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EXAMINING THE GEOGRAPHY OF WATER RESOURCES AND MANAGEMENT

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ABSTRACT

The past half-century, the management of water resources in India has been a task that has become much more difficult to overcome for a variety of reasons, the most prominent of which are the increasing demands and the increasing environmental degradation. The majority of the challenges that are encountered in water management in India can be classified into the following categories: water availability, variability and increasing withdrawals, environment and quality, project construction, water sharing disputes, water governance and institutions, and challenges that are induced due to changes in climate and land-use cover. This section provides an in-depth discussion of each of these problems. It has been proposed that the management of water resources in India should be built on the foundation of water conservation and the control of variations. In addition, this paper discusses recent measures taken by the Government of India (GoI) and offers potential solutions to the problems that have been identified.

Keyboard: climate change, water governance, water resources.

INTRODUCTION

Mountain glaciers, snow, surface water bodies (such as lakes, rivers, and reservoirs), soil moisture, and groundwater are the primary sources of freshwater resources that people have the potential to utilize. The world's water supplies are coming under growing pressure as a result of the extremely uneven distribution of water in space and time. On the other hand, local water sources, such as deep groundwater with restricted availability and mountain glaciers and snow that are separated from the rest of the world, might not be observed by the general population. In the field of water resources engineering, the objective is to investigate and create methods for the management of water distribution in a manner that fulfills the requirements of both humans and the environment in terms of the quantity and quality of water used. Because these systems ensure the continued operation of ecosystems, which in turn ensures the continuation of our way of life, society is dependent on water resources.

In order to assist the modeling, storage, retrieval, analysis, and presentation of geographical data, Geographic Information Systems (GIS) make use of computer-based information systems. This is a popular depiction that does not highlight the potential of GIS to integrate data management and decision-making across a whole company. When we take a step back, we can see that geographic information systems are mostly utilized for the management of ecosystems that are both natural and manufactured. In addition to this, they provide a framework for making well-informed judgments on the allocation of Earth's resources. The Geographic Information System (GIS) integrates databases that offer attribute data on the features in order to display information in the form of maps and feature symbols. When you look at a map, you could learn the placement, classification, and connections between a lot of different things. Through the utilization of a Geographic Information System (GIS), it is possible to mimic river flows, travel times, or pollutant dispersion. Additionally, a GIS can give you with a rundown of all the nodes in the network as well as tabular data on the qualities of the map. There are a wide variety of studies and models that may be performed with Geographic Information Systems (GIS), including those that include the administration, display, and processing of geographical data.

OBJECTIVE

1. To learn more about Water Resources Management in India: Obstacles and Solutions.
2. For the purpose of learning about GIS and remote sensing.

GEOGRAPHY AND GEOGRAPHERS' PERSPECTIVES

Although many people mistakenly believe that geography is only the study of physical locations, this is far from the case. It is understandable that those who are not familiar with the field of geography may perceive it as a hodgepodge of unrelated fields without a cohesive whole, according to the National Research Council (1997). The various subfields within geography, including hydrology, geomorphology, climatology, population, and biogeography, lend credence to this view. The four primary concepts of geography—space, area, man-environment, and earth science—remain consistent across all of geography's subfields, despite the emphasis on specialization (Pattison, 1964).

According to Robinson (1974), features of the distribution and shape of spatial phenomena, as well as place, location, position, direction, and distance, are deeply ingrained in the spatial legacy of Geography. As a foundational principle, the area studies tradition holds that functional linkages rank small, medium, and large areas in a hierarchical fashion. A geographer's in-depth familiarity with a region allows them to pinpoint its defining characteristics, learn about the diverse ways in which humans have arranged their dwellings, roads, resources (water included), and more in relation to the natural world, and so on. To better understand the causes of geographical similarities and differences, geographers constantly survey the world for evidence of both.

To investigate the man-environment link is to probe the connections between man and his physical surroundings. The mind of man and his beliefs and perceptions of his surroundings, according to Robinson (1974), is the most important aspect in man-environment connections. The way water is seen by humans has a major impact on its exploitation, development, usage, and management. The development and management of water resources may be further improved by gaining an awareness of the linkages between ecosystems, humans, and water resources. Understanding the processes occurring on Earth's surface and how they interact, as they differ from one location to another, is central to the earth scientific heritage. To learn more about the four schools of thought within geography, consult Pattison (1964) and Robinson (1974). Even more crucially, these four traditions have been the center of attention for geographers' work and methodology. All of these things contribute to Geography's singularity and shape how we study Earth, our own planet.

Because the scope of geography is elastic, there is a school of thought that holds that everything is geography and geography is everything (Olorunfemi, 2001). Given the breadth of Geography's influence across the hard and soft sciences, this is an invaluable tool in the management of water resources. Regardless, it has a leg up when it comes to environmental challenges like: thanks to its well-developed set of geographic viewpoints (NRC, 1997).

The field of geography that studies the Earth from the perspectives of space, location, and size: By centering on place, we provide a transdisciplinary window into processes and phenomena that are typically seen in isolation by other fields. The emphasis, then, is on the interdependencies and linkages among the processes and occurrences that are the essence of any given area. Water resources management will undoubtedly benefit from geographers' attention to place, space, and scale, as this will aid in comprehending the size and spatial aspects of any given location's present water condition.

Areas of synthesis in geography: physical system dynamics, human-societal system dynamics, and environmental system dynamics all pertain to the interplay between human activity and the physical world. This pertains to environmental-societal dynamics, which is central to geographers' work and focuses on human impact on the biophysical environment.

Visualization in space: As an example, consider the strong relationship between cartography and geography across many centuries. The geographical notions inherent to geography, including place, area, distribution, size, spatial interaction, and change, limit and determine the spatial representational tools used by geographers. To better illustrate the spatial distribution pattern of water resources and how it varies from one geographical place to another, geographers will make use of maps and charts to depict phenomena in space.

To put it another way, geographers look at the world through the lens of identifying locations, environmental challenges, and the human and non-human factors that influence both. As part of this process, we must determine the geographical distribution and interconnectedness of phenomena as well as the links and interactions between locations. A defining feature of geography is its ability to take a systemic view while maintaining a fine-grained awareness of the finer points, such as the interconnections and feedback loops between an issue's constituent parts.

Water Resources Distribution, Development and Management

In its broadest sense, the term "water resources" refers to an investigation of the many ways in which bodies of water—including the ocean, rivers, lakes, ponds, groundwater, and ice—have historically been associated with human civilizations (Frioux, 2014). Water management's past is inseparable from humankind's past. There has to be effective management of water since its distribution on Earth's surface is not uniform. An essential part of man's plan for survival and well-being since the beginning of time has been dealing with the availability or lack thereof of water supplies. Human ingenuity has been on display in the allocation, transportation, and procurement of water throughout history. The quantity, distribution, quality, and seasonality of water have all played important roles in health, sustenance, and the possibility of settling down.

The majority of the world's water supply consists of saltwater (97%) and a little percentage of freshwater (3%). Lagoons, seas, and oceans make up marine water resources, whereas rivers, streams, lakes, wetlands, and subterranean water reservoirs make up freshwater resources, which account for just 3%. Orubu (2006) notes that residential water usage, as well as support for agricultural and industrial uses, mostly comes from the 3% freshwater supply. This is ironic. Freshwater resources, such as precipitation and runoff, are not always reliably distributed and available. The amount of water that different parts of the world receive varies throughout time and place, according to the United Nations World Water Assessment Programme (UNWWAP), 2015. This suggests that water availability varies both geographically and seasonally. UNWWAP (2015) went on to say that this can cause water status to vary greatly between climate types and seasons.

Countries in developing regions, particularly in Asia and Africa, have relatively low water resources per capita when compared globally, according to the geographical distribution of renewable water resources per capita. Regrettably, these nations lack the necessary technological expertise to effectively manage their little water supplies. The already significant variety in fresh water availability across the world may become much more severe as a result of the rapidly changing global climatic conditions. Water, formerly thought of as an endless gift from nature, is now distributed unevenly over the planet, necessitating a holistic approach to its management. As a result, how we see the development and management of water resources in respect to their availability and status across regions has to shift.

As people learned about the finite nature of water supplies and the many dangers of water contamination, their once-naive perspective on water as a gift from Mother Nature began to shift (Frioux, 2014). Because of this, the preservation of both humans and ecosystems depends on how water supplies are managed. Water resources management was defined by Porter (1978), as a man-environment system that transforms raw materials into finished products that meet user needs, as quoted in Ayoade (2003). Increasing the amount of useable water and changing its geographical and temporal patterns of occurrence are two ways in which humans influence the water cycle, according to Ayoade (2003, p.247). Water resource development and management, according to Stephenson and Peterson (1991), should include adjusting the hydrologic cycle to control the flow of natural water to satisfy human demands.

In their study, Stephenson and Peterson (1991, p.5) highlighted the importance of planners understanding the interconnectedness of the hydrologic cycle with various systems. These systems include: land use, soil conservation, watershed management, groundwater supply and use, drainage and aquatic weed control, economics, social well-being, flora and fauna, public health, and the control of disease vectors. Effective water management, according to Ayoade (2003, p.191), necessitates thinking about certain aspects of water sources, including as:

- The flow characteristics of water that allow downstream usage of the same water and trigger upstream abstractions or discharge to affect downstream;

- The inherent relationship between groundwater and surface water needs their management as a unified system;
- Spatial changes in precipitation and aquifers cause unequal water resource distribution and temporal volatility in water from precipitation;
- Water resources and demands conflict geographically and temporally.

Water Resources Management and Geography

The allocation of resources is a decision-making process that incorporates people's wants, goals, and wishes, as stated by O'Riordan (1971) and Hooper (2003). This decision-making process takes place within the context of societal innovation, political and social institutions, and legal and administrative structures. In the process of managing water resources, one component is the allocation of water based on human necessities, objectives, and aspirations. Other aspects of water resource management include the geographical distribution of the resource and its complex interaction with the environment. The management of water resources is best understood as an integrated system that involves interactions between "land-resource-environment" (Hooper, 2003, page 12; Burton, 1984). This is the most effective method to approach the topic. For one to be able to effectively manage water resources, they need to have a solid understanding of the interplay and connections that exist between water, the natural world, and humans. This includes the ability to evaluate the combined qualities of surface and groundwater, as well as their supply and demand, and the numerous applications that they have.

This interacting phenomenon should be the primary focus of resource management, according to Hopper (2003, page 12), who claimed that this should be done because of the relevance of resource management to spatial tradition. Because of this, the management of water resources is strongly dependent on the insights that geographers have into phenomena and problems that are anchored in the geosciences, area studies, human-environment, and earth science disciplines. The use of geographic knowledge will result in enhanced practice in the management of water resources; however, this is not confined to any one particular issue. From the perspective of a geographer, the first stage in the process of managing water resources is to identify the locations of the water resources. The second issue that has to be answered is: exactly how significant are the differences that have been observed? The third element is gaining an understanding of how the exploitation of the environment has an effect on the water cycle and how people are connected to it. The fourth step is to acquire knowledge about the numerous activities that occur on the surface of the Earth and how these processes interact with one another to influence the hydrological cycle, which varies from one region to another.

In an article that she named "Geography's Covert Operation in Water Resources Management," Wilkinson (2001) provided a thorough account of the pattern that she discovered in her research on geographers associated with water resources management. The fact that "geographers were trained to incorporate many different components involved in water resources management" was one of the replies that she received was one of his responses. Due to the fact that obtaining everyone's support for a resource management plan is essential to the success of the strategy, this is a significant advantage. Geographers are better equipped to interact with other groups since they are familiar with the different facets of resource management. This is because geographers are experts in each of these areas.

In response to the question of what differentiated him from his colleagues in the water sector, another geographer who took part in Wilkinson's (2001, page 123) survey mentioned his capacity to maintain a wide perspective while also being knowledgeable about the specifics. He continued by stating that an extensive number of specialists in other fields are unable to concur with him because their job is so narrowly focused. It was said by him that one of the issues with professionals is that they do not always have a complete picture when it comes to the things that influence water supplies. The wide information I possess as a geographer is beneficial to the work I do with other people.

Hydrological Models, Geographical Information System and Remote Sensing

Researchers may learn about and foretell how any big environmental factor will behave in relation to water resources by using hydrological models or modeling. Hydrologists and water resources engineers have relied heavily on hydrological models due to the inherent challenges in directly measuring and estimating the water budget and the hydrological cycle. The hydrological cycle is an incredibly complicated system that defies complete comprehension; as a result, it necessitates the use of models that mimic its simpler counterparts. A model is a simplified depiction of a real-world system, according to Wheater et al. (2008). Various hydrological models have been utilized for a wide range of purposes, including but not limited to: flood prediction, efficient management of water resources, assessment of water quality, circulation of nutrients and pesticides, land use, and climate change. Therefore, as a tool for integrated water resource management and policymaking, hydrological cycle modeling is excellent.

To better understand different hydrological processes and to foretell how systems will behave, models are frequently employed. A simple model with few parameters can provide results that are near to reality. These days, hydrological models are seen as an essential resource for managing water and environmental resources. There are a few ways to classify hydrological models: by how their parameters change with time and place, or by whether they are deterministic or stochastic. In order to account for geographic variation in parameters, inputs, and outputs, a spatially distributed model partitions the whole drainage basin into smaller units. This allows for the model to make predictions about spatial distribution. Notably, geographically dispersed models have recently become more feasible in water resources management because to advancements in remote sensing and geographic information systems.

CONCLUSION

The geographic information system is a highly effective technology that supplies us with the ability to acquire outcomes via the utilization of spatial and visual interpretation. The application of geographic information system (GIS) technology, as was mentioned before, considerably enhances hydrologic studies of surface water and ground water. The GIS's data processing and manipulation skills are able to efficiently manage the huge volumes of geographic data that are related to watershed characteristics and parameters. Additionally, the GIS's mapping features are able to give a clear visual representation of all the associated elements. According to a number of publications, the examples of specialist GIS applications in water resources engineering are presented.

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