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Identifying and characterizing different notions of water scarcity

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Abstract

Scarcity of water has become a significant barrier to socio-economic progress and a risk to way of life in many regions of the world. Hydrologists, social scientists, environmental scientists and economists are collaborating to develop various integrated approaches that fully reflect the multifaceted nature of scarcity of water. Research studies on water scarcity has attracted a lot of public and political interest since the 1980s. The current study seeks to re-conceptualize the term, water scarcity and to offer a summary of the water scarcity researches done in the world to capture various aspects of water scarcity during 1990-2010.The technique used consists of obtaining the studies from the Scopus, Science Direct, and Google Scholar databases that are pertinent to the topic of interest. Then reviewing the articles that were recovered after separating the studies that primarily focus on water scarcity. The study showed that throughout the years, there have been an increasing number of studies in this field. The majority of early research were on identifying and characterizing different notions of water scarcity, but as the field has gained popularity, water scientists has started exploring its different domains along with various methodologies to assess water scarcity. Reports that "the next conflict may be over water" or that "approximately forty countries may not have enough water resources in the near future" reflects the seriousness of the water issue that exists or may emerge in the near future, particularly in developing nations.

Key words: Water Scarcity, Water Availability, Hydrological Cycle, Demand-Supply Gap.

1. Introduction:

Water is a natural resource that only exists on Earth. Water availability is becoming a major problem in many developing nations, including India. Water is a common property resource that belongs to everyone, yet its supply and availability are unequal because not everyone has access to it at all times. This causes a water shortage, which is when there is not enough water available to meet demand. However, problems with the availability of water and how people

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can access it are equally essential in terms of social and political perspective(UNDPI,1998).

When there is an imbalance between the supply and demand for water, it is called a water scarcity.It can be described with regard to the present and potential water supply or the current and future water demand or both. Because measuring water scarcity differs fromregion to region within a country and from country to country and, it may also be said to be a relative concept and thus considering it partially a "social construct" (Molden,2003). Within the social construct, the availability and consumption patterns work together to determine the scarcity.

Five contexts may be used to classify water scarcity:

(1) physical water scarcity;
(2) economic water scarcity;
(3) Institutional water scarcity;
(4) Managerial water scarcity; and
(5) Political water scarcity.

These are different type of scarcity of water can coexist, making them more severe and having more negative effects.

When natural availability of water is limited, physical water shortage occurs. It may be described as a scenario in which there is not enough water to satisfy all of the population's needs. The majority of studies derive their definition of physical water scarcity on the foundation of 75% water availability by rivers. For instance, the FAOdefines physical water scarcity as a scenario when agriculture, industry and domestic uses withdrawn 75% of a river's flow. The water demand in dry areas is not included in this definition. Approaching physical water scarcity is also depicted on FAO maps with a 60% reduction in river flows. This definition suggests that there will soon be a physical water scarcity. The symptoms of this type of scarcity are distinct. Declining river's seasonal flow, water pollution, groundwater depletion and environmental deterioration are some of these symptoms. In a region or nation where hydraulic infrastructure has been built up excessively, physical water scarcity may occur (IWMI, 2002).

Economic water scarcity occurs when there is insufficient human, institutional or financial capital, despite the fact that there is naturally adequate water locally to fulfill human needs. It is mostly brought on bya lack of human capacity or a lack of water investment to meet the requirements for water. Poverty, shortage of infrastructure and lack of investment in water resource management are all signs of economic water scarcity. People who are experiencing this problem more frequently go to lakes, rivers, and ponds to get water for their homes and farms. Economic water shortage affects a large portion of Africa; consequently, improving water infrastructure might aid in reducing poverty (Molden et.al.,2010).

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Political water shortage is a scarcity brought on by political disputes and political negligence, it exists when political factors make it difficult for individuals to access the available water supply. When management organisations prevent individuals from using the water resources, there is managerial water scarcity. It is mostly a result of the management institutions' ineffective and submissive behavior. Managerial water scarcity and institutional water shortage are somewhat similar. It results from the limitations imposed by institutional flaws, deficiencies and inadequacies. The severity and effects of water shortage are exacerbated by the simultaneous occurrence of all forms of water scarcity(Hanja et.al.,2009).

All of the aforementioned water scarcity issues are brought on by a wide range of variables. All of the reasons of water shortage are listed by the International Institute of Water Management. These factors include growth in population (high demand), issues related to institutional capacity, water demand and storage competition, climate change and vulnerability, economic policy and poverty, political realities, poor water quality and pollution, sociological and cultural issues, international disputes, inappropriate land use, legislation and management of water resources. Problems with water scarcity are important because they have an impact on both human and the environment. Water scarcity problems result in shortages of food, health crises, and national and international disputes for humans. The effects of looming water scarcity issues for environment include waste disposal issues, erosion and pollution etc.

Mehta (2003) asserts that there are several aspects of water scarcity, and that each aspect must be considered in order to fully comprehend the issue. Water is a resource that is renewable, and its accessibility depends on it's state in the hydrological cycle. Second, there are temporal and cyclical water shortages. Thirdly, there are relational and distributive aspects of scarcity of water.The term "anthropogenic dimension" refers to the fourth dimension, which encompasses management techniques and actions. Mehta's claim that social and anthropogenic factors are responsible for the formation of water scarcity relate to the complicated mix of socio-cultural, political and institutional factors that affect and restrict water access and availability for specific local consumers and even may force them to face net scarcity of water regardless of hydrological sufficiency. Additionally, the distributional aspect of water scarcity is crucial to understand water scarcity. In the 2006, Human Development Report titled "Beyond Scarcity: Power, Poverty and the Global Water Crisis," it is stated that institutional and political factors rather than physical supply shortages are typically the root causes of water scarcity.

Water scarcity has an effect on all spheres of society and commerce and puts the sustainability of the natural resource base in danger. At both the individual and organizational levels, the fight for water has frequently resulted in intimidation, corruption, and even violence. Due to a lack of political and financial backing as well as inadequate understanding on how to protect their

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rights, the socially backward and the economically underprivileged frequently lose in such disputes. In order to achieve the ultimate aim of eradicating scarcity, the current phenomenon of water scarcity emphasize the requirement for extensive research, assessment and evolutionary adaptation.

2. Aims and objective:

The study focuses on giving an overview of the scientific studies done during the previous twenty years on various water scarcity related subjects. The research tries to give a framework that shows how the discipline has advanced.

The following research questions are addressed in the study in order to meet the predefined objectives:

i. What progress have scholars made in their studies of water scarcity?
ii. Determine the possibility for future study in terms of water scarcity and water management to expand and develop.

3. Materials and Methods:

The three main steps of the methodical approach are as follows: (1) The first phase is obtaining articles on the chosen topic from three academic databases (Scopus, Science Direct and Google Scholar). These periodicals include a significant amount of scientific data for different topics.

After defining the databases, the following keywords were used to search them: "water scarcity" OR " water poverty" OR " water crises" OR " water shortage". All document types (such as articles, editorials, conference papers, comments and book chapters) were included in these searches. The search returned 1451 papers from Scopus, 678 documents from Science Direct, and 18150 documents from Google Scholar for the work published in the previous 20 years (1990-2010).

The second stage involved extracting the work relevant to the case studies of water scarcity from the produced records, which was followed by analysis and evaluation in the third step.

4. Result and Discussion:

Based on the published documents extracted from Scopus, Science Direct and Google Scholar for the present paper covering various notions of water scarcity, a detailed literature review was conducted, which is outlined below-

Winpenny (1994) contends that "in general usage, water scarcity is a scenario of affairs when there is not enough water to satisfy normal requirements" in a discussion document formed for the FAO. He argues that policy makers and planners will not benefit much from this commonsense definition. According to him, there are several types of water scarcity, including absolute, cyclical, seasonal, life threatening, short-term etc. Furthermore, he contended that scarcity may be having its origins in water shortage but it can also be a result of societal

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constructs, expectations, wealth and customary behavior. According to him, shortage of water can have a variety of causes and can be addressed by nations that experience it. He believes that scarcity need not be inevitable or immutable.

According to statistics cited by Pallett (1997), Botswana, Namibia, Malawi ,Zimbabwe and South Africa would all experience complete scarcity of water by the year 2020. He estimates that South Africa is approaching <1000 metre^3 of water per person. According to him, water resources of South Africa's are exceedingly restricted in quantity and scarce in global terms.

The 1997 UN report Comprehensive assessment of the world's freshwater resources established the idea of technical water scarcity i.e. the % of total blue water extraction that is relative to available water resources (United Nations,1997).A state was stated to be entering a high water stress condition if more than 40% of its water resources had been developed, compared to a low water stress condition if less than 10% of the resource had been produced. This measurement indicated that South Africa was under severe water stress.

Batisse (2000) discusses the difficulties that the world is presently experiencing and considers the unique water problems that arise when producing enough food to meet the needs of everyone. He contends that there is enough water for domestic use. In order to fulfill the need in other sectors, however, this might not be the case. He asserts that contemporary scientific techniques may be used in agriculture to generate enough food to fulfill the demands of the entire world's population. However, he did express concern about the rising restrictions on rain-fed agricultural development (green water), which will result in a larger reliance on irrigated crop production in the future.

In their reflection on the history of management of water resources, Ohlsson and Turton (2000)propose that first order scarcity of water is chased by second order scarcity of water i.e.the capabilities of societies to overcome the shortages of water. He contends that the answer to securing adequate water must alter with the changes in the society. thus, adaptive capability refers to a society's ability to find new water scarcity remedies. According to him, the ways to guaranteeing water security have evolved in a way that oscillates between a perceived shortage of water as a natural resource and a lack of adaptive capacity as a social resource. He wraps upthat the idea of adaptive capacity transforms scarcity of water from absolute scarcity to relative scarcity and from a natural set up to a social set up by removing the concept of water scarcity from the context of natural resources and putting it in a social context.

Mehta (2001) investigates the social build up of scarcity of water in reference to how the "powers that be in-fuelling exploit the perceptions of scarcity" to support development expenses in major water infrastructure. She cites the example of the Sardar Sarovar Project (SSP) in Kutch, a region of western India that is largely dry. According to the results of her study, the

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emphasis on a discourse regarding decreasing rainfall and escalating droughts leads people to adopt the notion that water is scarce in the region. This is true even when scientific evidence contradicts the social discourse and widespread perceptions of water scarcity.

The term "virtual water," which refers to the volume of water that could be included in exchanged commodities and services, is first introduced by Allan (2003). In fact, he argued that Israel has been living ahead of its water barrier for a long time, compensating its shortage of water by importing it in the forms of food and other products.

As outlined by Hussian and Hanja (2003), scarcity has created considerable issues in a variety of areas, including increasing rivalry for water usage within and across sectors, the transfer of water out of agriculture, and the resulting decrease in water availability for food production and increased disparity in access to food and water, which furthers perpetuate poverty.

According to the Human Development Report (2006), institutional and political factors rather than physical deficiency are typically the root causes of water scarcity. Even though the study discussed effective water management, it also emphasized the value of equality and put emphasis on pro-poor policy and technology. It was noted that integrated water resource management is less likely to raise equity issues than discussions on how to distribute land. It is also highlighted that nations with high levels of inequality in land distribution do worse than those with lower levels of inequality in terms of efficiency and equity in managing irrigation systems. It challenges the widespread notion in the global discussion of water scarcity that connects population pressure with growing water scarcity. This report made the argument that, although the availability of fresh water is declining, the main causes of the water scarcity are power imbalances, poverty, and inequality. Understanding the context of fresh water shortage is made easier by these concepts that emphasize the significance of institutional and political variables as well as the inequalities in water supply and access for different consumers.

Poverty, shortage of infrastructure and lack of investment in the management of water resources are among the signs of economic scarcity of water (Molden,2007). People who experience economic water scarcity more frequently collect water from ponds, lakes and rivers for agriculture and domestic purposes. Economic water shortage affects a large part of Africa; consequently, improving water infrastructure there might aid in reducing poverty.

According to Lopez and Llamas (2008), the Southern European nations were experiencing water crisis for years and view this crisis as a serious concern. This issue, for example, has a significant impact on Spain, particularly because of irrigation and tourism. A solution and technology are absolutely required to address the issue since the country on has a 30% water stress index.

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Kamal (2009) claims that Pakistan is experiencing crisis of water, which is a consequence of shortage of water, rapid growth in population, climate change, shrinkage of the Himalayan ice and snowcaps, urbanization, industrial expansion, inequalities in distribution, poverty, unsustainable habits of water consumption, loss of ecosystems, increased runoff and poor management of water resources by governments are all critical factors that have degraded the resource base and put a significant strain on the quality and quantity of water resources.

Despite the fact that the European Union is generally thought to have ample water resources, water shortages and drought are becoming a more common and pervasive phenomena. It is no longer unusual for there to be a long-term imbalance caused by water demand surpassing available water supplies. This commission explained that if temperatures continue to rise, water contractions can be anticipated. According to the European Commission, water shortage affects all 500 million people in Europe and is not only a regional issue (European Commission ,2010).

5. Conclusion:

Water is necessary for both life and the majority of human society's operations. The maintenance of human health, as well as the growth of the economy and society, are wholly dependent upon easy access to sufficient water resources. There is a lot of strain on water supplies as a result of the rising demand for water brought on by population increase, urbanization, and economic growth. The globe is heading towards water scarcity as water availability per person keeps declining. Water availability will vary substantially over time and space, which will likely make the problem worse. Despite being a widespread problem, not everyone is affected by water scarcity. In the vast majority of instances, institutional and political factors, rather than a physical shortage of water resources, are the underlying causes of scarcity. Water shortages are not caused by a lack of physical resources; rather, power, poverty, and inequality are at the base of the problem. To address the issue of water scarcity, all water sector players must work together. The appropriate distribution, management, and conservation of water resources are key components of the solution to the problem of water.

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