrenchment, capital is scarce, and donor financing for the sector may well reduce in real terms. There are two significant ways forward: *resource mobilization*, both domestic and international; and *cost reduction*. Other than economic pricing and cost recovery, a key strategy for resource mobilization is private

sector participation. In the case of cost reduction, other than ensuring a range of appropriate technology choices (essential, but not discussed in this short paper), a key strategy for cost reduction is demand and asset management.

Public - private partnership. Commercialization will almost invariably increase the efficiency of a public utility and is an important first step. Despite the controversy often caused in the public sector, across the world there has been an extraordinary move over the last 10 years towards privatization in water resources development, and particularly in the provision of water and wastewater services. Reasons for this include:

- fiscal retrenchment - the need to raise private capital;
- poor performance of public utilities (with unaccounted-for-water often 40-60%, when it is 10-20% in well-managed companies);
- overstaffing (5-15 staff per 1000 connections in public utilities, 2-3 in an efficient water company);
- inability to regulate yourself, leading, for example, to major environmental problems (discharge of untreated sewage).

There are many different types of private sector participation, some of which are listed in Box 2. A key distinction is that the first two in the list comprise private management only, while the others include management *with investment*. Full privatization of assets - as in the UK - is left out. All the options listed require close public - private partnership and retain full public control through contracts and regulation.

Box 2: Examples of Private Sector Participation

- service contract - outsourced services, simple (Chile)
- management contract - full O&M contracted but no investment of commercial risk (Mexico, Guinea Bissau)
- lease contract (affermage) - working capital (not major works) - Bolivia, Cote d'Ivoire, the Gambia (Guinea, Maputo)
- concession - full investment in capital expansion (Argentina, Chile, Cote d'Ivoire, Queenstown RSA)
- Build-Own-Operate-Transfer (BOOT) and variants, increasingly used (e.g. for dams or for treatment plants) (Mexico, Chile, Australia, Malaysia, Zimbabwe).

Price, quantity, quality must all be regulated and monitored by government so that the public sector maintains control. However, absolute transparency is essential, and regulation needs clear specification if the private sector is to be attracted to bid. Experience shows that the contract design is critical but, in practice, not often appropriate. Poor contract design results in perverse incentives for the private sector; thus this process should be undertaken carefully and thoughtfully. Once again, the notion that this is a long journey whose eventual destination is not known is repeated. In many countries, the start is slow, initially with a management contract leading to a lease or a concession in a second contract.

Box 3: Why is there resistance to PSP?

- resistance to what is perceived as lack of control;
- lack of adequate legislation;
- lack of confidence in (knowledge of) the private sector (just want to make money);
- lack of interest by the private sector;
- reluctance to face labor problems;
- unfavorable public opinion;
- fear of foreign operation/involvement.

Demand and asset management. There are already enormous investments across the Region in water infrastructure for water supply and for irrigation, and yet much of this infrastructure is in poor condition, giving a low return on the investment. Asset management is about restoring and sustaining the condition of this infrastructure, so that it performs efficiently. One obvious area is in the reduction of physical losses in distribution networks (whether for domestic, industrial, or irrigation supply). In addition, demand management goes beyond asset management to include reducing the unnecessary use of water. Demand management includes the use of pricing to reduce consumption and technology to conserve water. There are examples of where the adoption of water saving devices in irrigation and in water supply has reduced consumption sufficiently to delay otherwise pressing urgent new scheme development (at incomparably higher costs) for over a decade. In seeking investment choices at any time, but particularly under the conditions of fiscal deficit and growing water scarcity common across the Region, demand and asset management is always a rational first choice.

7. CONCLUSIONS

This brief paper has sought to highlight strategies and investment options, taking account of the potential roles of government and the private sector. It is the thesis of this paper that a long-term vision is important, but that there is no blueprint for the strategies needed to achieve this vision. Each country embarks upon its own journey, a journey it may do well to share, to the extent possible, with its co-riparians and a journey with a destination that is not in sight. Most countries present at this workshop have already embarked upon this journey; some are already far down the road.

TABLE 1. A MENU OF STRATEGIC OPTIONS

- ◊ **Build Awareness**
 - ◊ **Regional/basin level:** create a climate of mutual understanding.
 - ◊ **National political level:** create commitment.
 - ◊ **Executive level:** build capacity.
 - ◊ **Community level:** create society-wide stewardship.
- ◊ **Build Capacity**
 - ◊ **Develop water resources management skills and institutions**
Enhance human, technical, financial, organizational, and institutional capacity - an unprecedented, yet feasible, effort to build capacity is needed.
 - ◊ **Promote people's participation**
Promote: public/private accountability through community 'watchdogs'; community ownership of water system assets; and community management of water environment.
 - ◊ **Promote private sector participation**
Promote a major (formal and informal) role in financing infrastructure and delivery of water services, ensuring an enabling regulatory and incentive environment.
- ◊ **Promote an Enabling Environment**
 - ◊ **Ensure an effective legal and regulatory framework**
Adopt regulation which complements market-based incentives; effectiveness depends on competence and accountability of the relevant institutions.
 - ◊ **Ensure effective regulation**
Separate regulatory functions from supply functions to avoid conflicts of interest; successful regulation needs good governance and an accountable public sector.
 - ◊ **Adopt appropriate allocation strategies**
Adopt economic instruments to allocate water among users and complement regulations; specific allocation strategies will determine appropriate pricing and incentive structures.
 - ◊ **Sustain hydrological information systems**
Develop/sustain hydrometric networks and information services to inform policies, regulations, investment plans, and environmental management.
 - ◊ **Institutionalize coping strategies for drought**
Develop, institutionalize, implement, and continuously refine strategies for drought "proofing" in society-wide efforts to manage and mitigate consequences of drought.
- ◊ **Ensure Sound Sectoral Strategies**
 - ◊ **Extend rural water and sanitation services sustainably**
Promote a fundamental change in the role of government, from provision of services to promotion of service provision, with beneficiaries shouldering at least O&M costs.
 - ◊ **Meet demand for urban water supply and sanitation services sustainably**
Promote financial autonomy of utilities, recovery of costs, use of the private sector, demand management, a range of different service levels.
 - ◊ **Increase agricultural productivity and food production to meet growing demand**
Promote agricultural intensification in rainfed and irrigated agriculture through improved technology and farming practices, efficient use of water, and preservation of soil fertility.
 - ◊ **Integrate water resources management into a power sector strategy**
Integrate hydropower and power cooling needs into water planning when developing the underutilized hydropower potential of the Region.
 - ◊ **Mainstream the environment into water resources management**
Recognize that degrading water quantity and quality can inextricably alter the water resources system, affecting present and future generations.
- ◊ **Promote Regional Cooperation**
 - ◊ **Adopt a basin-wide approach**
Adopt cooperative strategies, from coordinated behavior (e.g., harmonious legislation and enforcement) to actual joint action (e.g., multi-lateral investment projects).
 - ◊ **Facilitate exchange between riparians**
Develop a 'level playing field' of knowledge; recognize rights of other stakeholders; share information and resources; and promote joint action between co-basin states.
 - ◊ **Develop/strengthen river basin organizations**
Promote carefully-designed River Basin Organizations, with modest and clear mandates, to serve the needs of all basin states and foster sustainable use of water resources.

THEMATIC DISCUSSION: CAPACITY UTILIZATION, BUILDING, AND RETENTION

By Shimwaayi Muntemba, AFTES, World Bank

1. INTRODUCTION

Management of water resources remains critical to human development and welfare in Sub-Saharan Africa (SSA) as well as to the health of ecosystems and the natural resource base, i.e. to sustainable development. Presently, SSA is experiencing an as yet unstabilized population growth, population movement resulting in urban pressure, and unabating environmental degradation. This is taking place against a backdrop of a rising number of countries, or regions within countries, characterized by water stress and scarcity. In 1955, one country was recorded to have experienced stress and scarcity. The number has risen to eight and is projected, on medium population growth, to reach 21 in 2025. Moreover, SSA's rainfall particularly in arid, semi-arid, and sub-humid areas is characterized by extreme and unpredictable variation, highly localized availability, and high costs of water transportation. Many countries, therefore, which enjoy a relative abundance of water suffer acute regional problems of drought, shortages, or flooding.

Against this reality, the challenge to Africa's march towards sustainable development is to put in place a comprehensive and sustainable water resource management strategy. A prerequisite to such a strategy is availability of capacity to develop requisite policy and regulatory frameworks; create an enabling environment through, among other things, decentralization and stakeholder participation; shift water management approaches from sectoral to integrated, multisectoral; implement the policies at all the necessary levels; manage the resource sustainably through user- and stakeholder-friendly structures, suitably allocate responsibilities and prioritize tasks; know and understand the state of water resources; develop information systems' ability to capture and share the state and nature of water resources.

Yet, currently in SSA this capacity is largely absent, despite impressive investments into the sector in recent years. In some cases it is absent in absolute terms; in others it is misallocated; in yet others it remains uncoordinated, is underutilized, or remains unrecognized. Retention mechanisms remain elusive to many countries. The purpose of this intervention is to examine the state of Africa's capacity for sustainable water management and to raise some questions, suggesting how to deal with this difficulty.

2. MEASURING CAPACITY

It may be useful to start the discussion by understanding how we interpret capacity. In modern times, we seem to see capacity mainly in technical terms. Thus to many minds, a country must have people who went to universities, tertiary colleges, or embraced technical training in their secondary education. This interpretation leaves out many youngsters who may not have gone beyond primary school, those who did not make it to universities or colleges. Typically in this scenario, solutions to capacity insufficiency have been sought through training, which still could not serve the purpose as fewer than the required numbers can be trained, a situation worsened in recent years by Africa's deteriorating economies. Another way, and by far more easily resorted

to, has been importation of expatriate staff. The implied distortion to capacity building has been compounded by donor approaches of attaching their nationals to any support given.

Alongside this technical orientation has been the highly bureaucratic approach to organization. This has tended to centralize decision-making, overemphasize supervision, and delay operations and delivery of services, all resulting in unfocused and frustrated staff and other stakeholders. In addition to the sector being bureaucratically organized has been the domination of western/modern perspectives. The indicators for sustainability, for capacity efficiency, and for efficient management have been based on western parameters. Management styles have been western dominated. Thus, they do not augur well with the social organization and cultures of the majority of the people the sector has purported to serve.

The above have contributed to the observable cleavage between government-propelled and indigenous knowledge systems. The last few years have seen a recognition in some national and, especially, international circles of indigenous knowledge systems in many areas. There has not been as much documentation of this knowledge in water management as in other areas, but there is sufficient information in some countries to indicate the value of this knowledge in water harvesting, water sourcing and protection, and management of watersheds. Women and girls have been the carriers of water. Because of this they have also sourced and managed water almost on a daily basis. To-date the organizational and technical orientation of mainstream management systems has, generally, not made it possible to establish a link to this knowledge base. Thus, indigenous knowledge has been undervalued and, with this, under/non-utilization of the capacities of the end-users at this level. Non-governmental organizations (NGOs) have been working at legitimizing this knowledge base and utilizing it in their own work. But NGO efforts are themselves yet to be seen as part of mainstream endeavors. Moves towards respect for and appreciation of NGO work will go some way in creating desirable links with indigenous knowledge.

3. STATE OF AFRICA'S CAPACITY

INSTITUTIONAL CAPACITY

Institutional capacity is central to sustainable water management. We shall look at the three key levels: national, local government, and grassroots/user levels in order to understand what functions each has to perform, matching capacities to these functions.

At national level. At this level may be found line ministries and water authorities. Their major task is to develop policies to guide sustainable utilization and management of water. Sustainable utilization also points to conservation of ecosystems, especially watersheds. Another of their tasks is to develop regulatory frameworks. Policies and regulatory frameworks both help create an enabling environment that encourages all stakeholders to value water as a common yet finite good that requires stewardship. The policies and frameworks would be developed with the participation of stakeholders, including primary stakeholders – poor rural and peri-urban dwellers and women. Through decentralization and devolution of power as well as good governance, participation would be promoted. Another task of this central organ would be to facilitate creation of mechanisms for decentralization and power devolution to reach the communities, both rural and urban.

Clearly, the central organs would require certain skills to enable them to carry out these tasks. First, they would need staff trained to monitor and measure the state of water resources, the condition of the source, the quality and quantity of water in the immediate, medium, and long-terms, potential conflicts in the case of multiple users or where water is shared by more than one country, as is the case in many situations in Africa. Negotiation skills are also required at this level to preempt or deal with national and transboundary conflicts over water. Negotiation skills are also needed to help in the transition from a sectoral to integrated, multisectoral approach to water management that is emerging as one of the principles underlying lasting water management. The integrated approach would also require technical skills going beyond the narrow perception of water management perceiving the latter as not part of the whole but instead working with other relevant ministries, such as agriculture, environment, energy, local government, mining, and organizations such as NGOs and community groups (i.e., women), and with the private sector. Policy analysts would also be essential to the process of policy formulation.

Few SSA countries can boast of having on board personnel with the skills to carry out the above functions, skills which are not only technical. Many central organs are suffering from inadequate staff in these areas. I would like us to cite a few examples where work has been impaired because of this lack in the countries where we live and work. Part of this inadequacy results from non availability of staff in desirable quantities. But in some situations, this has been exacerbated by not so careful recruitment, placing staff whose qualifications do not match the tasks they are required to perform and misplacing and misutilizing those with requisite skills. As water becomes accepted as central to human and sustainable development and growth, the question of skills utilization will have to be addressed as fundamental.

At local government level. This is the level where national policies are first interpreted to bring them in line with the local realities. This is also where implementation is first tested. In urban areas, city or municipal councils, or village councils/district assemblies in rural areas, take the policies and regulatory frameworks to the primary stakeholders and together devise ways of implementing them. Councils and assemblies devolve decision-making and day-to-day management to the communities they serve. Is the requisite capacity available?

Except in a few instances, the mismatch seen in central organs occurs less at this level. The main question is that of availability. The state of affairs in many African countries is such that rural areas in particular suffer from staff shortages because these areas are found to be less attractive. Perhaps incentives are in greater need in rural areas. Councils/assemblies do not have sufficient capacity to interpret national policies for specific locations. Moreover, central organs have tended to interfere in local government affairs. Often, the latter are not equipped to deal with such situations on a scientific basis. For example, if the state of water resources is well grasped, a local government organ could counter pressure from the center to implement policy without adapting it to the local realities. Local governments are also closer to the primary stakeholders. They would, on one hand, have sharpened skills in enabling stakeholder participation and, on the other, be in a position to offer help, especially in management. Local governments are the second entry point (after primary stakeholders) in ensuring sustainable management of water and water facilities. Do many of them have the capacity enabling them to assume this role? During the discussion, we may wish to hear about those countries/regions where capacity is indeed sufficient and the lessons we can draw from such experiences in terms of how a local government can go about achieving this.

At the grassroots and user level. Many African countries are currently characterized by non-participation of primary resource users. We shall look at the different categories of users to see where each of them is and why and the likely impact on sustainable water management.

The urban middle class. This class is distinguished by non-participation despite its apparent sophistication and its advantaged position in relating to the dominant orientations and its proximity, in time and space, to the central organs. Except for when taps are turned on or when they drive to fetch water from another part of town/city, there is an amazing conceptual cleavage between this class and water. Yet, there is need to bring this class into the water issue. Water needs to be managed sustainably at the household level; equipment needs to be maintained; water needs to be priced at sustainable levels. In many countries, people from this class have retained their links with the rural sector which they still consider "home" and the ultimate place for retirement. Some have links with peri-urban situations as NGO workers or through relatives. Their understanding of water regimes, gained through the participation process, could help in empowering other users through access to information, albeit in informal yet powerful ways.

The poor in urban areas. These have been disenfranchised, as it were. The voices of the majority are not heard. The fact that many are dealing with water systems and facilities still foreign - and until recently associated with the modern world - has compounded their marginalization. Yet, at the household level, many women are good at managing the scarce water available to them for kitchen use, gardening, and other domestic chores. Many are also taking initiatives in bringing water to their compounds and have worked out ways of enabling others access through charging them. But how are such charges determined? Are they sustainable? Are they legal? Etc., etc. Yet, if they were brought into a dialogue with local governments, perhaps more realistic, locally rooted policies could be developed. Moreover, management on a day-to-day basis could shift to neighborhood groups. Where methods of devolving management, setting tariffs, and allocating collection to the end-users have been adopted, improvements in water management have been quite dramatic.

Rural dwellers. Except perhaps for large-scale farmers, these have been the most disconnected from mainstream water management systems. Yet, in rural areas, systems of water protection and management can be found. There can also be found knowledge of local water regimes, although as said above, this knowledge has not been acknowledged and utilized by the modern technically oriented systems. Unlike the poor in peri-urban areas, rural people can relate to the water systems. There is, therefore, a store of knowledge that can be built on and utilized. We say "built on" because in some cases it may be necessary to augment what people know. Moreover, not everyone is conversant with this knowledge so that it may be essential to build the capacities of those who may lack such information. The important thing in this respect is to ensure that capacity strengthening is based on local realities. If possible, people from the same location could be used as trainers, employing methods such as observation and "learning-for-work". I believe that would sit better with the cultural setting. An entry point to this approach could be local institutions/organizations/groups which prevail in many situations in rural SSA.

Women are a viable resource for tapping local capacities, understanding indigenous knowledge systems, and providing local capacities for water management. Girls are a viable resource also. Yet, it has been the fashion in development to relegate women to activities such as sewing and knitting and to marginalize them even further from decision-making. Because of their work as water drawers as well as their experience in water management, any strategy for sustainable water management in Africa will have to tap women's knowledge and capacities. The first step in accomplishing this could be through inviting their participation in policy evolution, especially at the local government/village council/assembly level. In partnership with NGOs, the next step would be to tap their capacities, both to impart the knowledge and skills to others and to manage water resources.

Industry/private sector. Perhaps of all the stakeholders, this one has been the most powerful. In many countries, mines, large-scale farms, and power companies have been effective users of water. Some have dictated policies that have guided water distribution and management. A

more recent development has been privatization of water utilities in some countries. In most countries, however, governments continue to play a major role, and in the light of an emerging private sector, both micro and mega, it will be important for the central organs charged with policy formulation and setting of and safeguarding regulatory framework to enable a meaningful participation of this sector. In terms of capacity, perhaps this sector is the best equipped of all the stakeholders including government. This is why it is essential to ensure the participation of other stakeholders as well, so that emerging policies are not biased towards this group to the latter's disadvantage. But, it must be borne in mind that the micro enterprise sector is weak in capacity. Thus, it may be necessary for the larger industries to invest in the capacity building of the micro sector.

It is also worthy bearing in mind that the private sector is motivated by profit-making. Therefore, it is going to bring in place economic prices. This is desirable for sustainability. However, over much of SSA, the majority consumers, urban and rural, are poor and may not be able to carry high prices which may be introduced at once. While the private sector should be encouraged to move into the water sector, especially because of their relative efficiency and assured sustainability, perhaps a more gradual approach should be adopted so that the pace at which this sector takes over the utility could correspond with poverty reduction rates.

4. CAPACITY UTILIZATION AND RETENTION

In many African countries, the problem lies as much in under/mis utilization of available capacity as it does in its shortage. Some of the people working in the water sector itself may have relevant skills but may be assigned tasks for which they are not qualified and thus end up not being fully utilized. In some cases, they may not be provided with the tools for enabling them perform the tasks. Earlier, we referred to a mismatch of capacity. Hence, within a local government may be found people with functions for which they are not prepared. For example, an engineer may be allocated a social welfare responsibility; a medical doctor may be assigned housing functions; a Council clinic remains short-staffed. Incentives should not be seen as monetary rewards and other material perks only, although in more recent times of deteriorating economies these can also play important roles. Job satisfaction is an important incentive.

Frustrations that have arisen through under utilization or misapplication of skills have contributed significantly to exodus of people with the requisite skills. Another expression of this frustration exists when underutilized staff spend their time by trading their skills elsewhere. With retrenching economies this has become a permanent feature of the scene and may even have negative impacts on skills. It appears, then, that in order to utilize available capacities efficiently and to retain staff, bodies responsible for water policy, regulation, and overall management need to develop a policy on capacity utilization, ensuring that skills and functions are matched; incentives are put in place, both in terms of remuneration and other perks; and also in promoting an environment conducive to efficient utilization of the available capacity.

We have also referred to capacity that may not be tied to academic or technical qualification but that is acquired through experience and indigenous methods of knowledge transmission. This is the capacity that exists at the grassroots level which may be tapped through indigenous institutions and groups as well as through individuals. Because of socio-economic changes in recent years, women dominate the knowledge base at this level. However, despite over two decades of focus on women, their knowledge remains unlegitimized and marginalized, to their frustration. Shifts towards greater utilization of this knowledge pose a challenge because these

would require a paradigm reversal, where the knowledge and requisite capacities are seen and accepted as part of the whole. Efficient utilization of this capacity would contribute to sustainable management of water resources at the local level. Existing knowledge of the watersheds and ecosystems could be tapped, monitoring the state of water resources. In other parts of the Third World, youths have become involved in monitoring the state of the natural resources on an on-going basis. In utilizing local youth capacity in this way, we may hit on ways of carrying out a fundamental task at an affordable cost.

5. STAKEHOLDER PARTICIPATION

It should be clear by now that stakeholder participation in policy formulation, implementation, and management is fundamental to sustainable water management. Stakeholder participation would result in policies that are rooted in realities on the ground. This becomes the case because policies would be better informed. Policies would reflect the social and cultural reality of the user societies, as well as work ethics if the stakeholder is some institution/industry. Another advantage of participation may be found in information on the state of the resources that users may provide. They would thus be playing an important role in information generation in situations of cash-trapped economies.

Participation also inculcates a sense of ownership by the consumers and other stakeholders. This injects a sense of stewardship and a willingness to pay economic rates for the resources and services where required and provided by some external authority. Rural users are known to guard watersheds and to adopt agricultural methods that would curtail siltation when they do not associate ownership with invisible authorities. They are known to have apprised authorities when trees are cut near river banks. Women in peri-urban areas who have been responsible for bringing water to their neighborhoods have turned out to be good caretakers of equipment and salient managers. They have been known to arrive at cost-effective pricing, often through consultation with other users. Where neighborhood groups have been given responsibility for management by town municipalities in other parts of the Third World, grassroot users have set economic levies. The quality of water has been safeguarded because neighborhood residents shy away from behavior that might pollute the environment and underground water. Their effective management has relied on pooling of capacities and an appropriate allocation of skills.

The process of participation also allows interaction of the various stakeholders, enabling them to share experiences, leading to a respect for each other's knowledge. Interaction may also assist them in identifying skills among themselves. Through sharing, they might also develop ways of strengthening their capacities.

6. CAPACITY BUILDING

In most situations in SSA, after surveying and allocating tasks in the order of priority it is possible that gaps may be identified. These may be identified on two levels: skill gaps in existing capacity and total absence of skills/availability. In the first case, many ways can be identified in which skill gaps could be filled or capacities upgraded. It may be that formal training is necessary, but in some situations, especially at the grassroots level, exchange visits could help with skills-upgrading. Umbrella NGOs have been using this methodology whereby members requiring

skills are linked to those able to provide them. They learn through observation and “skills-for-work” experience.

In the second case, a clear identification of functions have to be made before a candidate is sent for training. It is assumed that a budgetary allocation exists for such training. Cases have been observed in SSA where students have been sent for training but have ended up taking jobs because of insufficient or discontinued allowances. However, the capacity retention policy mentioned above would take this investment into account and make sure that on return the capacity is retained within the water sector through incentive packages.

7. SYNOPSIS FOR A CAPACITY BUILDING AGENDA FOR AFRICA

This section is better developed within the working group, drawing on member experiences. However, we shall conclude our intervention with a series of questions.

1. Policy development and the establishment of regulatory frameworks are critical to comprehensive and sustainable water management.
What steps do we have to take to bring these about where they do not exist?
The steps should identify the capacities that would be required.
How would we go about attaining these capacities?
2. We have identified decentralization and devolution of power as essential to sustainable water management. Devolution of power assumes institutions at different levels: central, local government; district, village/neighborhood.
What are the prerequisites for this?
3. We acknowledge the value of indigenous knowledge and local capacities.
Against a backdrop of African realities, what are the most effective ways of tapping into this knowledge base, legitimizing and mainstreaming it?
4. Gender analysis is critical to issues of sustainable water management because of the value of indigenous knowledge, roles of men and women in water provision, and the reality of power relations at the local level, if the principle of decentralization advocated for sustainable water management is allowed to take root.
How conscious are policy-makers, men and women, to gender?
How do we ensure that this is understood and acted upon?
5. We have noted existence of capacities which may be uncoordinated at the moment.
In which ways can we mobilize these resources for efficiency and maximum contribution to water management?
6. What package do we need to put together for skills-upgrading; what methods need we apply to fill in identified gaps; and what package need we develop to utilize the existing capacities as well as those that may have to be built?

INFORMATION AND KNOWLEDGE BASE

By Naginder S. Semb
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1. INTRODUCTION

An information and knowledge base is a relatively small component of the integrated water resources development and management sector. In terms of capital investment and cost of operation and maintenance, its needs are minimal. However, its relative importance for planning, design, implementation, operation, and management of individual water resources projects and programs as a whole is invaluable. In fact, without an adequate information base it is not possible to develop and manage the water sector and many water-related economically important activities. On the other hand, in most countries in Africa, information on water resources is provided by governments and does not normally produce revenue. This is probably the main reason why many national services responsible for operating water resources monitoring networks have not been able to meet the data needs of users.

The timing of this Workshop to discuss the management of water resources is important in that it comes after the African Conference on Water Resources: Policy and Assessment, which was convened by the World Meteorological Organization (WMO) and the UN Economic Commission for Africa (UNECA) in Addis Ababa in March 1995. The outcome of the Conference was the African Water Resources Assessment Program: Policy, Strategy, and Action Plan which has been adopted by both the Conference of Ministers of UNECA and the Congress of WMO. The Conference document sets the strategy for the development of an information and knowledge base for water resources assessment and management.

2. VALUE OF INFORMATION

The water resources management problem has moved from finding solutions to a particular problem of conflicting demands and supply, to one of broader environment planning. A major portion of the information required for such planning comes from the monitoring of hydrological, meteorological, and associated environmental elements and parameters. Production of information is of little value if it is not used and communicated to decision-makers and to the general public. The value of information is enhanced manifold when it is used to develop cooperation and coordination at the regional and interregional levels for integrated management of shared water resources.

Scarcity of water resources means an increased demand for them and an intense competition in sharing so as to meet the needs for urban and rural communities from common river or ground water resources at the national level, as well as those of the countries from internationally shared river basins. This has become a formidable challenge for the managers of water resources. The basic tool that managers and policy-makers can depend on is accurate data on the resource itself. Availability of such data removes that first and foremost hurdle of conflict and promotes trust among the competitors.

Assessing and monitoring of water resources on a continuous basis are a necessity which frequently do not receive the importance they deserve although the need is abundantly recognized. It will not be necessary, therefore, to go into the technical aspects of information collection, processing, and methods of water resources assessment and management. There is convincing evidence that countries in Africa have their own abundant, maybe untapped, expertise to ably perform these activities. The question is how to give them the opportunities to use these untapped human resources.

Hydrological and related meteorological monitoring yields information on the status and trends of rainfall, water levels, inflows, outflows, storages, ground water levels, water quality, water use, sediment transport, and the potential for development in terms of sustainable food production, irrigation, hydropower generation, inland navigation, water supply for the home and industry, and pollution abatement. The provision of security for people and property against water-related hazards, particularly floods and droughts, is made possible through meteorological and hydrological forecasts which rely heavily on accurate meteorological and hydrological information collected in real-time.

The water resources manager requires such information for the assessment of the country's water resources; quantity, quality, distribution in time and space; to determine the potential for water-related development as well as the ability to meet actual or foreseeable demands. He also needs it to assess the impacts of water resources management practices and adopt sound policies and strategies in other water-related sectors such as urbanization or forestry.

3. STATUS

The status of monitoring for water resources in the Sub-Saharan Africa was brought to focus in the country reports of the Sub-Saharan Africa Hydrological Assessment project which was conducted between 1988 and 1995 and covered all the SADC countries except South Africa and Mauritius. These reports showed that the hydrological services in most countries had deteriorated seriously. In the words of the report on the SADC Region: "One of the most striking observations made during the study was the difference between meteorological and hydrological services. The former appeared to be better funded, generally more progressive, and much better supported by internationally aided projects. The staff appeared more confident and more deeply involved in their work. In comparison many of the hydrological services were run down and on the verge of collapse. The staff, although competent, were unable to undertake their work due to lack of funds. Generally there was an attitude of resignation and despair."

The reason for this decline is largely attributed to budgetary constraints, which arise because decision-makers and the general public are normally not aware of the economic value of high quality and timely data and the dependence of water development on modern information systems. The problems continued despite international programs promoted by WMO, UNESCO, and other UN agencies within the last few decades. They also continue despite parallel regional and national initiatives.

4. DEPENDENCY

Africa has the capability to monitor and assess its water resources. Regrettably, this capacity is not often used, partly because of defective policies and lack of funds, so that the services become dependent on external assistance and expertise. Inadvertently, the UN system and external aid might have, in the long run, increased this dependency syndrome. The Governments have now recognized this seemingly unhealthy trend. During the African Conference on Water Resources of Addis Ababa, they voiced their determination to break this "dependency syndrome", especially in the information and knowledge base component of the water sector.

The long-term objective of the strategy as enunciated in the African Water Resources Assessment Plan is to:

Rehabilitate, build, and adapt the institutional, financial, manpower, and technological capacity of the relevant services of the countries and regional bodies concerned, to enable them to assess the national water resources on a sustained and continuous basis for the development, management, and protection of these water resources.

This objective can be attained through concrete measures, such as African countries pooling together their national and regional resources - material, human (including the expertise that might be available in the private sector), and financial re-establishing/rehabilitating the services for water resources assessment and monitoring, and creating centers for the manufacture of basic water monitoring equipment. This will create commercial competitiveness as well as general employment. Africa has enough trained and experienced personnel. This is the time to give them full opportunities to perform and practice what they already know and thus create national consciousness, initiative, and entrepreneurship which are powerful traits and driving forces for the development of indigenous technology, for capacity building, and sustainability. Africa should take a cue from the achievements of a number of countries in Europe and Asia that took such actions.

5. NEW TECHNIQUES

Monitoring for information on water resources has gone through many stages. However, the last decades have seen computer-based improvements in technology and radar, and VHF telemetry systems have been freely used alongside the conventional hydrometric and meteorological sensors. Nowadays, with further improvement in telecommunications and information systems, monitoring of the environment has gone many steps further to use remote sensing involving satellites and sophisticated Data Collection Platforms (DCPS) which, when coupled with modern computers, prove very useful in providing fast, accurate, and reliable real-time data at river basin, national, and international levels. Nevertheless, the basic networks of stations employing conventional equipment are still "reliable" if properly manned and equipped.

6. NEW INITIATIVES

As a contribution to address the problem of lack of adequate and precise hydrological information, WMO with the support of the World Bank has developed and promoted the concept of a World Hydrological Cycle Observing System (WHYCOS), which will be implemented to act as a tool for the improvement of collection, dissemination, and use of high quality, standardized, and consistent hydrological information at river basin, national, regional, and international levels for socioeconomic development purposes.

A regional component of WHYCOS which has been proposed for the SADC region is called the Hydrological Cycle Observing System (SADC-HYCOS). Similar initiatives are being planned for other regions of Africa. These projects are designed to motivate regional and national services and mobilize external resources, but certainly not to be a wholesale importation of external equipment and experts.

7. INFORMATION AND INVESTMENT RISK

In the mid-1980s it became clear to the World Bank that there was considerable risk in investments by countries and external support agencies in developing the water sector. The World Bank also recognized that one of the major contributing factors to this increase in risk, particularly in Africa, was the lack of a common and adequate knowledge base in many of the areas where the allocation of priorities and far reaching decisions had to be made. Data of sufficient quantity and quality in both time and space are insufficient to demonstrate to the required accuracy the current state of the environment in relation to many of the major issues such as threats to forests and biodiversity. Among the most important of these is the area of freshwater.

8. FUNDING

It will be recalled that the Sub-Saharan African Hydrological Assessment Project had cost the UNDP and other donors between US\$5 million and US\$10 million. The project diagnosed and evaluated the decline of the water resources monitoring activities in most of the countries and had prescribed some 200 national and regional projects to treat the "illness", but without identifying the causes for the decline. The total cost of the proposed projects amounted to some US\$200 million, of which more than one half was proposed to be used to provide external experts. The costly "treatment" had been conceived as if abundant external support was readily available to implement the projects. Clearly the projects had not been drawn up in the context of and interlinked with the prevalent economic situation of the countries. Their cost-effectiveness had not been proven. The reports did not address the issue of affordability and sustainability of the deserving systems and of the institutions operating them.

9. STRATEGY

The Conference in Addis Ababa filled the gap left by the Sub-Saharan Africa Hydrological Assessment Project and identified the causes of the decline. The Conference prepared a new strategy to rehabilitate, build, and/or adapt the institutional, financial, manpower, and technological capacity of the relevant services of the countries and regional bodies concerned. This strategy is based on the following concepts:

- (a) The relatively slow pace of economic development during the last decade has generally meant a low demand for water resources assessment and for water-related data. However, there is clear evidence of significant economic growth in many countries, and the governments do not seem to be ready to meet the increased demand for water information.
- (b) There is clear evidence in government circles of the awareness of the new trends, attitudes, and initiatives regarding the need for innovation and the desire to go forward based on a given country's own efforts and by using external support in a more effective manner.
- (c) The expansion of expertise in Africa has been slow because the participation of trained personnel in actual development projects and in the decision-making process has been very limited due to the under-estimation of African expertise and the dominant role of external experts. This was considered to be the biggest hindrance for genuine capacity building and one of the important negative impacts of the manner in which external support has been implemented.
- (d) The case of importing even simple water equipment which could have been manufactured locally has resulted in a loss of initiative and entrepreneurship, which are powerful traits and driving forces for development of indigenous technology, for capacity building, and sustainability.

The Action Plan was prepared as an input to the World Bank water resources management strategy for Africa and has been formally adopted by the Governments. Therefore, it would be appropriate to include this Action Plan as a component of the overall water resources management strategy that the World Bank is presently preparing.

Reference: WMO, African Conference on Water Resources: Policy and Assessment, Addis Ababa, Ethiopia, 20-25 March 1995, Report of the Conference, May 1995.

**INTERNATIONAL RIVERS AND OPPORTUNITIES FOR
REGIONAL COOPERATION IN SSA**
*By Ariel Dinar, Agriculture And Natural Resources Department,
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1. INTRODUCTION

Sharing scarce water resources may be a trigger for conflict, but it surely is a better reason for cooperation. In a United Nations study, international river and lake basins were estimated to comprise about 47 percent of the world's continental land area (United Nations, 1978). In Africa, Asia, and South America, this proportion rises to at least 60 percent (Barrett, 1994). For example, all Sub-Saharan Africa (SSA) countries share, at least one and up to ten, international river basins, and many share also international lakes.

Most countries, in particular SSA countries, that share ownership of water resources also depend on those resources. The direct effects of water sharing in international river basins as well as indirect outcomes (externality effects) may include not only reduction of water level and flow volume (because of excessive withdrawals upstream), but also deterioration of water quality (as a result of pollution in return flows upstream). It is hardly surprising that international rivers have often been the focus of regional tensions and conflicts.

Although water sharing disputes are very common, there is a large number of cases where solutions were found. Some times a solution is established only between a subset of the riparians. A partial list includes one case involving twelve of the 15 riparian countries (Danube), three cases of nine riparians (Niger, Nile, Congo), three of seven riparians (Zambesi, Amazon, Rhine), four of six riparians (Chad, Volta, Ganges-Brahmaputra, Mekong) two of five (La Plata, Elbe), nine of four riparians, thirty of three and at least 148 of two, (Source: Panel of Experts on the Legal and Institutional Aspects of International Water Resources Development (1975, quoted by Barrett on page 2, Annex VII).

SSA is characterized by a substantial number (54) of river basins that are international in nature. The continent faces unstable precipitation patterns leading to severe water scarcity in many of the countries. Surface water (mainly rivers) is the major source for water in many of the SSA countries. Presently, very few of the international river basins in the region are effectively jointly managed. To what extent regional cooperation in managing international waters can lead to a better water situation in the region is a serious question. The answer to this question depends on the potential opportunities embodied in cooperation and collaboration of water, and other related regional issues of interest to the countries.

There are several approaches in attempting to resolve international water conflicts. When the water demand of a population in a water basin begins to approach its potential supply or when quality degrades existing supply translating into scarcity, there are a couple of alternative routes (see Falkenmark et al, 1989, for related work):

1. They can work unilaterally within the basin or state, pursuing strategies of:
 - Making no changes in both supply and demand sides and facing the hardships as they occur;
 - Managing supply or treating pollution along the waterway within their territory, and/or;
 - Managing the demand or reducing effluents to the waterway.
2. They can cooperate both intra- and inter-basin for:
 - Developing new water resources that otherwise could not be developed;
 - Managing more efficiently existing water resources; and
 - Controlling pollution of the water resources.

What is becoming increasingly clear as patterns of international water conflict begin to emerge is that a variety of factors tend to preclude cooperative management within basins. (Here we use the term cooperative management also to address the resolution of conflicts, which need some degree of cooperation.) These factors may include unequal power and hostile political relations between riparians or an especially large number of riparian states. Any successful basin-wide arrangement in the face of these factors has come about as a result of strong NGO or other third-party involvement, roles that have been taken up with increasing reluctance (Bingham et al. 1994).

2. SSA COUNTRIES' WATER SITUATION AND RIVER BASIN CHARACTERISTICS

SSA countries are among the most water scarce countries in the world. In 1955, only one Sub-Saharan country, Djibouti, was already troubled by water scarcity (Engelman and LeRoy 1993). In 1990 seven countries (Djibouti, Cape Verde, Kenya, Burundi, Rwanda, Malawi, and Somali) were classified as water scarce, and South Africa was listed as water stressed. Based upon the medium population growth projections of the UN, the number of water scarce and water stressed countries in SSA will grow from eight in 1990 to 21 in 2025 (Table 1).

Table 1: Water scarce and water stressed countries of Sub-Saharan Africa in 2025.

Water scarce countries (less than 1000 m ³ /capita)	Water stressed countries (1000-1700 m ³ /capita)
Burundi(269)	Burkina Faso (1,237)
Cape Verde (258)	Ghana (1,395)
Comoros (620)	Lesotho (1,057)
Djibouti (9)	Madagascar (1, 1 85)
Ethiopia (842)	Mauritius (1,575)
Kenya(235)	Mozambique (1,598)
Malawi (361)	Nigeria (1,078)
Rwanda (306)	Tanzania (1,025)
Somalia (363)	Togo (1,280)
South Africa (683)	Uganda (1,437)
	Zimbabwe (1,005)

Source: Engelman and LeRoy (1993)

About 80-85% of the 4,184 billion m³ of water resources utilized in SSA per year comes from surface sources, mainly rivers (Hirji 1996). There are several common features of SSA countries' rivers that can be identified in affecting the availability of water resources in the region and also possible international cooperation (Rangeley et al. 1994): (1) concentration of run-off in the upper stream reaches of the basin, creating difficulties in utilizing the water continuously over time and space; (2) relatively small number of tributaries, narrowing the area that can potentially be benefiting from water utilization; (3) wide variation in precipitation affects long-term planning on a local scale; and, (4) long distances between river basins, complicating possible inter-basin transfer of water.

With the nature of the water supply pattern in most of the sub-continent, the international nature of the main water supply sources, the relative advantages of various SSA countries sharing the same river basin, and the need for massive development of these basins, both for water-related and other types of projects; it is suggested that international cooperation between both SSA countries and international development agencies could be of a great importance, providing substantial benefits.

3. INTERNATIONAL RIVER BASIN DEVELOPMENT AND MANAGEMENT EXAMPLES

The literature includes successful and less successful experiences of cooperation between riparian countries in various parts of the world. Several examples detail the experiences of various River Basin Organizations from Africa (e.g., Rangeley et al., 1994). One of the examples for International River Basin Cooperation is that of the Senegal River (LeMarquand, 1990), originating in the French colonial era and continuing after the independence of three of the Basin states-Mali, Mauritania, and Senegal.

Several examples of special interest are the Mekong and Danube Rivers. These examples are summarized in Boxes 1 and 2.

Box 1: Creative Outcomes Resulting from the Resolution Process in the Mekong.

The Mekong rises in China and flows through Myanmar, Laos, Thailand, Cambodia, and Vietnam. Its experience is the first successful application of a comprehensive approach to planning development of an international river. Yet it is one of the least developed major rivers in the world, in part because of difficulties inherent in implementing joint management between these diverse riparians.

China and Myanmar had no interest in regional cooperation, and their development plans did not disrupt the downstream riparians until recently. The downstream countries, although realizing the potential benefits of the River, could not find the resources for joint development, the mechanism to overcome their different interests. A formal international basis for cooperation was established in 1957 when the Mekong Committee, comprising representatives of the four latter riparians, was created. Programs for developing the resources of the Mekong for irrigation, navigation, power, and flood control were developed with support from the United Nations, Asian Development Bank, a group of country donors, and the World Bank.

The Committee country members have authority to speak for their countries, and the committee mandate is to prepare and submit to participating governments plans for coordinated research, study, and investigation, make requests on behalf of the governments for special financial assistance, receive and administer these funds, and draw up and recommend to participating governments criteria for use of the water for development purposes. All Committee meetings must be attended by all four representatives, and each decision must be unanimous. Meetings would be held 3-4 times a year, and chairmanship is rotated annually by alphabetical name of the country.

With agreement among the riparians on priority issues came extensive international support. Along with the collection of physical data and the establishment of hydrographic networks, the Committee encouraged undertaking of economic and social studies, a regional training activity, and programs for aerial mapping, surveying, and leveling. Navigation has also been improved along the river. The work of the committee also helps to overcome political suspicion through increased integration. Laos and Thailand signed an agreement on developing the power potential on one of the Mekong tributaries inside Laos (Nain Ngum). The project that provides electricity to Thailand was funded via international funds. As a sign of the Committee's viability, the supply of electricity from Laos to Thailand and the payment in hard currency by Thailand to Laos were never interrupted, despite hostilities between the two countries.

During the 1970s, the Committee's work momentum started to fade and international support diminished for several reasons including: (1) political and financial obstacles that impeded the shift from data collection and studies to actual development projects; (2) Cambodia left the Committee in 1978, paralyzing its activity, and rejoined in 1991; (3) not all the Committee objectives were shared by all the riparians; (4) the projects prepared by the Committee were too ambitious and not always consistent with the countries' long-term needs. (Source: Bingham et al., 1994; and Kirmani, 1990).

Box 2: A Strategic Action Plan for the Danube (DSAP) River Basin 1995-2005.

The Danube River is shared by a number of riparian states (see footnote 1) that for decades were allied with hostile political blocs, and some of which are currently locked in tense national disputes. During the period of centralized planning systems, the central and eastern European countries did not develop full environmental protection policies which responded to the degradation of the river environment. Legal standards for environmental quality were often un-enforced or un-enforceable. Apart from Germany and Austria, all other Danube countries are undergoing fundamental transformation of their political, legal, administrative, economic, and social systems.

Recognizing the increasing degradation of water quality, the eight riparians (at the time) of the Danube signed the "Declaration of the Danube Countries to Cooperate on Questions Concerning the Water Management of the Danube," the Bucharest Declaration, in 1985. The 1985 Bucharest Declaration committed the riparians to a regional and integrated approach to water basin management. Basin-wide coordination was strengthened at a meeting in Sofia in September, 1991, in which the riparians elaborated on a plan for protecting the water quality of the Danube. At that meeting, the countries and interested international institutions, including the World Bank and UNDP, met to draw up an initiative to support and reinforce national actions for the restoration and protection of the Danube River.

The countries and donors established a Task Force¹ to oversee the program, which covers monitoring, data collection and assessment, emergency response systems, and pre-investment activities. A Program Coordination Unit was established to monitor the day-to-day activities of the Environmental Program.

In 1991, as part of the overall Danube Environmental Program, each riparian country identified a country coordinator and a focal point who would liaison with the Program Coordination Unit in Brussels (and now in Vienna). Both the focal point and the coordinator were members of the task force. The country coordinator was usually from a ministerial/political level. The focal point was a technical person who handles the day to day issues of the country team.

The public consultation process that was designed to guide and support the development of the DSAP in 1994 required a facilitator from each country who had some technical background either in water or environment. The local facilitator organized and ran the local meetings based on an agreed design.

The World Bank designed and initiated the consultation process, including training sessions. This served as a resource to the country facilitators as they implemented the public consultation meetings in each of the 9 countries.

A major accomplishment of the Program was the development of a *Strategic Action Plan for the Danube River Basin* which was adopted by the Task Force in October, 1994 and ratified by Ministers of Water or Environment in December, 1994 in Bucharest.

During late 1993 and early 1994, another major Danube River activity was being carried out in the basin. The riparian countries were developing the *Convention on Cooperation for the Protection and Sustainable Use of the Danube* (the Danube River Protection convention) at the same time that the Danube Environmental Program began developing the Strategic Action Plan. The Danube River Protection Convention is aimed at achieving sustainable and equitable water management in the basin and was ratified in June, 1994 in Sofia. (Source: Task Force for the Program, 1995).

¹ Members of the Task Force include the Danube countries of Austria, Bulgaria, Croatia, Czech Republic, Germany, Hungary, Moldova, Romania, Slovakia, Slovenia, Ukraine, the European Commission (EC), European Bank for Reconstruction and Development (EBRD), the United Nations Environment Program (UNEP), the World Bank, The Netherlands, USA, non-governmental organizations, IUCN, WWF, the Regional Environmental Centre, Cousteau Foundation, and the Barbara Gauntlert Foundation.

4. INTERNATIONAL FRESHWATER DISPUTE AND COOPERATION - SOME BASIC IDEAS²

BACKGROUND

As can be realized from previous work, no other natural resource has so many users as a river. A comprehensive river management must find a balance for the following fundamental, but sometimes conflicting, interests:

1. Maintaining the river flow (for electric power generation and for the disposal of industrial and urban wastes);
2. Maintaining and expanding the navigable water ways;
3. Assuring an adequate supply of water (for irrigation, industrial cooling processes, residential use, and environmental purposes);
4. Protecting the water quality (for drinking, irrigation, fishing, recreation, tourism, and environmental purposes);
5. Preventing floods; and
6. Preserving the river and its surroundings.

Historically, international river disputes have involved mainly conflicts over water allocation, but it is evident that all other interests mentioned above are part of more emerging conflicts.

The search for a framework and an operational way to involve the parties in a process seeking a stable agreement over international water issues includes several aspects. These aspects have been analyzed in the literature and in conjunction with the notions of justice, stability, and fairness (Hipel, 1976). Various outcomes can become more attractive as the scope of the issues is widened and as the number of the parties increase (Riaffa, 1982). The assumption that the more riparians involved renders the management of disputes raises the question about the accord. The issues at stake are not always tangible, and the needs to have the recognition of rights in principle are often of a symbolic nature and are influenced by cultural patterns or previous historic traumatic experiences.

Political considerations are not ignored as constraining variables, but during the problem-solving process the parties should act from a situation of symmetry. Demonstration of force or veto threats by one participant is sufficient to paralyze the process, but the expectations of the other participants generate an atmosphere that is often conducive to the opponent's realization not to block such outcomes. This usually facilitates the emphasis on agreement on areas of interest.

If the parties bring to the negotiating table their own solutions, and even if the joint fact-finding and analysis have provided a good documentary background from other cases and from their own past experience, it is expected that through the particular nature of the dynamics of problem solving, the participants become members of the epistemic community able to invent and develop new shared solutions.

² This section is based on: Kaufman et al., (1996).

OPERATIONAL FRAMEWORK

There are several aspects that need to be addressed in the process:

- **Issues such as:**

Disaggregation of the issues at stake into relevant categories or baskets. The introduction of many baskets to which the sides attached different values may be seen more complex but at the same time opens up more opportunities for trade-offs.

Recognition of seasonal and yearly fluctuations of water as a factor of instability. This calls for addressing technologically sound solutions to alleviate the fears for the basic needs of the parties in the treaty.

Economic efficiency and flexibility of water allocation and pricing; water quality and environmental concerns; conservation; sustainable water resource development; security and geopolitical considerations; irrigation technology; land reclamation and flood protection; multipurpose water storage; drainage and sewage; improvement of water use efficiency; navigation; fishing; timber floating; tourism; health; energy; short-term investment; and financial linkages to donor parties.

- **Stakeholders**

A broad range of directly and indirectly related stakeholders should be brought into the process. They may include: domestic (e.g., indigenous communities, local, provincial/national public and private actors); transnational (e.g., riparian, regional and international, governmental, and non-governmental actors).

- **Decision-Making Process**

Chronological mapping of the different stages; issues which were agreed upon first and those that are still debated; sources and types of rewards to the political decision makers, directional inputs (top/down or bottom/up). Ranking of various techniques (arbitration, mediation, reconciliation, facilitation; other alternative techniques, multi-track approaches; and other relevant, effective techniques). Short term agreements as a useful step towards more permanent solutions (mechanisms perplexed for transforming temporal to permanent more important than pressure for start for a permanent agreement). Different levels of negotiation at different stages of the process. Issues of agreement at different stages, from an agreed agenda for data gathering and research, to feasibility studies of external financial sources, programs with UN, World Bank, donor states.

- **Outcomes**

Agreements can be of implicit cooperation: Application of principles of equitable legal standards and rights (prior or proportional); criteria for water allocation (quantity and percent including population, amount of irrigable land, percentage of flow during dry season, acquired rights plus division of any additional water resulting from development projects, historical and planned use); notions and standards of fairness (e.g. safety); ad hoc (informal) and institutionalized (formal) arrangements. (Often it is quicker to agree to some points if it is explicitly agreed that a precedent is not being set.)

- **Implementation**

Interim/permanent stages and enforcement mechanisms with third parties' involvement ("neutral expert," each side appointing a negotiator to work with a mutually accepted mediator), special courts for arbitration, etc. Or, enforcement by the riparians themselves including monitoring activities; joint resource management mechanisms regularization of tradable water rights and tribunals (i.e. the US-Canada International Joint Commission); or enforcement by both, such as the participation of relevant institutions - riparian, regional, international- (i.e. the Mekong Committee); and other directly and indirectly involved parties.

5. A SUGGESTED STRATEGY FOR REGIONAL COOPERATION IN SSA INTERNATIONAL RIVER BASINS

The Water Resources Strategy paper for Sub-Saharan Africa (World Bank, 1996) that is being discussed in the workshop suggests a general strategy framework under which specific strategy items deal with regional cooperation, including and focusing on international rivers.

- The main strategic imperatives are:
 1. Long-term vision and planning,
 2. Utilization of innovative instruments underpinning the problems,
 3. Comprehensive approach and cross-sectoral coordination.
- Key strategic interventions for achieving goals of sustainable and equitable water resources in the region are:
 1. Strengthening policy and regulation,
 2. Building and strengthening local capacity,
 3. Strengthening and improving data and information systems,
 4. Increasing awareness and involving stakeholders in decision making processes, and
 5. Supporting long-term national and regional programs.
- The strategy for regional cooperation in water resources calls for:
 1. Adopting a basin-wide approach
 - Promote consensus on importance and urgency of international water problems at each river basin
 - Plan future regional activities based on countries' physical parameters
 - Discuss future plans between riparian countries
 - Promote harmonization of water regulation among the basin countries
 - Encourage participation of all subsectors
 - Evaluate basin-wide development alternatives
 - Identify, modify, promote successful regional shared water agreements

2. Facilitating exchange between riparians
 - Hydrological data services (e.g., SADC-HYCOS), data, and information sharing
 - Regional technical training and exchange of knowledge
3. Developing/strengthening River Basin Organizations (RBOS)
 - Identify most appropriate functions of each RBO
 - Define relationships between RBOs and countries' agencies
 - Support RBO by legislation and financial means
4. Expanding areas of interaction and joint interest
 - Identify overlapping interests between basin countries
 - Identify relative advantages of basin countries
 - Promote joint water-related and non-water related projects benefiting all countries in the basin
5. Establishing dispute-resolution mechanisms
 - RBOs to play a major role
 - Include out of basin expertise

6. CONCLUSIONS AND SUGGESTIONS

Several broad issues could be brought as a basis for international water disputes and cooperation in SSA. They include: (1) institutional structure for managing potential conflicts, and (2) developing incentives for voluntary cooperation.

The lessons learned from past experience suggest that integrated international water management will be best implemented before conflict develops within a river basin. In doing so, river basin cooperative development plans will be more stable if linking quality and quantity, and surface and ground water sources.

Creating incentives for voluntary cooperation of an international river basin can be done either by identifying a broad set of issues of interest for all riparians, by ensuring an attractive outcome, or by providing a trades or linkages. The role of a third party in the process of resolving existing disputes, or preventing disputes from happening is crucial.

A list of rules of thumb (Bingham et al., 1994) for reducing the likelihood of disputes and laying the basis for international river basin cooperation, in addition to the strategy in section 4 may include:

1. Focusing on interests underlying each riparian's position,
2. Sharing information,
3. Developing strategies for joint fact finding,
4. Expanding the set of alternative development options,
5. Preventing asymmetrical outcomes,
6. Developing mechanisms for transparent and fair allocation of joint gains from cooperation.

REFERENCES

- Barrett, 1994. *Conflict and Cooperation in Managing International Water Resources*. Policy Research Working Paper 1303, The World Bank, Washington, DC.
- Bingham, Gail, Wolf Aaron and Wohlgenant, *RESOLVING WATER DISPUTES, Conflict and Cooperation in the United States, the Near East and Asia* (ISPAN, Arlington, 1994)
- Engelman, Robert and Pamela Leroy. 1993. *Sustaining Water. Population and the Future of Renewable Water Supplies*. Population Action International. Washington DC.
- Falkenmark, Malin. 1989. "Freshwaters as a Factor in Strategic Policy and Action." *Population and Re-sources in a Changing World*. Stanford University: Morrison Institute.
- Hipel, Kieth W., Regade, R-K., and Unny, T.E., "Political Resolution of Environmental Conflicts," *Water Resources Bulletin*, 12 (4), 1976: 813-827.
- Kaufman, Edward, Joe Oppenheimer, Aaron Wolf, and Ariel Dinar, International Freshwater Disputes and Conflict Resolution-An Integrated Approach. Paper to be presented at the Conference "Water: A Trigger for Conflict/A reason for Cooperation" Bloomington, Indiana, March 7-10, 1996.
- Kirmani, Syed, Water, Peace, and Conflict Management: The Experience of the Indus and Mekong River Basins. *Water International*, 15(4):200-205.
- Kirmani, Syed and Robert Rangeley, 1994. International Inland Waters, Concepts of a More Active World Bank Role, World Bank Technical Paper 239, Washington, DC.
- LeMarquand, David G., International Development of the Senegal River. *Water International*, 15(4):223-230, 1990.
- Hirji, Rafik, *River Basin Management in Sub-Saharan Africa. Challenges and Opportunities*. Draft World Bank, September 1995.
- Rangeley, Robert, Bocar M. Tuam, Randolph A. Andersen, and Colin A. Lyle, *International River Basin Organizations in Sub-Saharan Africa*. World Bank Technical Paper Number 250, Washington, DC, September 1994.
- Raiffa, Howard, *The Art and Science of Negotiation*. Harvard University Press, Cambridge MA, 1982.
- SADC, WB and WMO (Southern African Development Community, The World Bank, and World Meteorological Organization), 1993. World Hydrological Cycle Observing System (WHYCOS) HYCOS-SADC. Preparation of the Detailed Project Document, Washington, DC.
- Task Force for the Program, Strategic Action Plan for the Danube River Basin (1995-2005), Environmental Program for the Danube River Basin, Vienna, Austria, 1994.
- United Nations, 1978. *Register of international Rivers*. Oxford, U.K.-: Pergunon Press.
- World Bank, African Water Resources: Challenges and Opportunities for Sustainable Development, World Bank, Washington, DC, Draft, January, 1996.

DONOR COLLABORATION

By Mona Gleditsch, NORAD

There are many forms of donor collaboration, from policy dialogue between like-minded donors to co-funding of investment programs in particular countries. I will try to show you some of the forms of collaboration Norway as a donor country participates in and some of the experiences we have made.

First of all, however, I want to make a clear distinction between donor collaboration and donor coordination. Donor coordination is, as NORAD sees it, the responsibility of the developing countries themselves, and it is best done in a very concrete manner at country level. Any country receiving assistance should make sure that it coordinates donor inputs in such a way as to maximize benefits and avoid duplication and wasted investments. Several of the multilateral donors routinely try to help recipient governments do this, sometimes with the sad result of taking over the coordination. In some cases developing country governments themselves ask donors to help coordinate in a particular sector, usually if they are a large donor in the sector. In NORAD's experience the effectiveness of coordination in the medium and long term is clearly related to the active involvement and lead taken by the recipient government institutions. Donors coordinating themselves in splendid isolation from the government they are trying to assist is a sad sight where it occurs and can only lead to misunderstandings and distrust, not a constructive dialogue.

Donors should collaborate, however, on many more issues than they are doing today.

Let us look at **Investment Procedures**. I am sure many of you are familiar with Governments' producing multiple requests for funding a program, tailored to the formats different donors have given. Further along in the process, ministries may have five different donors for what is essentially just different parts of their unified work program and have to produce five different reports in five different formats at five different times of the year (specified by the donor and bearing no relation to the planning/budgeting cycle of the country in question). Some of this is inevitable; we are after all dealing with public funds from donor countries for which their governments are responsible to the tax-payers, to the auditors-general, and to their own budgeting cycles. But there could be better collaboration which would relieve developing countries of unnecessary burdens. NORAD has tried to stimulate this in several ways:

- helping recipient governments create national programs where several donors can make inputs;
- co-funding a program with other donors and accepting common/joint reporting; and
- channeling funds through other donors; bilateral, multilateral, or non-governmental.

It seems to us that a lot more could be done to streamline such things. It needs to be examined at country level, however, and the driving force should be the recipient country government. Some of you may know the expression **Country Level Collaboration (CLC)**. Some years ago a lot of us sported badges proclaiming "We believe in CLC!" as a result of a report done by a working group of the Collaborative Council for Water and Sanitation which pointed out how effective this is in some countries. Collaboration at country level can be between different ministries, NGOs, donors, and specialist organizations such as FAO and UNICEF.

If we look at **Investment Programs** in Africa, the move towards national sector investment plans and programs has been a welcome development. By investing in national sector programs,

NORAD is able to have a meaningful dialogue with the country in question on overall policy issues, on implementation strategies, and on reporting mechanisms including financial audits. National sector programs combining physical investments with capacity building and institutional development can increase the sustainability of the transfer of knowledge and technology and stimulate structured learning and replication of successful pilot projects.

NORAD currently participates in several different ways in such sector programs in several sectors. In some cases we supply funds, goods or services directly to governments; in other cases we supply inputs to World Bank coordinated programs by funding Norwegian goods or services or simply by channeling funds through the Bank.

Policy Dialogue is a crucial area of collaboration. As I have already mentioned, the dialogue on best practices and policy development in a sector in a given country should take place in that country, led by that country. In many sectors, however, both donors and recipient governments benefit enormously from discussions in regional and international fora on what are most effective policies and investments in that sector. Developing consensus principles for a sector enables countries to learn from each other and avoid failed experiments.

NORAD staff regularly (annually) meet with other Nordic colleagues at sectoral level to discuss our experiences in the sector. We discuss failures and successes, disagree or agree on how to go forward, inform each other what we are doing in various countries, and invite comments from the others on recent developments. This is an annual learning experience which I personally would hate to do without and which is immensely useful for small countries such as ours.

Internationally, the water supply and sanitation sector is a good case to look at. During the water decade of the 80s, there was a lot of research and dialogue on what worked and did not work. Few other sectors have documented so well the relationship between technology and social organization; few have examined the different roles of women and men so extensively. We should learn from this and be prepared to discuss as extensively integrated water resource management. If managers are going to be able to put together integrated strategies in their countries which get the backing of different line ministries, ensure the participation of stakeholders, and look after the interests of the poorest users; many of the tools and practices discussed and utilized in the water and sanitation sector are going to be central to success.

This implies, of course, that there are fora for such discussions. In Africa you will need to examine what fora you can use and whether new ad hoc or permanent fora must be found. A suggestion was made last year that we need a Global Water Partnership as a forum for ensuring development of better practices based on the consensus principles for water resource management which are contained in Agenda 21, as well as for fostering a better partnership between donors and recipients. A suggestion has been made in this meeting that some kind of consultative forum for Africa may be a good idea, to ensure better exchange of information between African countries on integrated water resource management. As a donor I can only urge you to look at what mechanisms you already have, and what you need, for better policy debate and exchange of experience. As you are no doubt aware, the Nordic countries have supported many initiatives within SADC because we have seen this as a useful forum for the sub-region. Being a regional forum it has enabled us to support regional initiatives and projects resulting in better regional cooperation in the different sectors.

We can also learn something from the Water Supply and Sanitation Collaborative Council. This is a network which meets every two years in the form of a conference where topics central to that sector are discussed by a very large group of sector professionals and operators from a host of countries in the south, as well as donor representatives.

When this forum was created, at the end of the water decade, some donors wanted to create an organization which would take the consensus principles which had been developed forward into the 1990s. Instead, a network with only a small permanent secretariat was created. It has very little finance and is dependent on the enthusiasm of participants for the work going on between conferences. This has its drawbacks, but at least no topic gets much attention unless there is a felt need for answers, strong enough to generate funding from developing and industrialized countries and agencies. Unlike many other development fora, developing country professionals represent the bulk of the participants, and although findings and principles agreed upon are not binding on anyone, for many of us these meetings inspire confidence in the ability of sector professionals in the field to come up with viable solutions.

Lastly let me turn to a forum entirely for the industrialized countries themselves - the OECD/DAC. DAC, the Development Assistance Committee of the OECD, is the forum where industrialized countries meet to discuss development assistance. It is an important forum because it aims to regulate the format for development assistance in such a way as to maximize the benefits to the recipients, not to the donors. DAC has no powers to enforce, but it can and does make guidelines on how to give assistance and ensures that purely commercial exports of goods and services cannot be counted as development assistance. Based on DAC-set criteria OECD makes up statistics showing volume and content of development assistance from industrialized countries.

The strength of DAC is that it is a forum of the industrialized countries themselves. This is where they reach agreement on what effective development assistance is, and if and when industrialized countries go against the regulations and guidelines, this is pointed out to them by their peers.

Every DAC member is examined on a regular basis by a group of the countries put together for that purpose in that year. Thus we all take turns examining and being examined. The examination is based on statistics submitted by the country being examined, as well as on interviews with members of staff in missions/embassies and head office organizations dealing with the official development assistance of the country in question. The results of the examinations are then communicated to the country. In a sense you are getting marked on your performance as a donor country. I don't know how this is received in other countries, but I can assure you that Norwegian politicians care about these results.

As I mentioned, DAC has agreed on guidelines for many different aspects of development assistance. Various specialist groups have also tried to develop tools for analysis and planning of better and more effective development assistance. One important area where DAC has adopted guidelines for members is on gender. One specific tool that is being developed is a framework for including a gender perspective in water resources management. It is not intended to be a checklist, but simply to provide a framework within which to identify relevant gender issues and raise important gender-specific questions related to the commonly accepted principles of integrated water resources management. It is meant to be used by all of us, adapted to specific needs in a particular environment. I have shared copies of this as yet unfinished tool with you, to enable you to make your own journey into gender analysis and as an example of useful and innovative donor collaboration.

CLOSING SPEECH

Mr. Narendra Sharma, World Bank

I'd like to trace where we are at this point in time in terms of how we have seen some of the issues and challenges, what we have agreed on as key points, points that need to be translated into actions, actions that will lead to results on the ground, and results that we are talking about in terms of the livelihood of the people. The theme for this particular workshop was to look at the key issues and challenges facing Africa today and the sustainable management of water resources. Of course the idea was to ensure that we have a glimpse of what the African perspectives are in this area.

During the course of the week we have heard from about 21 different countries talking about the issues, problems, solutions, and some of their achievements. The focus, of course, was to ensure that it leads to partnership and a broad coalition for promoting more efficient and an equitable use of water resources. This is important. There are two important words here: efficient and equitable. Implicit in this is the recognition that there are some social aims that are equally as important as the economic considerations as well as environmental considerations.

So, what we have seen here is an important step in a process to promote actions, foster cooperation, and establish an avenue to exchange information and knowledge. This dialogue among stakeholders will enhance understanding, build consensus, and establish a network. This is the first time that we have stakeholders from different quarters; from the public sector and from different levels of the public sector. There are people from the NGOs. There are people from the donor group. The circle is quite large compared to how it was previously. As a matter of fact it can be larger. It is important incumbent on all of us to ensure that indeed the circle becomes larger as we look at this process in a dynamic way. From our narrow standpoint at the World Bank, we have prepared a document which was completed to be important for two reasons: 1) internally in the Bank, it gives us a clear agenda for what we should be doing to help our African partners; 2) ensures that we do integrate the African perspectives and what has been achieved in African countries in terms of results and achievements, taking into account the opportunities that do exist in the African countries, and that we reflect on the type of programs and projects that we develop at the country level.

After this session and a meeting in Dakar, Senegal, we will be going back to Washington. I will be reporting to the senior management of the Bank, people who matter in the sense that they do have bearing on the final decisions which relate to country programs, lending programs, and the type of support that we give to our African partners. It's important for them to hear what we have heard here during the four days. There are indeed clear messages that you are giving to us. You are telling us a few things that we need to take into account as we look at our programs and as we engender development in African countries.

What I have heard very clearly, during the four days, is that indeed there are some emerging imperatives. What are some of these emerging imperatives?

- There is a strong commitment by African countries to accelerate transition to sustainable and equitable use of water. This is important. There shouldn't be any lingering perceptions on our part and on others' that there is not any commitment on the part of the African countries. What we heard, very clearly, is not only commitment but a strong will to build on what African countries have already achieved and the results that you see on the ground.

- Development should be country-driven, making optimum use of African capabilities, resources, and experiences. I think this message is loud and clear. It was not isolated in one particular group. It was not restricted to any particular agency but was a recurring theme that we heard consistently throughout the meeting. It's an important message for us to carry back and also for us to recognize that indeed this matters. And it matters more importantly to you all.

Translating what we heard in terms of the emerging consensus. What do we see before us on the road ahead?

- Stakeholder participation at all levels. This is important. I think we heard how important it is to take into account gender consideration as we look at this and not to take it for granted because gender plays an important role.
- Multi-sectoral focus and action programs.
- Demand management and water concentration replacing other supply-driven notions.
- Equitable sharing of international resources. I think that compared to any other forums in which we have participated, even within the Bank and other donor agencies, we have clearly heard up to this point that indeed transboundary considerations and issues are becoming very important. Perhaps they are becoming more important than what we listed in the past in terms of accessibility and quality considerations. This does not mean to say that those other factors and variables are not important. They are equally important, but what we are hearing, for a change, is that we need to look at this particular aspect very carefully. It needs to be in our agenda and our policy dialogue. It needs to be woven into the types of programs and country assistance strategies that we develop because it is indeed important. As a matter of fact, it is so important that it will loom over the horizon for the next 8, 10, 15 years.
- A need for effective policy and regulatory framework. I think the recognition comes very clearly.
- Capacity-building, utilization, and retention; these are the areas that countries are already emphasizing, and this is the road ahead.

Now if one translates all of this and sees basically where we are in terms of this emerging new agenda which is already taking place in African countries, it essentially changes our perception. If you recall, when I made my presentation, I was talking about the old agenda. What was that old agenda from our perception? Indeed, it was an agenda that was very much supply-driven, where we focused a lot on engineering solutions. Secondly, we were focusing a lot on a single sector and a single stakeholder. True, some of these changes were taking place, we should not be naive, and some of these were recognized by people in donor agencies outside the African countries. Nonetheless, this old agenda did dominate the patterns of our interventions and our behavior. We also were somewhat materialistic and utilitarian. What do we see when we try to look at the other side of the coin and ask, for example, what is this new agenda?

- Here we see that the emphasis already on the rise is on an integrated approach to water resources management. Integration not only in terms of a river-basin or ecosystem approach but in terms of recognizing that indeed there are multiple sectors and, indeed, these sectors do matter in the final analysis in terms of how water resources are allocated and utilized. Also integration in terms of stakeholder participation. Gone are the days when one stakeholder can dominate the sector and

drive the types of policies that lead to allocation and utilization. The stakeholder also transcends the political boundaries of an individual country.

- Increasingly we are beginning to see that riparian states do matter and they will continue to matter, perhaps more now and in the future. It is a factor that has to be taken into account. Partnership, integration, and pluralism are the key variables that are being emphasized now. Partnership has come up constantly in just about every issue that we have discussed. Integration that is needed to take place to ensure that indeed we can achieve these so-called broad objectives or sustainable or equitable management of water resources.
- I think we have come a long way, the World Bank and some of us, in terms of recognizing that indeed water is not only an economic good but also an environmental and social good. It does fare in terms of your overall social objectives, in terms of your programs, that indeed poor people are important in terms of having access to clean water. So as we really look at our own strategies and at how we can internalize your priorities, your needs, and your objectives, we must take this into account.
- Cooperation in the water resource management of shared rivers. I will say no more about this; it is very obvious.
- Public awareness and indigenous knowledge. It was emphasized that we need to bring in the civil society. We need to get all the stakeholders and empower them so that they also become knowledgeable and cognizant of the type of issues and problems that we all face. They should understand that indeed there is divergence between the interest of an individual and the interest of a society or community at large and that there has to be some reconciliation on the management of these diverse concerns and interests.
- Gender sensitivity. This is hammered, and I think often we have a tendency to overlook this. Listening to all the discussions, I feel we need to be careful about this particular consideration. We have a tendency to take it for granted. It's not a question of rhetoric or of writing it down in our presentation but more a question of what sort of actions would allow us to take into account gender considerations much more effectively.

Now, when I look at the notes that we have gathered and the findings of various discussions, I ask myself, "What are some of these development priorities?" It basically comes down to five:

- Enhanced service coverage with priority for the poor, in rural areas and in peri-urban areas. In our document, based on the advice that we got from the African advisors, we made a significant change in our presentation. We have agreed in no uncertain terms that the Bank needs to redirect its focus to peri-urban and rural areas as well. This is where most of the poor people live. We need to provide support in the context of your programs and in the manner that you designate as the type of support necessary.
- The importance of food. Food production in Africa is going to be significant, and water is an important variable. I was very impressed with the presentations that were made in Group A where I listened to the representatives from Ethiopia and Sudan and others. They all talked about food production and the need to expand irrigation. Irrigation is now back to the level of four and a half million hectares, and there is potential for small-scale irrigation development. I staggered when I heard the figures mentioned by Ethiopia that presently 160,000 hectares are irrigated while the potential is roughly about 3.4 million hectares. When I did my calculation in

Washington very briefly for my presentation, I found that if you can increase the present level of irrigated areas, just doubling it and sticking to cereal production, you can increase production by 35–40 million metric tons which is equivalent to the projection for year 2025.

- Emphasis on water harvesting and conservation, as brought up by a number of representatives. This is equally important. In Africa today more than 200 million hectares of land are under rainfed agricultural practices. Rainfed agriculture will play an important role. Therefore, the action and type of programs that we should be thinking about should also go beyond irrigation. Water quality and human health increase the recognition that water contamination needs to be dealt with. The representative from UNESCO and others brought up this point. It also came up in just about all the country presentations that I heard on Wednesday.
- Protection of watersheds and wetlands. There were a number of representatives who talked about land degradation and deforestation and how they will impact not only the quantity of water but also the quality of water.
- The importance of regional cooperation.

I see these as the emerging pillars of development which translate into priority areas. What may be a priority in one country may be somewhat different in another, but I think in aggregate this is the type of picture we are seeing.

Now, let's capulize the various presentations that were made this morning based on the thematic discussions and look at them in terms of what actions need to be taken.

- Again, to achieve sustainable and equitable use of water resources, one should utilize and build on local capacity and human resources. It is important that the Africans take the lead. We should use their own resources. I think the message to the donors and others is loud and clear; it is no longer a case of our pushing for technical assistance or not using the resources that are already available here within the country and within the continent itself.
- Strengthen data information systems. I think this is something that we all recognize collectively. We recognize that without good data information systems we will be hard pressed to do effective planning and monitoring systematically on a long-term basis.
- We also realize that the involvement of all stakeholders is important as is building their awareness, a point that I mentioned earlier.
- Establish the type of framework and mechanisms for cooperation and conflict resolution. I believe that this is going to be one of the biggest challenges for the Region and for all of us, partly because the answers are not clear and because we don't have a proto-type or blueprint to deal with. Also, there are many factors, such as externalities, etc., that we really don't know how to deal with, particularly when it comes to the question of international externalities. This comes strictly through cooperation and income transfer although we really don't have the type of models and prototypes, not even methodologies at this stage, to look at these things systematically.
- Establish long-term major investment programs. I think the Minister of Ethiopia made a very astute observation about why were the donors stepping on each other's toes, why was there so much over-lapping and duplication, etc. He said that perhaps it is time now for us to move away from project-oriented approaches to program-oriented approaches. Within the Bank we are starting to draw lessons. Within the

Bank we are already talking about the importance of moving in this direction, to ensure that there is country ownership in this program and that perhaps this program vehicle will allow countries to coordinate donor participation, donor support, and involvement.

- Donor coordination. This important action does not fall squarely in our laps as donors; it also falls in your laps as well. Why? Because it should be coordinated by the countries. You should lead; we should follow.

Regarding the strategies and investment options, I'd like to very selectively take some of the points that came out during the last two and a half hours and focus on some of the key points that I believe deserve attention. Naturally there might be some other important points that have fallen through the cracks; that is not intentional. We will be sure that they are integrated in the document as well as in the proceedings.

- Country-led strategies with responsive donor support, a point I've made already.
- Commercialized approach to service provisions.
- Pluralism, participation of other stakeholders, private sector, etc.
- Community-level management and resource mobilization, a point I made in my earlier presentation. The dependency that some of you talked about in some of the presentations links into this.
- Pricing and cost-recovery; focusing more on demand-management.
- Equitably and environmentally sustainable development. In other words, recognizing that indeed what is at stake is the interest of future generations, and it is our responsibility to ensure that we do not degrade the type of systems that are benefiting us today, that give us options for future use, and that also provide options for future generations as well.
- Capacity utilization, building, and retention. I think the Minister from Namibia made excellent points here that very relevant and that come from the participants themselves. They were quite evident in the presentations. The need to use indigenous resources, indigenous knowledge as well, to take into account existing capacities. Not to reinvent the wheel. We all have a tendency to reinvent wheels, we all have a tendency to create new institutions. We also have a tendency to build on institutions and thus don't pay much attention to retention and sustainability.

When the African advisors were reviewing the zero draft, they said "Look, we all have a tendency to build capacities. Let's backtrack. Let's talk about using existing capacities. Let's move forward and talk about retention and sustainability." These are the things that matter, and these are the things that we should be talking about.

- The other one is equipping all stakeholders for an effective role. Our tendency, the donor tendency, is always to look at the public sector. But this spectrum is much broader now. We have to have client consultations; we need to look at other stakeholders. We should look at their capacity building requirements and needs. And it should be much more broad-based. This is the area where we need to be a bit humble because we need to find out more. The way to find this out is by interacting with stakeholders because in many instances they have the answers.
- In the domain of regional cooperation, again, we need to give some special thought to what sort of mechanisms, what sort of regional framework and legal framework need to be set up that will promote some level of cooperation among states.

- Policies, institutions, and legislative reforms to create an enabling environment that will promote the type of actions and interventions that we have talked about.

I'd like to move now to the more important point concerning *transboundary issues*. We, the donors and others, have to look at instruments that will allow us to deal with multiple-country interventions and to go beyond the single country approaches that we have taken so as to identify win-win solutions. The representative from Zimbabwe is not here, however, he made a very good point in yesterday's session. We should consider how we can create win-win situations for the riparian countries. Why is it important to create an even playing field so that the negotiations and discussions and other interactions will take place among equals and foster cooperation through capacity utilization and building? This point was made this morning by the Chairperson of the group that dealt with international waters.

Training and exchanging information. In the past, we all talked about the importance of setting up data and information systems, but we failed to recognize how important it is to setup networks, a point made by the representative from South Africa, to ensure that indeed these exchanges do take place and that there are advantages in doing so, and not to reinvent the wheel.

Treaties and agreements and joint investments. Where there are economies of scale, there are certain advantages. These are the areas into which countries ought to be moving. In these areas we donors need to be doing some thinking; we need to be a bit creative and innovative in trying to find ways to be more effective in these areas.

Information and knowledge base. I would like to emphasize more strongly that the question is not just one of hydrological information but a wider range of information. We are talking about demand and supply, about socio-economic data and information. We are talking about information that will enhance our understanding of how social systems interact with natural systems, the components of natural systems. What does it mean when there is degradation of a watershed? What are some of the implications and impacts in terms of an economic time horizon versus beyond the economic timeframe, e.g., in a couple of generations? I think the point was also made by a number of others.

The things listed here are issues that my colleagues and I were able to discern and extract from the presentations made this morning. The slides will be available to you after the meeting.

I'd like to come to the last point which is very important, donor coordination, looking at it from our angle. I think Margaret made a very good point. Maybe it's high time now that we look at this in terms of a partnership. A partnership based on a common denominator that doesn't distinguish us as providers and you as recipients, but a partnership on a plane which will allow us to have mutual respect and to recognize that indeed answers lie on both sides. A partnership that will also allow us to appreciate that indeed you have your priorities, your needs, your strategies which we need to internalize. A partnership also which will allow you to recognize that indeed we are also humble in what we are trying to do, that we are not dogmatic and are not trying to be paternalistic. We are trying to forge ahead with a partnership together with you to find answers and solutions that can come out with better projects. That's the type of partnership we are looking for.

- Support African-driven national programs. This is a point that has been made, and this is the message we will carry back.
- Respond to multi-sector and multi-country challenges. I've heard other donors talk about these points and I think it's a good and positive sign. What I see among the donors is a move in the right direction.

- Rely on African capacity and human resources.
- Enhance client consultation. We have to do this more systematically. We have to do more listening. Listening and enhancing client consultations will come through such get-togethers as this conference, whether they are formal or informal. But I think it's important. It is through such interactions that we are able to dispel some of the misperceptions that we have and also to come out with perhaps some understanding that will allow us to move ahead.
- Focus on results on the ground. We donors get out of the mold of focusing excessively on processes and on program designs and instead focus more on development impacts, on what sort of results are taking place, on the question of sustainability.
- Harmonize procedures and approaches. This is very important. I think some of these points were made in yesterday's and today's presentations. We donors have cumbersome procedures with requirements. We need to see to what extent we can harmonize these. Obviously there are some differences; you have to recognize these. We do report to our stockholders, people that we are accountable to, the taxpayers that are involved; several donors have to comply with such requirements. But I think, broadly speaking, we can define some areas in which we can do certain streamlining. And this is something we ought to do.

The final point about where we are going to go from here, as far as the World Bank is concerned, is very clear. We have a document that will shape the way we do business, the way we develop Country Assistance Strategies. We have heard messages from you all. We will try to work with you as partners, to work with the donors as partners, so as to move ahead. We have found this particular stakeholder workshop very important. I know in the four days we have been here it has impacted me although I have work on this topic now for almost 2 years on a very intensive level. I'm quite sure that some of you have told me in private that you have learned a lot and have benefited from this. It is up to us to ensure that this process goes on and, even on an informal basis, for us to have dialogue. We are willing to help, but we want this process to be African-led where the agenda is set by you. Whether we meet again in a year or two years, I hope we will be one step further and will discuss what we have achieved since today as we look at the future.

With this note I'd like to conclude now. I'd like to extend our gratitude to UNEP for providing us with the facilities and allowing us to meet here. We met here two years ago when we worked on a similar exercise on the forestry strategy for Sub-Saharan Africa. We appreciate it. My final note of thanks is to all of you. I think you all have played your roles as representatives of your country or whomever you are representing. I think you have brought to this conference diverse viewpoints, and you have made it a rich conference, rich for all of us. We have made a lot of friends. I hope you will continue with the network. I know now that if I'm going to visit any of your countries I know who to contact and vice versa. I hope that you will contact us as well so that we can continue in this spirit. With this I wish you all good luck and hope you have a safe journey. And I also hope that we will have opportunities to meet again and interact. Thank you very much.

ANNEXES

ANNEX 1 - WORKING GROUP REPORTS

GROUP A: STRATEGIES AND INVESTMENT OPTIONS

1. STRATEGIC VISION

The key elements of a long-term vision for water resources management (WRM) in Sub-Saharan Africa were identified as:

- Complete coverage of currently unserved populations and their integration as stakeholders in WRM
- Environmentally sustainable use of water
- Economically efficient water allocation taking account of equity considerations
- Strong water institutions with sufficient (not excessive) regulation
- High level of stakeholder participation
- Efficient use of water for food in dryland and irrigated agriculture, with effective involvement of the private sector
- Proven drought and flood management capacity
- Water demand management in growing cities
- Effective wastewater management

2. BARRIERS TO ACHIEVEMENT

The Working Group took the view that Africa's problems were well recognized and that the emphasis should be on achievements and the way forward. So, while it acknowledged the difficulties caused by a shortage of financial resources and of qualified people and by demographic trends and constraints on private sector investment, the group did not devote time to amplification of the problems.

3. MEDIUM-TERM GOALS

In the medium-term, national sector goals should include:

- A focus on extending water and sanitation service coverage to the poor (urban and rural), paying particular attention to women and health
- Completion (with stakeholders) of a water resources management strategy
- Decentralized water system management
- Community participation and management of rural water (supply and irrigation)
- Training and extension for local agencies/institutions

- Restructuring of public utilities to include commercialization
- Private sector participation, where the government is confident it will be effective (examples include Angola, Mozambique, Rwanda, Tanzania, Zaire, Zambia)
- Emphasis on rehabilitation and optimum asset management
- Institutionalization of water conservation and demand management
- Resource assessment matching availability with supply
- Reinforcement of water laws and regulatory frameworks
- Separation of regulatory and supply functions
- Recognition of environmental needs/demands (including wildlife) and environmental assessment of all new infrastructure
- Political commitment and establishment of national water investment programs
- Promoting private sector capacity building in the water sector
- A priority focus on sanitation

4. INVESTMENT CHOICES

In seeking to use available resources in the most effective way, countries need to focus on some important principles:

- Extending service to the rural poor
- Demand and asset management as a priority
- Seeking international opportunities for joint water development
- Capacity building to optimize the development and use of indigenous resources

5. FINANCIAL SOURCES

The scope for increasing resources available for water resources management includes:

- Domestic resource mobilization (which in many cases is likely to be adequate for recurrent costs, though not for new investment)
- Recognition of urban-rural links in basin planning and water resources development, to avoid duplicated or inefficient efforts (examples of good practice here include Madagascar, Tanzania, Zambia)
- Private sector participation in large urban infrastructure
- Small commercialized utilities at district level (Zambia is an example)
- Community level resource mobilization linked to community management
- Recognition of the opportunity costs of raw water, stimulating pollution prevention and charges related to environmental costs, including the "polluter pays" principle
- Encouragement of smallholders through initial support
- International cooperation with equitable cost sharing (e.g., Lesotho selling water to South Africa)

- **Multipurpose benefits such as hydropower helping to fund investments in water supply and agriculture**
- **Improved donor coordination at country level**

GROUP B: CAPACITY UTILIZATION, BUILDING, AND RETENTION

Group B addressed this topic by looking at the existing strengths of African nations in relation to a series of key capacity issues and then identifying critical gaps which needed to be plugged and the priority actions needed to address the capacity issues concerned.

1. RAISING AWARENESS

Existing strengths and achievements

- At regional level, governments are aware of water shortages
- Awareness at both government and public level is increased by frequent droughts
- Networking is increasing, both nationally and regionally
- Interagency collaboration is bringing together governments, NGOs, and research institutions

Critical gaps in awareness of WRM needs

- The well-to-do remain protected by law and tradition and continue to waste water, while the needs of the rural poor are neither well known nor adequately addressed
- Learning institutions are not keeping pace with changing requirements and knowledge, leading to poor preparation of future professionals
- No sustained mechanisms are known for reaching the public with regular awareness raising

Priority actions in raising awareness

- Increase regional cooperation
- Increase national and provincial interactions
- Address the needs of the poor in rural areas
- Target wealthier people with awareness campaigns on the harmful effects of water mismanagement, misuse, and overuse
- Direct initial efforts to charge economic rates for water services towards the better-off
- Work with schools and/or school leavers to mobilize children and youth as agents for change

2. CAPACITY AT THE NATIONAL LEVEL

Existing strengths and achievements

A number of countries have reformed institutional structures and developed water legislation, policies, and plans. In general, sector agencies are relatively effective at the administrative level but weak at the technical level.

Critical gaps

- There is a shortage of skilled manpower at management and technical levels, aggravated by an absence of incentives to retain trained staff
- Often resources, capabilities and needs are badly mismatched
- Water resource initiatives are often uncoordinated at national level

3. CAPACITY AT LOCAL GOVERNMENT LEVEL

Existing strengths

Having closer contacts with users, local governments have the opportunity to tap a huge fund of indigenous knowledge and are more accessible to deal with user queries or complaints.

Critical gaps

- Countries generally do not tap indigenous knowledge fully, and this is especially true in the case of women's potential positive contributions
- Links with modern scientific learning are generally poor
- A severe shortage of professional staff exists in rural areas
- Human resource shortfalls and other gaps in capacity can lead to non-implementation of water programmes

Priority opportunities and actions

- Tapping the existing human resource strengths and indigenous knowledge available at local level
- On-the-job training of local technicians
- Implementation of institutional and legislative reforms
- Tapping of existing national trained manpower, with an emphasis on gender balance and gender sensitivity
- Promotion of traditional indigenous water management systems. (There are examples from Sudan and the Western Province of Zambia of equitable water sharing through traditional systems.)

4. STAKEHOLDER PARTICIPATION

Existing strengths

- Locally-specific knowledge to be tapped
- Financial resources which can be mobilized
- Well-established water user associations/groups contribute to better policies and more sustainable projects
- Recent years have seen improved links between policy-makers and users in a few countries

Critical gaps

- Assumptions that government must be the lead shareholder in the water sector
- When industries put their own interests ahead of other stakeholders, such as communities and individual consumers, the result may be damaging pollution badly affecting others
- Some communities are apathetic about protecting their own interests

Priority actions

- Sensitize all stakeholders, particularly the poor, to exercise their rights
- Government focus on national strategy formulation and regulation
- Industry to safeguard its interests through interactions with other stakeholders

5. THE ENABLING ENVIRONMENT

LEGAL AND REGULATORY REFORM

Existing strengths

A number of countries have introduced or are introducing water acts. Some have policies and action plans in various stages of completion.

Critical gaps

Generally there is a lack of sector policies. Except for a few countries, existing laws do not reflect the aspirations of many stakeholders, with the poor especially neglected. Few countries have action plans for the sector; there is an absence of consultation with local communities; and little attempt is made to make use of traditional legal systems.

Priority actions

- Strengthen stakeholder consultation
- Review water rights
- Build on indigenous resources/legal systems

PRICING AND WATER ALLOCATION

Issues

The Group saw the issues of efficiency, commercialization, and privatization as those most relevant to decisions on water pricing and allocation of scarce water resources.

Existing strengths

Recognition of water as an economic as well as a social good and acceptance of the principle of cost recovery will help sustainability, though each country will have to decide for itself on the degree of commercialization/privatization appropriate to its circumstances.

Critical gaps

- Little application of the user-pays principle contributes significantly to pollution problems
- Inefficiencies in meter reading, billing, and revenue collection lead to high rates of unaccounted-for-water and shortage of revenue
- Weak service delivery leads to reluctance to pay on the part of poorly served consumers

INFORMATION

Existing strengths

A considerable amount of useful information exists at national level, and the information flow is helped by NGOs generating and sharing water-related information at local and national levels.

With improved telecommunications systems, new opportunities exist for sharing information easily and economically.

Critical gaps

Information rarely reaches stakeholders in rural areas or the urban poor. What information is disseminated is often not in usable form for different stakeholders.

Priority actions

All those generating and receiving information need to recognize that it can be very valuable in water resource planning and should make recording and sharing it in usable ways an important part of their activities.

GROUP C: INFORMATION AND KNOWLEDGE BASE

1. PROBLEMS

- Capacity building, utilization of local expertise, retention of qualified staff
- Misdirection of human resources leading to well-qualified people occupying "non-jobs"
- Lack of linkage between water information services and WRM, and the decision-making process
- Severe shortage of data on water demand and water use
- Inadequate awareness among policy-makers, the public, and users
- Insufficient optimization of water monitoring network, including quality of data
- Insufficient funding of operation and maintenance
- Need for improved leadership and management to guide external assistance
- Unsatisfactory institutional and financial autonomy to market products and services
- Charges for hydrological services go into general coffers
- Too much dependency on external support
- Reluctance to exchange water data and information

2. BENEFITS AND COSTS

The cost of information systems is very small in relation to overall costs of water resources management and development. It is estimated to be less than 1%. However, information is vital for all development and management. It is difficult to establish a realistic cost benefit ratio.

3. INITIATIVES AND OPPORTUNITIES

Regional initiatives such as SSAHA, HYCOS, FRIEND, GEMS offer windows of opportunities to:

- Mobilize external resources and motivate national services
- Promote exchange of information (efforts are being made to ensure that data can be made freely available to everyone; South Africa has already adopted this principle, and the HYCOS concept includes a regional data base which countries can link to.)
- Encourage application of new technology (Internet/FTP/E-mail capabilities are expected to become available soon.)
- Enhance service capacity
- The SADC ZACPLAN project is an example of coordinated information generation and exchange and management of shared water resources
- The UNECA and WMO initiative, in response to SSAHA, has been formulated to utilize sub-regional political groupings to implement the "Addis Ababa" Action Plan

- National initiatives in Tanzania, Uganda, and South Africa have resulted in institutional restructuring and the establishment of linkages between water information services and WRM and has helped the decision-making process
- Decentralization and commercialization of WRM and water information services are planned in Mozambique
- Several national services have adopted GIS and remote sensing technology
- Drought monitoring services exist for eastern and southern Africa

4. RECOMMENDATIONS

- Implement recommendations of the African Conference on Water Resources: Policy and Assessment (Addis Ababa March 1995)
- Endorse the Strategic Actions stated in the World Bank's WRM draft document, January 1996 (D.4 pp 66)

Specific recommendations:

- Seriously consider commercialization of WRM functions including hydrological services
- Strengthen training of hydrological and hydrogeological personnel at all levels

GROUP D: INTERNATIONAL WATER RESOURCES

1. PROBLEMS/CONSTRAINTS

- Increased water scarcity and quality problems (a function of managerial ability)
- Increase in conflicting demands and usage (intra and interstate national conflicts)
- Technical incapacity (economics; resource and environmental economics; engineering science)
- Lack of technological capacity
- Lack of data and information
- Inadequate skills and managerial capacity
- Inadequate attention to consensus building and political commitment
- Varying perceptions of the value of water (social good/economic good)
- Lack of enforceable legal frameworks

2. RECENT, CURRENT, AND PLANNED INITIATIVES AND LESSONS LEARNED

National examples

- Okavango River Basin (Angola, Namibia, Botswana)
- Tripartite Technical Commission concerning the Incomati River (Mozambique, RSA, Swaziland)
- Joint water commission concerning the Orange River (RSA, Lesotho, Namibia)
- SADC Protocol on Shared Water
- Tripartite Agreement concerning Lake Victoria (Kenya, Uganda, Tanzania)
- Permanent Joint Technical Commission concerning the Nile Water (Sudan, Egypt)
- Commission on Zambezi River (in progress)
- Kaguru River Basin and international agency for managing Lake Victoria inflows from Kaguru
- TECONILE between several Nile basin states
- Limpopo Technical Committee
- Joint commission between Zimbabwe and Mozambique on some shared rivers

Lessons learned

- Political will is very critical
- There is a need fully to utilize the capacity of existing regional organizations
- The existence of an agreement *per se* does not guarantee effective cooperation in the use and management of shared water

Some benefits of establishing joint commissions

- Promotion of joint management on a basin-wide basis
- Utilization and enhancement of local technical expertise
- Promotion of technical information and data collection and sharing
- Facilitation of the process of long-term planning and financing

3. GUIDING PRINCIPLES TO PROMOTE REGIONAL COOPERATION

- Comprehensive and enforceable legal frameworks (define and abide by respective obligations; allocate water use, management and ownership)
- Informal/formal negotiation
- Mediation/conciliation/fact finding
- Mutual trust is critical
- Technical data collection/sharing
- Market-based incentive mechanisms, economic instruments/compensatory measures
- Equitable allocation and use - Helsinki Rules
- Long-term planning and monitoring
- Synchronized budgets (long-term considerations)
- SADC Protocol as a guiding principle example
- Subregional agreements

4. INSTITUTIONAL AND POLITICAL SOLUTIONS

- Establish neutral/credible bodies (for those who do not have one already) - technical, ad hoc/permanent (dispute resolution)
- Prepare a national master plan consistent with integrated planning and management of shared rivers
- Enhance technical capacity
- Involve all stakeholders at all levels (local, central, regional)
- World wide peer review process/Internet, etc.

5. IMPLICATIONS FOR INTER-COUNTRY EXCHANGE AND PARTNERSHIP

- Voluntary loss of sovereignty to enter into a win-win solution
- Make sure the proposal is such that the end result is a win-win scenario (reduce transaction cost)
- Genuine commitment of countries to participate fully; mutual trust

6. POTENTIAL ROLE OF INTERNATIONAL AND REGIONAL ORGANIZATIONS

Concerns

- Inconsistent communication and mode of operation of international organizations
- Bias and hidden agenda of some international organizations
- Importance of acting in a transparent and fair manner
- Need for increased donor coordination

Potential role

- Provision of some global neutral view points
- Establishment of data banks
- Valuable source of varied competent and technical skills
- Facilitation of consensus building
- Use of carrot/stick approach
- Means to avoid and solve potential conflict before escalation
- Provision of funding/grants to facilitate the development of regional initiatives
- Establishment of a fund to address externalities (pollution problems and compensatory mechanisms)
- Ability to use diplomacy as an instrument and a multi-country focus
- Capacity to establish a convenient repository of case studies and treaties

7. FUTURE ACTIONS AND PROPOSALS

- Monitor what is happening now
- Provide additional technical and financial support to regional river basin organizations to manage the shared waters effectively
- Keep the dialogue alive - continue to gather and share data and information
- Build, mobilize, and retain technical capacity
- Establish a forum to discuss issues dealing with international river basin management (for those countries that have not yet done so)
- Establish a process of follow up and regular review of case studies on the use and management of shared river basins
- Bring national governments and external support agencies together to develop proposals for win-win joint management of shared rivers.

GROUP E: DONOR COLLABORATION

1. MAIN THEME

Recommended approaches to development support should:

- Focus on a national program
- Be country and demand driven, ensuring responsiveness to community demands
- Be an evolving process
- Focus more on local capacity building and less on technical assistance
- Promote regional (e.g. river basin) cooperation
- Assess and mobilize the rich capabilities within Africa

2. SUCCESSFUL EXAMPLES OF COUNTRY- AND REGIONAL-DRIVEN INITIATIVES

National examples

- Preparation of Tanzania Water Resources Management Strategy
- Development of Uganda's Water Sector Program (a rehabilitation program restored all broken systems in three years; all Uganda's aid programs have components for capacity building; the result has been significant achievements in disease reduction and other performance indicators)

Regional examples

- Development of the Zimbabwe/Mozambique protocol for sharing transboundary water resources
- Development of the SADC region protocol for managing shared water resources

3. NATIONAL LEVEL IMPLICATIONS

- Political will and accompanying financial commitment
- National policy framework
 - e.g., national water resources management policy with matching political statement
 - integrated, multi-sectoral basin-based approach
- Strengthen existing capacities
- Mobilize national (public and private) resources
- Initiate agreements between riparian countries
- Co-ordinate donor assistance
- Increase access to information on donor assistance procedures

4. DONOR LEVEL IMPLICATIONS

- **Develop simple and harmonized assistance procedures**
- **Enhance donor collaboration**
- **Support national programs**
- **Support multi-sectoral approaches (e.g. integrated river basin management programs)**
- **Support existing regional training programs and develop new ones where necessary**
 - **an example of the former is the ANSTI Regional Graduate Program on Water Resources Management in Tanzania**

ANNEX 2 - WORKSHOP AGENDA

Theme: African Water Resources: Challenges and Opportunities for Sustainable Management

Focus: Partnership and Consultation: Develop consensus and a broad coalition for promoting more efficient and equitable use of water resources in Sub-Saharan Africa

DAY 1, MONDAY, FEBRUARY 12

Morning Session

- 9:00 a.m. *Opening address:* Jorge Illueca, Managing Director, UNEP
- 9:30 a.m. *Keynote address:* The Continent in Transition, Kevin Cleaver, Africa Region, World Bank
- 10:15 a.m. Coffee Break
- 10:30 a.m. African Perspective: Issues and Challenges in the Sub-regions
Chair: E. Mwongera, Permanent secretary, Ministry of Land Reclamation, Regional and Water Development, Kenya
Speakers: H.E. Roberto Costely-White, Minister, Ministry of Water, Mozambique; Mark Muhwahusi, Insitute of Resource Assessment, University of Dar es Salaam
- 11:30 a.m. Plenary discussion
Moderator: Frederick Lyons, Regional Bureau for Africa, UNDP
- 12:30 p.m. Lunch

Afternoon Session

- 2:00 p.m. Fair Share Approach to Water Resources Management, Walter Rast, UNEP
- 2:30 p.m. World Bank Perspective: The African Water Resources Management Strategy, Narendra Sharma, Africa Region, World Bank
- 3:15 p.m. Plenary
Chair: H.E. Mr. Shiferaw Jarso, Minister of Water Resources, Ethiopia
Discussants: Fred Chunga, Permanent Secretary, Ministry of Land and Water Development, Zimbabwe; Gourisankar Ghosh, UNICEF; Peeter Heyns, Dept of Water Affairs, Namibia
- 4:00 p.m. Coffee Break
- 4:15 p.m. Plenary discussion continued
- 5:15 p.m. End Day One

Evening

- 6:30 p.m. Welcoming Cocktails, Safari Park Hotel
- 8:00 p.m. Host: Kevin Cleaver, World Bank

DAY 2, TUESDAY, FEBRUARY 13

Morning Session

- 8:45 a.m. Opening to Day Two
- 9:00 a.m. Country Perspectives: Achievements and Opportunities
- Concurrent Sessions A and B
- Session A:* (northern: Nile and Congo Basins, islands) Burundi, Comoros, Djibouti, Eritrea, Ethiopia, Kenya, Madagascar, Rwanda, Seychelles, Somalia, Sudan, Tanzania, Uganda, Zaire
- Chair A:* Dr. Ahmed Adam, First Undersecretary, Ministry of Irrigation and Water Resources, Sudan
- Session B:* (southern: Zambezi, Orange, Okavango, and Limpopo Basins, islands) Angola, Botswana, Lesotho, Malawi, Mauritius, Mozambique, Namibia, South Africa, Swaziland, Zambia, Zimbabwe
- Chair B:* Kevin Cleaver, World Bank
- 10:00 a.m. Coffee Break
- 10:15 a.m. Sessions Continued
- 12:30 p.m. Lunch

Afternoon Session

- 2:00 p.m. *Plenary, Chair:* Henry Kajura, Minister of Natural Resources, Uganda
- Group presentations: Session A summary
Session B summary
- 3:30 p.m. Coffee Break
- 3:45 p.m. Plenary discussion continued
- 5:00 p.m. End of Day at UNEP

Evening

- 8:00 pm "Private and Public Response to Drought in California", Ariel Dinal, World Bank
- "Promoting Research and Best Practices in Irrigated Agriculture: Presentation of the IPTRID Program", Randall Purcell, World Bank
- 9:30 pm End Day Two

DAY 3, WEDNESDAY, FEBRUARY 14

Morning Session

- 8:45 a.m. Opening to Day Three
- 9:00 a.m. Thematic Discussion: Concurrent Sessions
- Group A:* Strategies and investment options (cross-sectoral considerations, role of private sector and government, investment priorities, economic options)
- Chair:* H.E. Mr. Pius Njwando, Minister of Water, Tanzania

Speaker: David Grey, World Bank

Group B: Capacity utilization, building, and retention (awareness, institutions, human resources, stakeholder participation, policies and regulations)

Chair: H.E. Nangolo Mbumba, Minister of Agriculture, Water and Rural Development, Namibia

Speaker: Shimwaayi Muntemba, World Bank

Group C: Information and knowledge base (data systems, hydrological assessments, knowledge transfer, data sharing, information gathering)

Chair: Stefan van Biljan, Directorate of Hydrology, Department of Water Affairs and Forestry, Republic of South Africa

Speaker: Naginda Sehmi, Director of Hydrology, WMO

Group D: International water resources (river basin organizations, mechanisms for conflict resolution and prevention, regional cooperation, joint investments)

Chair: John Wambeda, Head of National Secretariat, Lake Victoria Environmental Management Program, Ministry of Natural Resources, Uganda

Speaker: Ariel Dinar, World Bank

Group E: Donor collaboration (policy dialogues, investment programs, implementation procedures)

Chair: Margaret Mwangola, KWAHO

Speaker: Mona Gleditch, NORAD

12:30 p.m. Lunch

Afternoon Session

2:00 p.m. Concurrent sessions continued

5:00 p.m. End Day Three

Evening

7:00 p.m. Dinner: Safari Park Hotel
"Environmental Considerations in Water Resources Management: Issues and Challenges" by Dr. George Okoye Krhoda, University of Nairobi

DAY 4, THURSDAY, FEBRUARY 15

Morning Session

8:45 a.m. Opening to Day Four

9:00 a.m. Plenary
Chair: Frederick Lyons, Regional Bureau for Africa, UNDP

Thematic group presentations

-- Group A: Strategies and investment options

-- Group B: Capacity building

-- Group C: Information and knowledge

10:30 a.m. Coffee Break

10:45 a.m. Thematic group presentations continued
-- Group D: International water resources

-- Group E: Donor collaboration

12:30 p.m. Lunch

Afternoon Session

2:00 p.m. Plenary discussion continued

3:30 p.m. Coffee break

4:00 p.m. Wrap-up, Narendra Sharma, World Bank

5:00 p.m. End workshop

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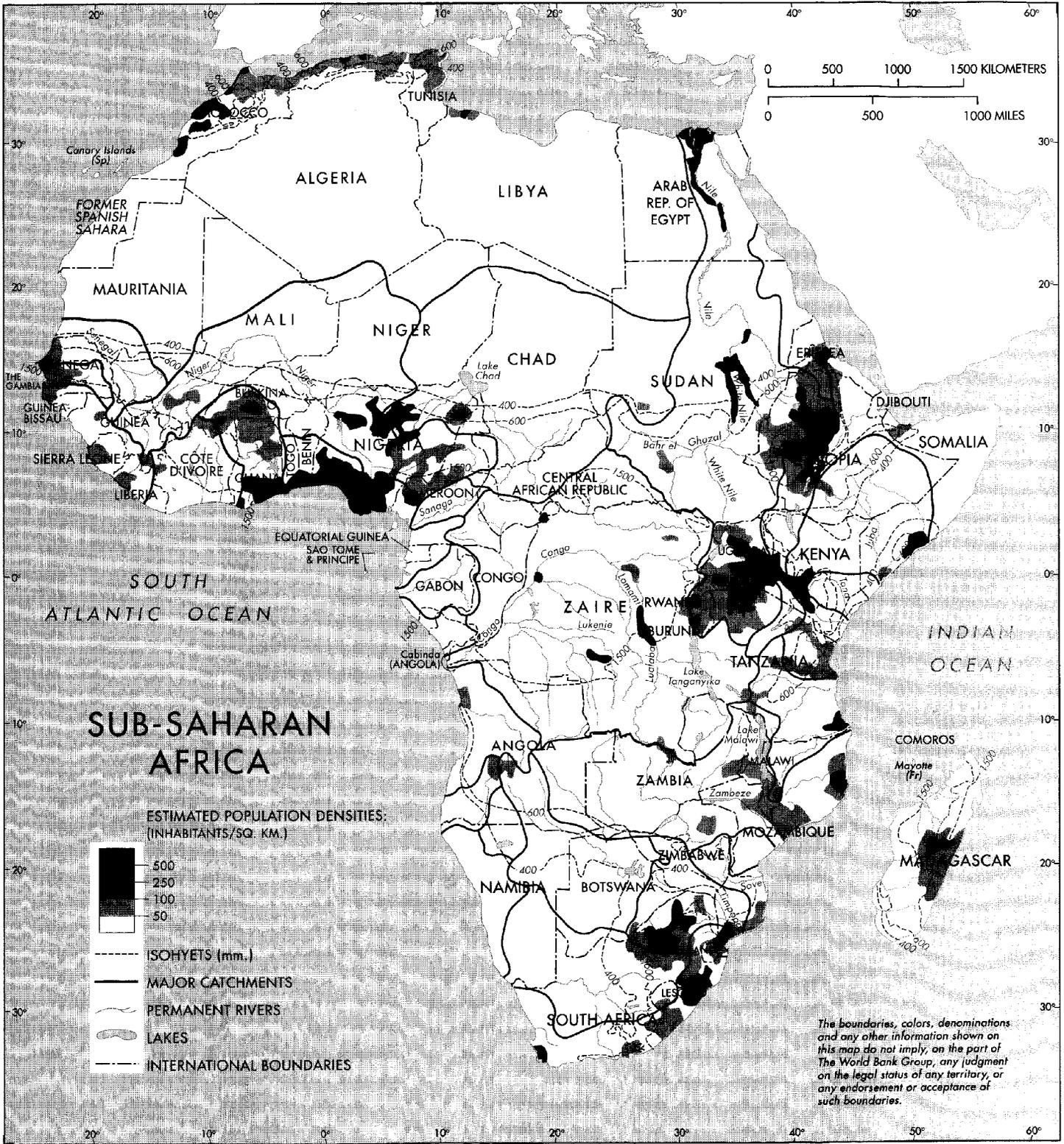
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(INHABITANTS/SQ. KM.)



- ISOHYETS (mm.)
- MAJOR CATCHMENTS
- ~~~~~ PERMANENT RIVERS
- LAKES
- INTERNATIONAL BOUNDARIES

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