MANUAL 1

Principles and Practices of Integrated Water Resources Management

Workplace-based Professional Training

SIWI

Contents

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Introduction

Welcome to *Principles and Practice of Integrated Water Resources Management*, the first manual in the Workplace-based Professional Training on Integrated Water Resources Management. Water is everybody's responsibility and its equitable distribution and sustainable utilization requires the informed engagement and active participation of all stakeholders in the management and development of water resources. This training manual is therefore intended for all stakeholders (water users and managers) in the Rift Valley Lakes Basin and its sub-catchment areas. The purpose of this manual is to introduce stakeholders to the concept, principles and practice of integrated water resources management (IWRM), the aim being to develop a solid understanding of IWRM amongst the trained participants.

Expectations

After going through the training in this manual you will be expected to achieve the following specific learning outcomes (see Figure 1).

1. Describe different water resources, water users and environmental sustainability.
2. Define IWRM.
3. Understand the key principles of IWRM.
4. Explain the IWRM approach and demonstrate understanding of IWRM in practice through analysis of case studies.

To get the most out of the course, remember to be an active learner and participate fully in the training programme!

Manual layout

The manual consists of four units that address the specific outcomes, as stated below (Figure 1). The guide is designed for an active learning approach, where you will be required to participate in discussions and take notes. You are welcome to add information derived from other sources and share these with your colleagues either during or after a training session.

Each unit will begin with questions to help you focus on specific aspects of the training. These questions may be linked to the specific outcomes. Thus, by the end of the training, you should be able to answer the questions and prove that you can fulfil the specific outcomes.

Figure 1. Structure and content of Manual 1.

Purpose, outcomes and assessment criteria

It is important to realize that the success of this training **depends on you**. It is your determination and will to learn that will make you and your community better. Learning can take place if you participate and become aware of all that you used to take for granted as well as correcting mistakes that you would have made previously. Remember, you will only learn if you move out of your comfort zone and participate fully.

The specific outcomes and assessment criteria are presented in Table 1. You can use this table as a checklist to evaluate your progress, including whether you have fulfilled the expectations.

Specific outcomes	Assessment criteria
Define water resources	• Understand and present the natural water (hydrological) cycle as part of the natural ecosystem using a diagram.
	• Understand different sources of water and their relation to the natural water cycle (e.g. the relation between land and water use, or between surface and groundwater).
	• Understand that all life and all sectors of the economy depend on water (interdependence). Identify different water users and water demands in the Lake Hawassa Basin.
	• Understand the threats to water resources and the need for ecological sustainability of water resources (the relationships between water quantity and quality, upstream and downstream).
Define IWRM and the IWRM approach	• Explain the history and background of the concept of IWRM
	• Understand the integration of natural (biophysical) and human (social, cultural and economic) systems in water resource use and management.
	• Understand the need for sustainable use of water resources and conservation of aquatic ecosystems.
	• Understand the need for inter-sectoral stakeholder participation and cooperation in shared water resources use and management.
Understand the key principles of IWRM	• Understand the implications of considering water as a finite and vulnerable resource.
	• Understand the need for participatory and consultative approaches involving all stakeholders in water resources development and management.
	• Acknowledge the central role played by women in the use, management and protection of water resources.
	• Recognize that water is an economic resource in all its competing uses and should be considered as an economic good. • Understand that water has social, cultural and ecological values.
Explore cases studies of IWRM Implementation	• Discuss factors that have led to successful IWRM implementation.
	• Discuss factors that have led to unsuccessful IWRM implementation.

Table 1. Specific outcomes and assessment criteria for Manual 1.

1. Water resources status and threats

GUIDING QUESTIONS

- What is the water cycle and what is the contribution of the water cycle to water resources?
- What types of water resources (physical forms of water) are available in the Lake Hawassa basin and how are they interrelated?
- In what ways is water important for biodiversity in the Lake Hawassa basin?
- Who are the different water users of Lake Hawassa?
- What impacts do human activities have on the quality and quantity of water in the Lake Hawassa basin?

1.1 Water cycle

The Earth is a closed (self-contained) system, which relies on the running of several ecological cycles of natural resources. Water as a renewable resource is naturally recycled (circulated) through the **water** or **hydrological cycle** (Figure 2).

Water moves from the earth to the atmosphere (sky or air around the earth) and back to the earth again. As water moves within this cycle, its forms are always changing. Water is therefore multi-dimensional in nature. It exists in liquid form, as found in surface water and groundwater. Water exists in gaseous form in the atmosphere as a result of the processes of evaporation from water surfaces when they are heated by the sun and through transpiration from plants. Water vapour rises in the atmosphere and is converted into water droplets through cooling and condensation. Water falls back onto the land as precipitation in the form of liquid rain or solid snow and it runs off on the ground into streams, rivers, lakes and seas as **surface water**. It also forms solid layers on the ground or on water surfaces as snow or ice. Some water infiltrates and percolates into the soil, becoming **groundwater** that collects in underground aquifers. Water then again evaporates from the Earth's surface into the atmosphere.

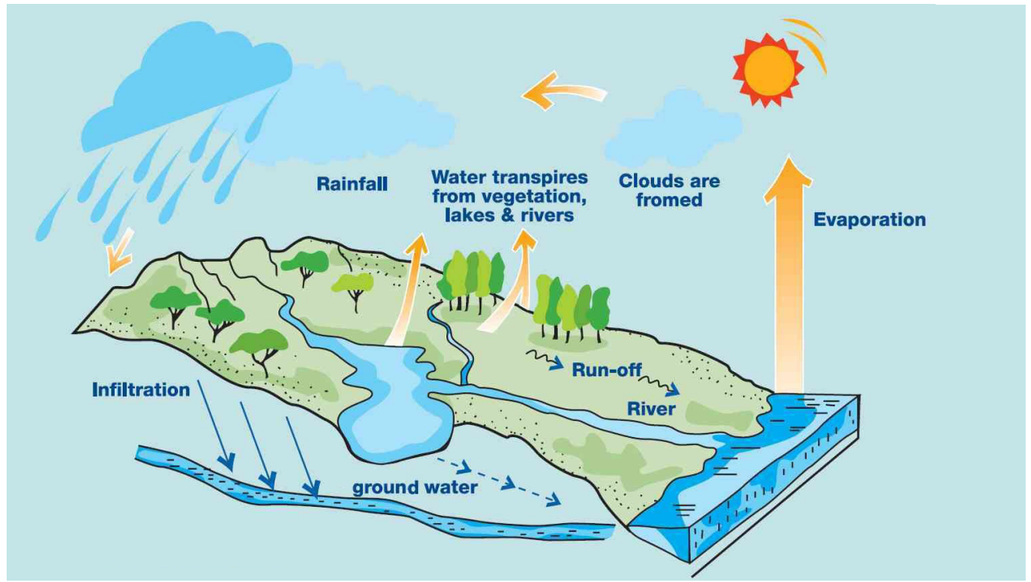

Figure 2. The water cycle.

This cycling of water is a repetitive process. Freshwater is therefore a renewable natural resource that is constantly replenished through the hydrological cycle. Through this cycle, water resources are constantly recharged, used, returned and reused.

The water cycle directly affects the availability of freshwater resources. Interruption of the water cycle through human activities will result in water scarcity, which affects natural ecosystems and human livelihoods. Such human activities include abstraction (withdrawal) of water, pollution and human-derived changes in the ecological landscape of the watershed. It is therefore important to maintain the Lake Hawassa catchment area natural ecosystem in a healthy state in order to sustain its water resources.

1.2 Water as a limited resource (water scarcity)

Of the Earth's water resources, 97% exists as **saltwater** and 3% as **freshwater**. Saltwater is found in seas and oceans but is unsuitable for human consumption and most human economic activities. Of the remaining 3% **freshwater**, about 70% is trapped in **solid** form as **glacier ice** or **snow** and cannot be used for human consumption, and only one third (30%) is in liquid form and can be used for domestic consumption and other purposes. This remainder is less than 1% of the total water on earth, meaning that water is a scarce resource and we should use it wisely. The distribution of water resources on Earth is illustrated in Figure 3.

Water is a limited natural resource that is necessary for all life. It supports ecological systems and is essential for human well-being and economic and social development. This limited nature of water resources is captured in essence in Chapter 18 of Agenda 21 of the Rio Earth Summit, which has the overall objective "to make certain that adequate supplies of water of good quality are maintained for the entire population of this planet, while preserving the hydrological, biological and chemical functions of ecosystems, adapting human activities within the capacity limits of nature and combating vectors of water-related diseases." (United Nations, 1992a).

The quantity of freshwater that is available for ecological and human uses is therefore limited but remains constantly renewed if the natural processes of water cycling are unaffected. Water scarcity is a human-made condition derived from inequitable use and abuse of water resources.

1.3 Types of freshwater resources

This manual focuses on freshwater resources, specifically freshwater in the Lake Hawassa basin.

Surface water

Surface water is the result of rain falling on the Earth's surface and collecting in open water bodies such as streams, rivers, ponds and lakes as a result of direct runoff from the catchment area. The amount of surface water available in most water bodies is largely dependent on the amount

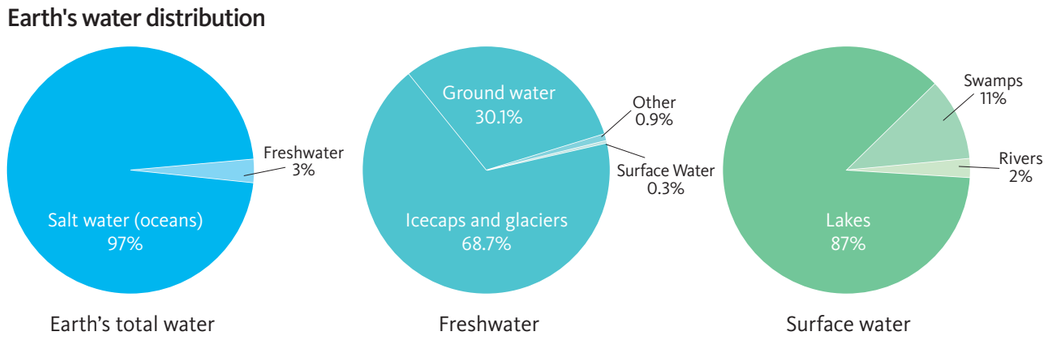

Figure 3. The distribution of water resources on Earth.

of rainfall received and this may vary considerably between the wet and dry seasons. The **surface water** in the Hawassa catchment is mainly freshwater contained in the lake. This is fed by surface water sources in the form of the Tikur Huwa River and ephemeral (seasonal) streams. Surface water is the main form of water resources in the Hawassa catchment area. However, open surface water is vulnerable to contamination from pollution.

Groundwater

Groundwater is rainwater that seeps underground into the soil. In the case of the Hawassa basin, this water seeps into underlying volcanic ash and pumice. Part of this water replenishes the soil moisture and is essential for plant growth and for maintaining the soil ecosystem. The moisture in the upper aerated layer of the soil is referred to as the zone of saturation. Some moisture penetrates beyond the zone of saturation into the underlying layers of the earth. Such water collects in porous rock layers (artesian) between two impermeable rock layers, and is referred to as groundwater. An aquifer can be confined between two impermeable rock layers or it can be unconfined, meaning the upper surface is not covered by an impermeable rock layer and can be accessed (see Figure 4). To access groundwater in a confined aquifer requires drilling a well through the impermeable upper rock layer to reach it.

Groundwater is important for recharging aquifers, sustaining springs and maintaining the flow of perennial rivers such as the Tikur Huwa. Lake Hawassa is also fed by groundwater originating from the surrounding highland areas. The surface and groundwater sources are therefore interlinked.

Interdependence between water resources

In the Earth's natural systems there is an interdependence between:

- Land (vegetation and soils), water quality (conservation) and water availability: conserving the ecosystem sustains water resources.
- Surface water and groundwater resources: surface water recharges groundwater sources.
- Water quality and quantity: human activities affect water quality and availability.
- Upstream and downstream water resources: water flows naturally by gravity from upstream to downstream; water users upstream should therefore consider the water demands of downstream users and how their upstream activities impact on water quantity and quality downstream as well as the need to share the limited water resources.
- Inland freshwater systems and coastal water systems: evaporation from coastal ecosystems provides rainfall to inland areas, thereby recharging inland water resources, while inland water systems flow into and recharge coastal water systems.

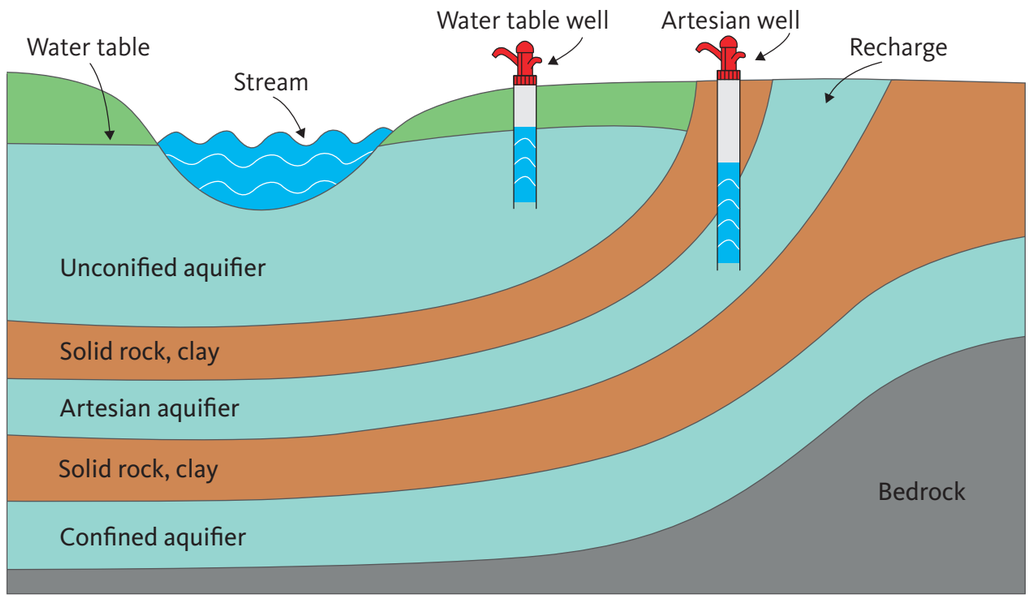

Figure 4. Types of groundwater aquifers.

1.4 Water as a source of life

All life and all human social and economic activities rely on water. Water is a multifunctional resource, serving ecological, social, cultural and economic roles. The water resources in Lake Hawassa serve these diverse functions as discussed below.

Lake Hawassa key facts

Lake Hawassa is a closed-catchment freshwater lake that lies in the Hawassa basin, an old caldera within the Ethiopian Rift Valley between Abjata-Shalla basin to the north and Lakes Abya and Chamo to the south. It is the smallest and highest (1,680 m above sea level) of the Ethiopian Rift Valley lakes. The lake is fed by a few ephemeral streams (flowing only during the wet season) to the north-west and western side of the catchment and the Tikur Huwa River, which is the only perennial river that enters the lake and drains the Shallo (Cheleleka) swamp on the north-eastern side. Although there are no surface outflows (outlets) from the lake, water can seep through the underlying volcanic ash and pumice. The level of the lake varies from year to year.

It has been noted that for the last 25 years the lake level has been progressively rising, although the causes of the lake level rise have not yet been fully established (it could be natural climatic or tectonic effects or human-derived impact). The lake frequently floods the town during extreme wet seasons and a dyke has been constructed to prevent the town of Hawassa from flooding. However, the lake level rise also affects the farms within the wide plains surrounding the lake, thereby affecting agricultural production.

Its maximum depth varies from 18 to 22 m, its surface area ranges between 8,500 and 9,000 ha, and the shoreline varies from 50 to 65 km in length. The Lake Hawassa catchment has a total area of 1,455 km^2 of which 93.6 km2 is the lake surface. The catchment area is generally low-lying, with a few scattered hills. The upland of the catchment area is deforested and eroded, leading to high runoff shortly after storms. The Hawassa area has a sub-humid climate and receives a mean annual rainfall of 1154 mm between March and October. See Figure 5.

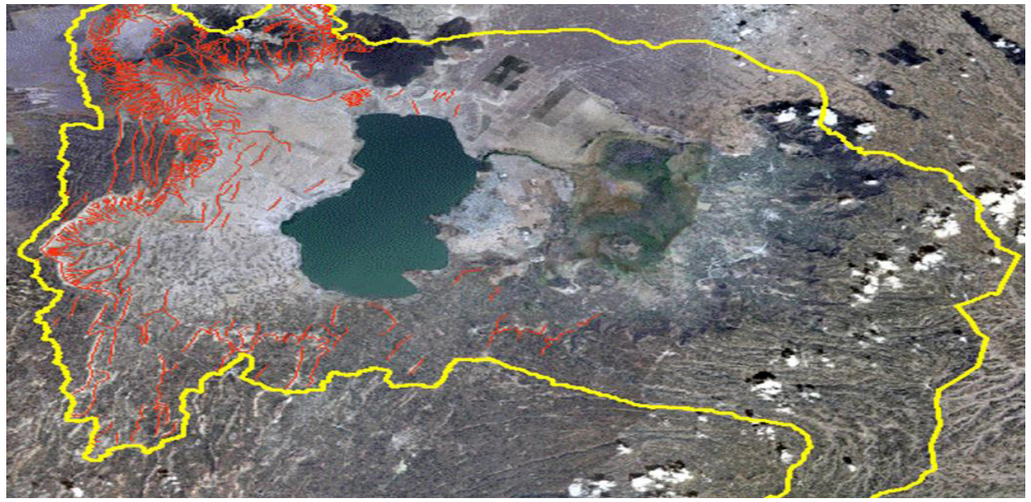

Figure 5. Map of Lake Hawassa.

Ecology of Lake Hawassa

Lake Hawassa

Lake Hawassa has high biodiversity compared with other Ethiopian Rift Valley lakes. Lake Hawassa is rich in aquatic diversity, with over 100 species of phytoplankton and zooplankton. These support large populations of six main fish species: tilapia (*Oreochromis niloticus*), African catfish (*Clarias gariepinus*), barbus (*Barbus paludinosus* and *Labeobarbus intermedius*), black lampeye (*Aplocheilichthys antinorri*) and Garra sp.

The plant life within the lake includes 'qetema' (*Cyperaceae*), 'fila' (*Typha angustifolia* and *Typha latifolia*), floating grass (*Paspalidium germinatum)*, blue water lily (*Nymphaea caerulea),* water cabbage *(Pistia stratiotes),* water primrose (*Ludwigia stolonifera*) and spotless watermeal (*Wolfia arrhizal*). The vegetation around the lake consist of acacia woodlands, while the banks are covered by grasses (*Cenchrus ciliaris*, *Cynodon dactylon*, *Hyparrhenia* sp., *Heteropogon contortus* and *Hypoestes* sp.) and sedges.

The lake is home to variety of lakeshore bird species, including some globally threatened species and endemic bird species, including the yellow-fronted parrot (*Poicephalus flavifrons*), black-winged lovebird (*Agapornis taranta)*, banded barbet (*Lybius undatus)* and forest oriole (*Oriolus monacha*) of Ethiopia. More than 80 bird species have been observed around the lake, including 24 palearctic migrants. Common migrant bird species observed around the lake include the Egyptian goose, cotton pygmy goose, white-faced whistling duck, knob-billed duck, red-knobbed coot and African fish eagle.

The animal population within and around the lake includes hippopotamuses, otters, monitor lizards, vervet monkeys and colobus monkeys.

The biodiversity in and around the Hawassa basin is dependent on the freshwater resources in the catchment area.

Economic, social and cultural uses of Lake Hawassa

Lake Hawassa plays an important role in the livelihoods of many people living in its catchment area. Beside use of water for domestic purposes, human activities around the lake include fisheries, tourism, agriculture and industries. The town of Hawassa is the regional capital of the Southern Regional State and has a population of approximately 113,000 with the urban community drawing its water from the lake. The majority of the rural population in the catchment area relies on agriculture. A large part of the lowland is intensively cultivated. Table 2 illustrates the different types of water users in the Hawassa basin.

Human activities around the lake can negatively affect water quality and quantity as well as having impacts on the natural ecosystems of the watershed area. This is summarized in Table 3 (page 12) and Figure 6 (page 13).

User	Examples of needs	
Domestic or household	Drinking, cooking, bathing, sanitation, gardening (lawns, vegetables and flowers), swimming pools, washing cars.	
Business entities and public places	Restaurants, hotels, schools, hospitals, offices, golf courses, laundries, dry cleaners, beauty shops, car washes.	
Agriculture	Irrigation of crops, watering of animals.	
Industry	Power stations, mines, refineries, chemical processing plants, food processing plants, manufacturing plants, transportation.	
Recreation and environmental activities	Swimming, water-skiing, diving, fishing, hunting, water for parks and wildlife (vegetation, animals, birds, fish, wetlands).	
Fisheries	The Nile tilapia and African catfish are the main commercially important fish species.	

Table 2. Lake Hawassa water users.

Activity	Effects on water quality and quantity
Urban residential development	Due to their high population densities, urban communities abstract large quantities of water for domestic purposes. Hawassa town has a population of approximately 113, 000 people. Urban communities also release large quantities of wastewater in reticulated wastewater systems, which eventually finds its way into natural water bodies. Residential wastewater systems can be a source of many categories of contaminants, including bacteria, viruses, nitrates from human waste, and organic compounds. This also includes the release of pharmaceuticals, cleaners and detergents through sewage systems. Litter and other rubbish (plastic bags, bottles, paper and tins), if thrown carelessly on the ground, will find its way into our rivers.
Urban landfill sites	Leachate runoff or seepage from landfill can contaminate surface and groundwater supplies, releasing organic chemicals, heavy metals and nitrates.
Industrial development	Factories release strong chemicals like caustic soda, acids, dyes and detergents into water cause birds, fish and humans to suffer insecticide poisoning. Chemicals, nutrients, minerals, salts, etc. change the state, colour and pH of water (whether it is acid, neutral or alkaline) making it unsafe for human consumption and killing plants, insects, birds and other wildlife. Industrial chemicals such as paints, motor oil and other inorganic chemicals can contaminate natural water bodies, affecting aquatic life and water quality. Manufacturing and service industries have high demands for cooling water, processing water and water for cleaning purposes. Industries therefore use large quantities of water in their treatment processes and can release large quantities of contaminated water into natural water systems.
Agriculture	Insecticides, pesticides and fertilizer (nitrates and phosphates) sprayed onto crops can wash into rivers and dams causing water pollution. Chemical fertilizers can drain into underground and surface water bodies, releasing nitrates and phosphates. Chemical herbicides and pesticides can leach through the soil into groundwater or be washed off into surface water bodies, thereby causing pollution. Release of organic wastes, such as slurry and manure from animal feedlots, into surface water or groundwater can result in high bacteria and nitrate levels in water bodies. Agricultural enterprises abstract high volumes of water for irrigation or watering animals, thereby affecting water availability if they remove too much water from surface water and groundwater. Also related to this is the salinization of soils and surrounding water bodies. Construction of canals for irrigation purposes results in changes in stream flows in the lake basin.
Deforestation	Deforestation results in soil erosion, increased runoff and siltation of the lake.
Fisheries	Overexploitation of fish resources, pollution, destruction of the shoreline.
Tourism	Pollution, habitat modification and destruction.
Rural communities	Use of rivers for washing and sanitation pollutes water causing water-borne diseases such as dysentery and cholera. Septic tanks, if situated near the water table, can contaminate groundwater supplies causing water-borne disease outbreaks.

Table 3. Impacts of human activities on the lake basin.

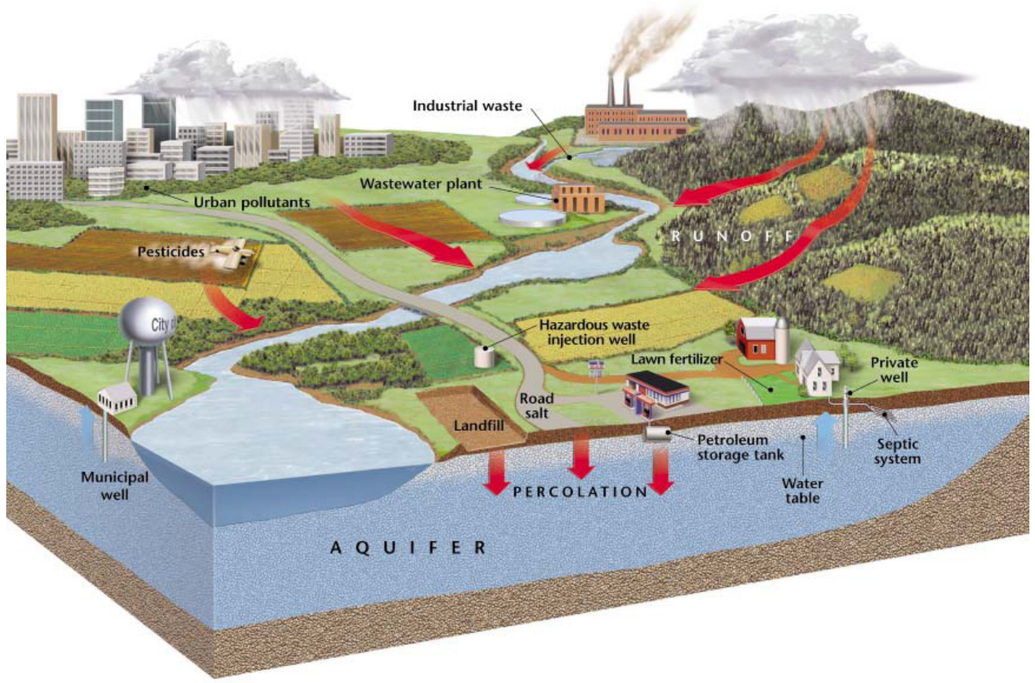

Figure: 6. Impacts of human activities on water resources.

Activity 1

1. Identify the different types of water users around the Hawassa basin. Discuss which are the heaviest users of the lake water. Who are the least demanding water users?

2. Defining integrated water resources management

GUIDING QUESTIONS

- What does the concept of IWRM mean?
- What aspects does IWRM emphasize and why?
- What does the IWRM approach involve?
- What are the four key principles of IWRM?

2.1 Introduction to IWRM and historical perspective

IWRM is a **holistic approach to water use and management.** It therefore differs from the traditional and fragmented approach in which different sectors implement water projects independently, often with overlapping responsibilities. It is **a systemic and sustainable approach to water resources management** that takes into consideration **the limited nature of water resources** and the **effects of negative impacts** on this resource. IWRM "promotes the coordinated development and management of water and related resources for equitable social and economic development without compromising the sustainability of vital ecosystems" (Global Water Partnership, 2000). IWRM is therefore an approach to the management of water resources that fits into the broader context of sustainable development. IWRM emphasizes **ecosystem sustainability**, **social equity** and **economic efficiency**. This relates directly to the **ecological, social and economic value** of water resources.

The Earth's freshwater resources are under increasing pressure from human social and economic development activities across the globe. According to Gumbo and Van der Zaag (2001), there is a growing awareness in the global community that:

- Freshwater resources are limited.
- The limited freshwater resources are becoming polluted, making them unsuitable for human consumption and use, and for ecosystem sustenance.
- There are many competing needs and demands for water in society.
- Not everybody has access to safe freshwater resources.
- Often, some technologies used to control water (e.g. dams and reservoirs) may have negative effects on the environment.
- There is a strong interrelationship between surface and groundwater resources, and between coastal and freshwater resources.

The realization of the above interrelated issues calls for a coordinated, comprehensive and holistic approach to water resources management that takes into account all the above aspects.

The idea of IWRM emerged from the Dublin Statement on Water and Sustainable Development (United Nations, 1992b) which was adopted on 31 January in 1992 in Dublin, Ireland during the International Conference on Water and the Environment (ICWE). The statement emphasized the scarcity and misuse of global water resources as a serious and growing threat to sustainable development and environmental protection, posing risks to human health and welfare, food security, industrial development and ecosystems. The Statement came up with four guiding principles, which form the basis of IWRM.

Principle 1:

Freshwater is a finite and vulnerable resource, essential to sustain life, development and the environment.

Principle 2:

Water development and management should be based on a participatory approach, involving users, planners and policy-makers at all levels.

Principle 3:

Women play a central part in the provision, management and safeguarding of water.

Principle 4:

Water has an economic value in all its competing uses and should be recognized as an economic good.

The ICWE was a preparatory meeting of the United Nations Conference on Environment and Development (UNCED) to be held later that year. Its Statement was submitted to UNCED (also known as The Earth Summit) in Rio de Janeiro in June 1992. The concept of IWRM was further elaborated in Chapter 18 of *Agenda 21: Programme of Action for Sustainable Development* of the Rio Declaration, which spells out integrated water resources development and management as one of its programme areas to be implemented at national level. It states that:

- *Integrated water resources management is based on the perception that of water as an integral part of the ecosystem, a natural resource and a social and economic good, whose quantity and quality determine the nature of its utilization. To this end water resources have to be protected, taking into account the functioning of aquatic ecosystems and perenniality of the resource, in order to satisfy and reconcile needs for water in human activities. In developing and using water resources, priority has to be given to the satisfaction of basic needs and the safeguarding of ecosystems. (United Nations, 1992a)*

It further emphasizes that IWRM should be a dynamic, interactive, iterative and multi-sectoral approach to water resources management that should be carried out at the level of the catchment, such as the Hawassa basin. It should also integrate technological, socio-economic, environmental and human health considerations in the management of water resources. Overall, IWRM is a flexible approach that can be adapted to diverse local, national and regional watershed contexts.

IWRM has been widely adopted by many countries and has become the reference framework for international water policy discourse. The principles of IWRM have been adopted by 150 member governments of the Ramsar Convention on Wetlands and are actively promoted through the Global Water Partnership (GWP). IWRM is a key element of the New Partnership for Africa's Development (NEPAD) (Jones, Newborne and Phillips, 2006). There was general agreement by governments at the World Summit on Sustainable Development held in Johannesburg in 2002 to develop IWRM and water efficiency plans by 2005. By 2012, more than 80% of countries had made considerable progress towards meeting this target (UNEP, 2012). Ethiopia has adopted the principles of IWRM and has put in place the Ethiopian Water Resources Management Policy of 2000 (in which IWRM is key concept), the National Integrated Water Resources Management Programme and supportive legislation, strategy and projects that mainstream IWRM principles and approaches.

2.2 The IWRM approach

The IWRM approach combines the aspects of integration, sustainable water use and inter-sectoral stakeholder participation in the use and management of water resources in a basin or sub-basin. IWRM uses the basin as the basic water management unit.

Integration

IWRM acknowledges the importance of the entire water cycle (the natural aspects and processes related to it) and its interaction with other ecological cycles in the natural ecosystem. It also recognizes the diverse interests of all water users across the different sectors of society in a catchment area, the usually uneven distribution of water resources across different socio-economic sectors of society, and the need for equitable decision-making processes as well as equitable use and affordable pricing of water resources. Water resources management and decision-making therefore require the holistic integration of these different objectives (ecological, social, economic, cultural, political).

There is therefore a need for an **inter-sectoral approach** to water resources management (see Figure 7). An inter-sectoral approach requires commitment by the different sectors, cooperation to work together, multi-sectoral coordination and an understanding of the water resource needs of all stakeholders in order to be effective. This encompasses:

UNIT 2

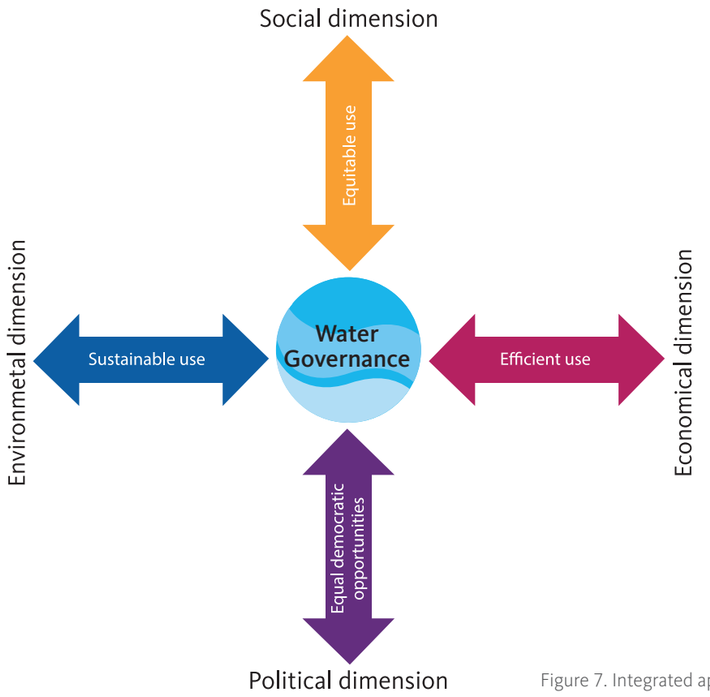

Figure 7. Integrated approach to water governance.

- Integration of environmental (ecological) and socio-economic sustainability objectives
- Integration of water uses, functions and values
- Integration of all significant management aspects
- Integration of all stakeholders in decision-making processes.

Sustainable use of water resources

The challenge of water resources management is balancing the use of water resources for human livelihood activities and the protection and conservation of water resources to enable them to sustain their functions. Water resources should therefore be used wisely for social and economic development, with due consideration for sustainability of the water resource base and the environment (ecosystem) for future generations. Water resources persist in natural ecological systems that enable the regeneration of the freshwater resource through the water cycle. Aquatic and terrestrial ecosystems in the water catchment area and upstream are import for maintaining the water cycle, surface and groundwater recharge, as resources for human livelihoods and as natural habitats for wildlife. Human development activities are usually associated with negative impacts on the environment that threaten sustainable development and sustainable water resource supply. An integrated approach to water resources management enables stakeholders to identify and analyse unsustainable (unfavourable and undesired) development activities and allows the design of sustainable water resources management systems that integrate human societal needs (socio-economic development) and environmental concerns (ecological and hydrological integrity) for the benefit of both. The importance of maintaining the integrity of ecological systems is emphasized in Sustainable Development Goals (SDGs) 14 (Life Below Water) and 15 (Life on Land) (UN, 2015.

Stakeholder participation

Water is a socio-economic requirement for everybody. Decision-making processes on water resources management therefore require the representation and participation (involvement) of all relevant stakeholders. A participatory approach helps to control and enhance integration, while enabling the decision-making process to be more transparent and inclusive. Stakeholder identification and mobilization is covered in Manual 2: Guidelines on Approaches for the Practical Implementation of IWRM.

2.3 The benefits of IWRM

The IWRM approach provides multiple benefits, some of which are listed in Table 4.

Type of benefit	Aspects
Ecological	• Allocation of water resource to ecosystems to sustain terrestrial and aquatic biodiversity • Maintenance of the flow of the natural water cycle and other natural nutrient cycles • Role of ecosystem in erosion regulation • Role of ecosystems in recharge of underground and surface water resources • Role of ecosystems in water purification and pollution regulation (ecosystem cleansing, of polluted water, carbon sequestration, etc.) • Role of ecosystems in flood regulation • Role of ecosystems in climate regulation • Role of ecosystems in air quality regulation
Economic	• Efficient and equitable supply of water for industry and agriculture • Water recycling, reuse and waste reduction • Sustainable sanitation (minimization of pollution and waste reduction) • Efficient irrigation systems • Fishing and other natural resources for economic activities
Social	• Provision of quality water for human consumption, health and sanitation needs • Transportation of waste by water
Cultural	• Natural and cultural heritage: water resources and ecosystems for recreation, tourism and sports
Spiritual	• Conservation of sacred sites and rare species
Political	• Democratic processes to ensure equitable participation and distribution of water rights and responsibilities • Inclusion of women in water resources planning and decision-making • Stakeholder cooperation and collaboration in water resource development, use and management

Table 4. Benefits of IWRM.

Activity 2

1. Discuss how the following aspects of IWRM are being implemented in your own contexts:
   - Integration.
   - Sustainable use of water resources.
   - Stakeholder participation.
2. Suggest how the above key aspects can be enhanced in your local context.

UNIT 2

3. Key principles of IWRM

GUIDING QUESTIONS

- What are the key principles of IWRM?
- What is the importance of IWRM principles

3.1 Water as a finite and vulnerable resource

Principle 1: *Freshwater is a finite and vulnerable resource, essential to sustain life, development and the environment.*

Water is available from the water cycle at any given period of time in a fixed quantity. Water is required for many different purposes, functions and services, which are competing water uses. The demands for water are increasing across the world, while at the same time the availability and quality of water resources are decreasing. This is mainly due to human activities such as population growth, urbanization, industrialization and intensification of agriculture. These activities associated with human development result in increased water use and pollution of water resources, which affect water availability and quantity. It is therefore essential to balance socio-economic development with the protection of natural ecosystems.

It is critical to integrate the management of water resources and the environment in a catchment area in order to balance water resource use and availability. Water is a renewable but finite resource. Water resources are dependent on constant recharge from the water cycle and the quantities in a catchment are more or less constant at a given time. The water cycle is in turn interlinked with and dependent on the maintenance of natural cycles in the ecosystem, which are vital for rainwater distribution. There is need to maintain a constant amount of water in the water cycle as this affects water availability. Disruption of the water cycle, such as through ecosystem damage, pollution or excessive abstraction of water resources, affects the replenishment and availability of good quality water resources in a catchment area. For example, human-induced climate change effects, such as higher temperatures, can affect the frequency and distribution of rainfall in an area, which in turn affects human economic activities such as agriculture. There is therefore a need to sustainably manage water resources and natural water flows in a catchment area in order to maintain water availability, sufficiency and quality for present and future use. This includes water conservation, water harvesting and the treatment of wastewater and its recycling for reuse.

3.2 Participatory approach

Principle 2: *Water development and management should be based on a participatory approach, involving users, planners and policy-makers at all levels.*

Water as a common good is everybody's business; we all require water for daily sustenance and for economic activities. Real participation occurs only when all stakeholders are actively involved in decision-making processes on water resources use and management. Dialogue, cooperation and collaboration between water users is important for ensuring water quality (reducing pollution) and equitable distribution of water resources as well as for decision-making on the development of water resource infrastructure. It is important to ensure representation of all stakeholders in water resources management issues as well as transparency, accountability and consensus for all decisions by creating necessary mechanisms for stakeholder participation. These include creating platforms for meaningful public participation and decentralizing decision-making processes down to the level of communities. The involvement and consideration of the needs of women, youth, the poor and marginalized people is critical in IWRM processes. It is also important to build necessary capacity among all stakeholders, particularly among community members at the grassroots level, on IWRM concepts, principles, processes and practices that they are not familiar with.

3.3 Role of women

Principle 3: *Women play a central part in the provision, management and safeguarding of water.*

Women are often excluded in culturally gendered, hierarchy-based decision-making processes, which are dominated by men as is the case in Ethiopia. However, women, particularly in rural communities, are important providers of water for consumption and water-related health and sanitation in the home. Women are also key users and safe-guarders of water resources in a catchment area. Women provide water for domestic needs in a home and are severely affected by water scarcity and poor water quality. In line with SDG 5 on Gender Equality (UN, 2015), participation by women in water resources management is essential to prevent gendered discrimination against them. Equal participation by women in decision-making processes (planning and management) in IWRM positively contributes to water resource quality and sustainability.

3.4 The economic value of water

Principle 4: *Water has an economic value in all its competing uses and should be recognized as an economic good.*

Water is a source of livelihood for all people with many competing uses. Water is usually perceived as a free good, yet there are costs involved in providing safe water for human use. However, the full value of water resources needs to be realized as it encourages sustainable use and protection. In terms of value, allocation of freshwater resources in a catchment area should first prioritize the need to meet basic human needs for water, particularly by the poor and most vulnerable sectors of society. The provision of clean water as a basic human right is specified in SDG 6 on Clean Water and Sanitation (Ensure Availability and Sustainable Management of Water and Sanitation, UN, 2015). After having ensured basic human requirements, water should then be allocated and priced in accordance with its highest economic value. This requires the establishment of necessary economic instruments to manage water demand (ensure equitable distribution of water resources), provide good quality water at an affordable price and recover costs for water services (water infrastructure development and maintenance, water treatment and reticulation).

It should be noted that water has important ecological, social and cultural values in addition to its economic value.

Activity 3

1. What principles of IWRM are being implemented in your local context?
2. Discuss the main challenges in implementing IWRM in your local context.
3. Suggest how you can enhance the implementation of all principles of IWRM in your own local context.

UNIT 3

4. IWRM case studies

GUIDING QUESTIONS

- What indicators of success can be used to assess the effectiveness of IWRM?
- What factors limit the success of IWRM projects?
- What considerations should be made in implementing an IWRM project?

4.1 Example of successful IWRM implementation

Success in IWRM depends on proper planning, implementation and continuous monitoring of the IWRM process. Some indicators of successful implementation of IWRM are listed in Table 5.

Aspect	Indicators
Policy, laws and regulations	• Development of appropriate policy and legislative framework for IWRM at national and sub-national (regional) levels
Participation	• Stakeholder consultation and participation in IWRM planning and implementation • Establishment of a multi-sectoral water basin management body • Establishing a multi-level management framework • Decision-making decentralized to the lowest appropriate level (community level) • Enabling information flow and transparency • Education and public awareness on IWRM • Training and capacity-building on IWRM processes and practices
Efficient water use	• Clear legal status of water entitlements and/or water rights • Establishment of water demand management tools for water pricing and cost recovery to support sustainable water allocation • Funding, development and maintenance of water resource infrastructure
Environmental (ecosystem) sustainability	• Recognition of ecosystems as drivers of the water cycle and their protection through relevant policy and legislation • Protection of aquatic and terrestrial (watershed/riverine) biodiversity • Allocation of adequate water resources to water basin ecosystems to sustain their natural functioning and the services (ecological, social, cultural and economic) they provide • Rehabilitation and restoration of natural ecosystems • Water pollution monitoring, control and reduction

Table 5. Indicators of successful implementation of IWRM.

Case 1: Mekong River Commission, Asia (Source: Smith and Claussen, 2015)

The Council of Ministers of the Mekong River Commission sits at the top of the hierarchy for integrated management of the Mekong basin and brings together ministers from the four countries of the Lower Mekong (Cambodia, Lao People's Democratic Republic, Thailand and Vietnam), as well as high-level representatives of dialogue partners China and Myanmar. The Council has adopted a formal IWRM-based Basin Development Strategy to guide the Basin Development Plan for joint development efforts in the basin. In turn, the Basin Development Plan is supported by and articulated with IWRM strategies and plans at lower levels, i.e. the national level, basins and tributaries at provincial level, and at sub-basin and district levels. Dialogues among stakeholders in formal or informal committees help to shape actions that contribute to the development and management of water resources at each level. Implementation actions take place through national, provincial and district authorities, including regulation and infrastructure development at basin and sub-basin levels, or in thousands of small watersheds, such as water quality regulation, flood protection measures, local water supplies, small-scale hydropower and irrigation dams.

The four Lower Mekong countries have all included references to IWRM in their national policies, with national Mekong committees put in place as a platform for cross-sectoral dialogue. The institutional arrangements in the Mekong basin hence cater for both vertical and horizontal integration. Basin and sub-basin committees draw members from the public sector (including across sectors between key ministries), the private sector and civil society. Hundreds of dams, mostly for hydropower production, are currently being planned and built on the tributaries of the Mekong and even a few, very controversially, on the main river. They are mostly being planned, built and operated by private developers, with a focus on stakeholder dialogues and increasingly bringing the private sector to the table.

Assessment questions:

1. What are the strengths and weakness of the Mekong Basin IWRM strategy as measured against the indicators given in Table 5?
2. Who are the stakeholders in this case study?
3. Suggest how the IRWM process for the Mekong river basin can be improved.

4.2 Examples of unsuccessful IWRM implementation

Unsuccessful IWRM occurs when aspects of integration, stakeholder participation and ecosystem sustainability are poorly implemented. However, it is difficult, if not inappropriate, to label an IWRM process as unsuccessful since IWRM is an ongoing process that is subject to changes and improvements.

Case 2: Tana River Basin, Kenya (Source: CapNet, 2008)

In Kenya the Tana Water Resources Management Authority under the Ministry of Water and Irrigation is responsible for the implementation of IWRM in the Tana river basin. However, responsibility for pollution control comes under the National Environment Management Authority and soil conservation is the mandate of the Ministry of Natural Resources. Coordination between the different water resources management functions is made through the basin stakeholder forum, the Tana Catchment Area Advisory Committee.

Assessment questions:

1. What are the strengths and weakness of the Tana river basin IWRM approach against the indicators given in Table 5?
2. Who are the missing stakeholders in this case study?
3. Suggest how the IRWM process for the Tana river basin can be improved.

Case 3: Sungai Lar River Basin, Malaysia (Source: CapNet, 2008)

In Malaysia the Selangor Waters Management Authority (SWMA) under the Selangor State Government has been given the powers to protect, regulate and manage the water resources in the Sungai Langat River Basin. SWMA is responsible for licensing and enforcing of water allocation and also oversees the monitoring of water abstraction. However, basin planning is the responsibility of the Ministry of Natural Resources and Environment under the Federal Government, supervised by a steering committee in which SWMA is represented.

Assessment questions:

1. What are the strengths and weakness of the Sungai Langat river basin IWRM plan against the indicators given in Table 5?
2. Who are the missing stakeholders in this case study?
3. Suggest how the IWRM process for the Sungai Langat river basin can be improved.

UNIT 4

Activity 4

1. Describe the state of water governance in your area (institutions, organizations and their relationships) in relation to IWRM.

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