

# Freshwater Crisis: A Challenge to Sustainable Development

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## ABSTRACT

Fresh water is a limited resource central to sustainable development the inadequate protection of which can set important limits to the latter. Currently, there is a growing global fresh water crisis which is manifested by fresh water over-drafting, fresh water pollution, insufficient access to safe drinking water, and regional conflicts over inadequate fresh water supply. Indeed, freshwater crisis is a crisis of governance as scarce water resources are allocated inefficiently, unregulated pollution compromises water quality, weak water service providers fail to serve the public and social and environmental concerns are left unaddressed. The uneven distribution of fresh water over time and space and the way human activity is affecting the distribution today are fundamental sources of fresh water crises in many parts of the world including Ethiopia. Fresh water crisis manifests itself in Ethiopia mainly in the form of complete dry up and/or decline in the levels of lakes; water hyacinth infestation; water quality deterioration; insufficient access to clean drinking water; inefficiency and competition in irrigation. A wide range of human activities affect the availability and quality of fresh water especially in areas with a high population density, concentrated industrial activity, and intensive agriculture. Deforestation, open grazing, water abstraction, excessive use of agrochemicals, poor solid waste management and discharge of untreated industrial effluents are the common practices adversely contributing to the fresh water crisis in Ethiopia. Sustainable development is impossible without sound fresh water management and integrated water resources management is essential to enhance the value obtained from freshwater resource and ensure its sustainability. There is also a need to adopt more water use efficiency measures along with integrated management of water resources in watersheds for sustaining the development measures.

**Keywords:** Fresh water; Over-drafting; Pollution; Sustainable development

## INTRODUCTION

One of the greatest challenges facing mankind is to meet the ever increasing basic human needs while sustaining the earth's environment and the resources upon which human society depends such as fresh water. Fresh water is both life and livelihoods and essential to sustainable development. Without adequate water supply food production declines, human health fails, the natural environment suffers and economic development is limited. The availability and access to clean fresh water is an important factor determining patterns of economic growth and social development. The availability of safe and adequate fresh water may be as crucial to economic development in the coming years as access to oil was in the 20th Century [1].

As we continue to grow in terms of population and technology our need for fresh water keeps on increasing. Nevertheless, the amount of utilizable fresh water available is finite and of this precious little

quantity a vast portion has already been polluted [2]. Currently, there is a growing global freshwater crisis which is manifested by fresh water over-drafting, fresh water pollution, insufficient access to safe drinking water, and regional conflicts over inadequate growth, rapid urbanization and industrialization, the expansion of agriculture, tourism, and climate change all put fresh water under increasing stress. This is critically affecting the social, economic and environmental needs of the current generation and is feared to risk the ability of the future generation to meet its needs.

Given the growing pressure, it is critical that fresh water be properly managed if the world is to achieve sustainable development. The traditional fragmented approach is no longer viable and a more holistic approach to freshwater management has become essential. This is the rationale behind the Integrated Water Resources Management (IWRM) approach that has now been accepted internationally as the way forward for efficient, equitable and

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sustainable development and management of the world's limited water resources and for coping with conflicting demands. This paper attempts to review the current fresh water crisis and its impacts on the global effort to ensure sustainable development.

**Fresh water distribution**

Water covers about 71% of the earth's surface and hence the earth is sometimes known as the blue planet. Of the total water that covers the earth, about 97.5% is salt water and fresh water constitutes only about (2.5%).

Of the total fresh water, about 69% is permanently frozen, 30% occurs as ground water, 0.3% is found in freshwater lakes and river flows and 0.9% in others including soil moisture. Thus, most of the water on this planet is stored in oceans and ice capes which is difficult to be recovered for our diverse needs and the world's useable renewable freshwater resources are found in lakes, wetlands, rivers and aquifers [3].

Moreover, the available limited fresh water is distributed unevenly all over the globe and fewer than 10 countries namely Brazil, Russia, China, Canada, Indonesia, U.S., India, Columbia and the Democratic Republic of Congo possess 60% of the world's available freshwater supply (UNEP 2002). Though local variations within countries can be highly significant some 80 countries, constituting 40 per cent of the world's population, were suffering from serious water shortages by the mid-1990s. Climate and normal seasonal variations, droughts and floods can all contribute to local extreme conditions.

The hydrologic cycle constantly purifies and redistributes fresh water, providing an endlessly a renewable resource. Hydrologic cycle describes the circulation of water as it evaporates from land, water and organisms; enters the atmosphere; condenses and is precipitated to the earth's surfaces; and moves underground by infiltration or overland by runoff into rivers, lakes, and seas driven by solar energy and gravity.

The water supply at any particular point on the land surface depends on several factors in the hydrologic cycle, including the rates of precipitation, evaporation, transpiration, stream flow, and subsurface flow (Botikin and Keller, 2000). It further indicates that if more fresh water is consumed through human activities than is restored by nature, the result is that the quantity of fresh water available in lakes, rivers, dams and underground waters is reduced which can cause serious damage to the surrounding environment [4].

**Fresh water as a natural resource**

Fresh water is a precious natural resource with multiple uses including drinking, cooking, cleaning, irrigation, industrial production, power generation, fisheries, aquaculture, recreation, transportation, aesthetics and even putting out fires. According to Chandra (1996) the major uses of fresh water may be broadly summarized as household, agricultural, industrial, environmental and recreational. It further states that though constituting a growing percentage of total water uses environmental and recreational water uses are very small and usually non consumptive.

It is estimated that 8% of worldwide water use is for household purposes (Table 1). These include drinking water, cooking, bathing, sanitation, and gardening. Drinking water is water that is of sufficiently high quality so that it can be consumed or used without risk of immediate or long term harm. Such water is commonly called potable water. In most developed countries,

the water supplied to households, commerce and industry is all of drinking water standard [5].

Agriculture is by far the largest water consuming sector in the world (70%) (Table 2) with the water used varying considerably from country to country (Table 1). In Europe, a region with abundant natural rainfall, a relatively small amount of irrigation is necessary whereas in other parts of the world, irrigation is essential to produce food (WBCSD and UNEP 1998).

**Table 1:** Competing water uses for main income groups of countries (Source: WBCSD 2006).

Main income group of countries	World (%)	High-income countries (%)	Low-and middle income countries (%)
Domestic use	8	11	8
Industrial use	22	59	10
Agricultural use	70	30	82

**Table 2:** Sectorial use of fresh water by selected countries (Source: WBCSD and UNEP 1998).

Country	Agricultural (%)	Industrial (%)	Domestic and Commercial (%)
China	87	7	6
Egypt	88	5	7
India	93	3	4
France	12	71	17
Netherlands	32	63	5
United Kingdom	1	78	21

Irrigation has been a key component of the green revolution that has enabled many developing countries to produce enough food to feed everyone (WBCSD 2006). In some areas of the world irrigation is necessary to grow any crop at all, in other areas it permits more profitable crops to be grown or enhances crop yield (WBCSD and UNEP 1998).

Various irrigation methods involve different trade-offs between crop yield, water consumption and capital cost of equipment and structures. Irrigation methods such as furrow and overhead sprinkler irrigation are usually less expensive but are also typically less efficient, because much of the water evaporates, runs off or drains below the root zone. Other irrigation methods considered to be more efficient include drip or trickle irrigation, surge irrigation, and some types of sprinkler systems where the sprinklers are operated near ground level. These types of systems, while more expensive, usually offer greater potential to minimize runoff, drainage and evaporation.

As global populations grow and demand for food increases in a world with a fixed freshwater supply, there are efforts underway to learn how to produce more food with less fresh water through improvements in irrigation methods and technologies, agricultural freshwater management, crop types and freshwater monitoring. Aquaculture is a small but growing agricultural use of fresh water and freshwater commercial fisheries may also be considered as agricultural uses of fresh water.

It is estimated that about 22% of worldwide fresh water use is industrial. European nations use a higher percentage for industry because so much less is needed for agricultural purposes. Industrial demand for water, particularly in rapidly industrializing countries, is also growing quickly. Major industrial users include power plants, which use water for cooling or as a power source (i.e. hydroelectric plants), ore and oil refineries, which use water in chemical processes, and manufacturing plants, which use water as a solvent. Hydroelectricity is a low-cost, non-

polluting, renewable energy source. The portion of industrial water usage that is consumptive varies widely, but as a whole is lower than agricultural use [6].

### Fresh water crisis

Demand for fresh water is rapidly growing while its supply is limited and decreasing gradually. Increasing demands for fresh water are occurring from 3 key areas which, in aggregate, are exerting unsustainable pressures both in developed and developing countries WBCSD and UNEP. These include human needs for safe drinking water and proper sanitation, agricultural needs for expanded production to meet population growth and industrial needs to provide more goods and services for a growing population. While demand from all sectors is on the rise, in most places it is agriculture that accounts for the bulk of water use. Steadily rising demand for agricultural products to satisfy the diverse needs of a fast growing population has been the main driver behind agricultural water use and such demand is expected to continue growing [7].

Environmental needs also must be met to attain sustainable development. The allocation of water for environmental needs is a growing area of investigation and policy development (WBCSD and UNEP 1998). The environment requires water of sufficient quality and quantity to maintain a diverse array of ecosystem functions and biodiversity resources (Chandra, 1996). Society cannot afford to ignore water needs crucial to protect natural ecosystems, endangered species, biodiversity, watersheds and unique areas of special interest.

Moreover, it is becoming increasingly obvious that the environment is not just a sectorial user of water like industry and agriculture, but it plays a fundamental role in maintaining the quality and supply of the world's water resources used by the other sectors (Chandra, 1996; WBCSD and UNEP 1998). One classic example is forested watershed protection. Proper forestry management can prevent wasteful water run-off and even serve to ensure the supply of fresh water. Conversely, clear-cutting of forests on steep slopes has led to disastrous soil erosion and flooding. Any short-term economic gains have led to dramatic social and disaster relief costs far outweighing the benefits (WBCSD and UNEP 1998) [8].

Fresh water demand already exceeds supply in many parts of the world and as the world population and the standard of living continue rising, so does the demand for fresh water (WBCSD and UNEP 1998). It further states that world population is expected to increase from approximately 6 billion in 2000, to 8-10 billion people in 2050, with 90% of future population growth occurring in developing countries. While the global population tripled over the past 70 years, the fresh water use has grown six fold (UNFPA 2005). Changing life styles and consumption patterns are also claiming increasing amounts of fresh water and are putting heavy pressure on local resources (UN WWAP 2009).

Growing population, modern agriculture, industrialization, and urbanization are not only depleting lakes, rivers, and aquifers; they are polluting them as well. Shortage of fresh water and deterioration of its quality which are already serious issues in most parts of the world are expected to worsen in next century. UNEP (2010) points out that the challenge of fresh water in the 21st century is one of both quantity and quality.

The uneven distribution of water resources over time and space and the way human activity is affecting that distribution today are

fundamental sources of water crises in many parts of the world (UN WWRP 2009). Indeed, freshwater crisis is a crisis of governance as scarce water resources are allocated inefficiently, unregulated pollution compromises water quality, weak water service providers fail to serve the public and social and environmental concerns are left unaddressed (WBI 2006) [9].

### Fresh water depletion

While the global freshwater supply is constant, increasing population density, economic activity, and unsustainable water management practices have led to over-exploitation of many of the more easily accessible freshwater resources at local and regional levels (WBCSD and UNEP 1998; WEHAB 2002). Competition for fresh water is growing leading to the depletion of many of the world's major aquifers and millions of pumps of all sizes are currently extracting groundwater throughout the world. According to WEHAB (2002) over-pumping of groundwater by the world's farmers exceeds natural recharge rates by at least 160 billion cubic meters a year. Increasing competition for fresh water and inefficient irrigation practices could constrain future food production. Industry could be at risk and the natural environment is often ignored when fresh water shortages occur since highest priority is given to domestic needs and to farmers to grow food [10,11]

A number of regions are already suffering fresh water shortages and as populations increase and living standards rise in the first half of the 21st century, more regions will suffer increased water stress (WBCSD and UNEP 1998). Fresh water scarcity ranks among the most urgent environmental challenges of this century (UNEP GEMS/Water Program 2008). According to WBCSD and UNEP (1998), fresh water would become a limiting factor for sustainable development and future industrialization in fresh water scarce regions like Africa.

Although Africa has abundant freshwater resources, there are great disparities in water availability and use within and between African countries because the water resources are so unevenly distributed. While the continent uses only about 4 per cent of its renewable freshwater resources water is becoming one of the most critical natural resource issues (African Water Development Report 2006). It is one of the two regions in the world facing serious water shortages .

### Fresh water pollution

Water pollution is defined as the addition of substances which degrade the quality of water so that it either becomes health hazard or unfit for use (UNEP GEMS/Water Programme 2006). A wide range of human and natural processes affect the biological, chemical, and physical characteristics of fresh waters and thus impact their quality UN Water . In recent times, on account of the increase in population, modern agriculture, urbanization, industrialization and climate change, there is an ever increasing threat to the quality of waters in rivers, lakes and streams UNEP and UN Water . Environmental degradation in surrounding ecosystems and of freshwater bodies threatens water quality and the opportunities derived from them.

Poor water quality threatens the health of people and ecosystems, reduces the availability of safe water for drinking and other uses, and limits economic productivity and development opportunities. Pollution often renders the limited fresh water that is available useless and damages ecosystems. A lot of surface fresh water is

polluted and thus not available for human use also. Growing populations will potentially magnify degraded water quality impacts while climate change will create new water quality challenges UNEP. Nevertheless, fresh water quality has received far less investment, scientific support, and public attention in recent decades than its quantity. Thus, water quality deterioration from human activities continues to harm human and ecosystem health.

## CONCLUSION

Successful implementation of the principles of IWRM at a basin level requires, above all, a political will from the government in the form of creating appropriate enabling environment and allocation of sufficient budget, knowledge and capacity at all levels, appropriate technology that facilitates and assists the implementation process, appropriate and stable institutional arrangement with clear mandates and responsibilities for discharging the principles effectively.

for and acceptance as well as active participation of stakeholders at all stages, sufficient and sustainable financial flow for covering the expenses associated with the process and proper forecasting of actions and timely accomplishments with inherent system for monitoring and evaluation are also additional factors for the success of the process.

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