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Research Paper

Water and Climate in the Global Sustainable Development Agenda

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Abstract
All nations are contending with the effects of climate change, but the poorer ones are particularly impacted because they lack the resources to counteract the changes that are occurring.The changing climate affects almost every part of our environment, and these changes in turn constantly prompt more changes in the external environment.Sustainability has become a crucial issue due to the effects of these changes and humanity's collective incapacity to survive with the finite amount of natural resources (including freshwater).This paper examines the connection between water supplies and climate change, as well as how water circulation affects climate change. and then briefly reviews several research techniques for examining how climate change has an impact on hydrology and water supplies. Finally, it highlights research challenges and suggests future directions, including refining the distributed hydrological model, enhancing the accuracy of climate and hydrologic models, and creating two-way coupling strategies for these models.

Keywords- *Climate Change, Sustainable Development, Environment deterioration, Globalisation, Water resources*

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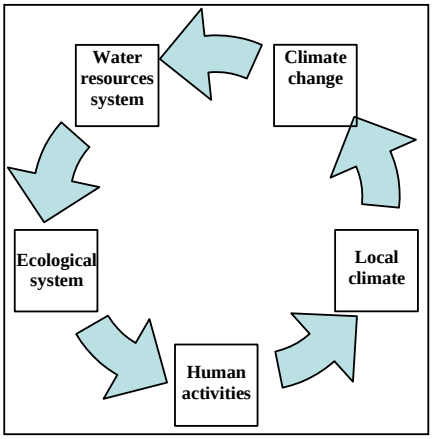
I. INTRODUCTION

Natural resource endowment varies throughout continents, nations, and even within nations; some are luckier than others. No living can thrive without water, which is the sole natural resource for which there is no equivalent. Other natural resources do not typically have the emotional and identity linkages that water has.Only a very small percentage of the world's 1.36 billion cubic metres of freshwater are usable, and the majority is still too deeply underground to be exploited. 500,000 km of moisture are released into the atmosphere each year globally, 86 percent from the ocean and 14 percent from the land. The result of a complicated balancing act between rainfall and evaporation between the sea and land, the amount of freshwater on earth increases by tiny amounts, reaching 40,000 km. The availability of freshwater is influenced by a wide range of elements, including meteorological, hydrological, and climatic factors.

Fig 1 Cycle diagram of climate change affects



Numerous internal and foreign studies on the effects of climate change on water resources have been conducted. Beginning in the 1980s, studies on the effects of climate change on water supplies were conducted on the outside. The World Meteorological Organization (WMO) reviewed the effects of climate change on water resources and published its findings in 1985. The World Meteorological Organization then proposed certain test and evaluation methods and issued the sensitivity analysis report that examined the influence of climate change on hydrology and water resources. The WMO highlighted the water resources system's sensitivity issues for both future and contemporary climate change in 1987. The Intergovernmental Panel on Climate Change (IPCC) was established by the World Meteorological Organization (WMO) and the United Nations Environment Programme (UNEP) in order to expedite research.

Watercourses and drainage basins have influenced human settlement patterns for many years. As explorers found new worlds and merchants investigated new markets, the sea played a significant role. The world political map was redrawn by the colonial maritime powers, Portugal, Spain, France, Holland, and Britain, to resemble what it is now. The colonial powers had to maintain a secure sea connection between their bases in the colonies and the cities. This helped create the laws and agreements that regulate how international watercourses are used.

Every area of human society is affected by the effects of climate change, which have broad implications. Most people agree that the unchecked release of greenhouse gases (or CO2) into the atmosphere is the primary contributor to climate change. And the main contributor to greenhouse gas emissions is the use of fossil fuels. Scientists concur that failure to manage CO2 would be terrible for humanity and that this gas is increasing the Earth's surface temperature. The economically and politically underprivileged parts of a community are more at risk in a disaster.

While Afghanistan is attempting to establish itself as an independent, well-governed state following the tribulations of Taliban leadership, Nepal, Bhutan, and Bangladesh are the smallest of the continental South Asian nations. China's participation gives them the chance to adopt independent stances on SAARC-related matters, regardless of India's preferences. People in these nations endure extreme poverty. Depending on how each country places itself in regard to these two neighbours so as to take full benefit of their rivalry, the presence of India and China could either be a blessing or a curse. It makes sense for China to seize these chances and benefit from them.

All of the mainland nations of South Asia, with the exception of Nepal and Bhutan, are on the verge of becoming water-scarce nations. In this setting, security concerns and related strategic worries are distinct due to internal conflicts and erroneous perceptions of defence and economic needs. The effects of climate change on these nations' physical environments and water supply are a common problem that none of these nations has any control over.

India is a country with both upper and lower riparian regions, unlike China. None of the significant perennial water sources are completely within India's control. Other nations will closely monitor how it manages the riparian waterways in reaction to its policy. Countries frequently use the political issue of water to distract the people from their own failed policies.

II. FRESHWATER AND CLIMATE CHANGE

People's access to water is already being impacted by climate change, which is creating increasingly severe droughts and floods. One of the key causes of this issue is rising global temperatures. The water cycle is impacted by climate change because it alters where, when, and how much precipitation occurs. Over time, it

also causes weather events to become more severe. Larger water evaporation due to rising global temperatures will result in higher atmospheric water vapour concentrations and more frequent, heavy, and violent rainstorms in the upcoming years.

Since more water will fall than what flora and soil can absorb, climate experts estimate that this transition will result in more flooding. Runoff, or the residual water, enters adjacent waterways and picks up pollutants like fertiliser. Larger bodies of water like lakes, estuaries, and the ocean eventually receive excess runoff, which contaminates the water supply and restricts access to it for both people and ecosystems.

Agricultural fertilisers that run off into lakes and the ocean encourage the rapid growth of algae. As a result, green, blue-green, red, or brown algae clouds block the beaches and streams. The blooms reduce the amount of oxygen in the water and prevent sunlight from reaching undersea life. Fish and other aquatic animals can die from the blooms' toxins, which can even sicken and kill humans. Due to their ability to withstand purifying procedures, these toxins are particularly harmful since they render tap water unsafe for consumption once polluted. Businesses that depend on the water are also impacted by algal blooms, which frequently lead local waterfronts to close down. Harmful algal blooms increase in frequency and severity as the climate warms.

By the end of the twentieth century, there were significant reductions in the amount of freshwater available globally per person due to fast population growth, the need to produce more food, and other lifestyle issues. The population of the world tripled throughout that century, while the amount of water used by humans increased by nearly seven times. In addition, according to experts, water demand will rise by around 32% between 2000 and 2025, and by that time, half of the world's population will be experiencing water stress.

Aside from the Middle East and North Africa, South Asia has the second-lowest per-capita volume of freshwater in the world (Table 2.1). The situation will worsen because to changing runoff and precipitation patterns brought on by climate change.

Table 2.1. Annual renewable water resources

Country	*Year of Estimate*	*m^3/yr*
Afghanistan	1997	65.0
Bangladesh	1999	1,210.6
Bhutan	1987	95.0
India	1999	1,907.8
Nepal	1999	210.2
Pakistan	2003	233.8
China	1999	2,829.6

Source: Gleick et al. 2006: 225.

Note: The estimates consist of natural renewable surface and groundwater, and flows from other sources; and the data comes from different sources; hence any comparisons between countries should be made cautiously.

Overcoming the water crisis becomes a policy issue for countries with a lack of water in a diminishing resource environment. Less than 34% of India's freshwater is imported from other countries. This water originates from perennial riparian rivers. A cooperative water-sharing agreement with the upper riparian countries is necessary in this situation for good policy. However, any ability to choose such a course of action is constrained by the subcontinent's traditions of mistrust, resentment, and aversion to cooperation.

Sea levels rise as a result of freshwater glaciers throughout the world starting to melt at an unsustainable rate as the oceans warm. Eventually, the freshwater from the melted glaciers enters the ocean. Aquifers, which are underground freshwater-bearing rocks, are more susceptible to contamination from saline water as sea levels rise. Desalination is a last-resort, expensive, energy-intensive method for areas with continuous droughts and a lack of freshwater that removes salt from saline water. Desalination is used to create freshwater in the Caribbean, North Africa, and the Middle East out of necessity.

Warmer temperatures result in less snowfall in the Northern Hemisphere, where snow, a source of freshwater, generally accumulates. Less snowfall results in less water remaining in regional reservoirs after winter. Farmers that are left without adequate water to irrigate their crops throughout the growing season suffer as a result.

Everyone can take a variety of actions to mitigate the effects of climate change. Consider producing your own fruits and veggies or purchasing locally produced food since produce is frequently carried by trucks from far away to grocery stores, increasing the amount of carbon dioxide in the atmosphere. Instead of driving a car, you may also choose to walk or ride a bike. To have a greater impact on the environment, sectors that rely on fossil fuels need to move to cleaner, renewable energy sources.

III. ACHIEVEMENT OF SUSTAINABLE DEVELOPMENT GOALS FROM WATER PERSPECTIVE

At regional and global levels, efforts to address local human water requirements may have detrimental environmental externalities and put stress on the water system. As a result, evaluating Sustainable Development Goals (SDGs) targets involves a thorough understanding of the dynamics of water supply and use from a global to local level. Furthermore, if the series of actions is not appropriately pre-designed to take into account such inter-linkages, interactions and trade-offs between various SDG targets may result in sub-optimal or even disastrous results. As a result, assessments and policy involvement at all levels, from the global to the local, can help to facilitate the implementation of the SDGs.

With a focus on the sustainability of water use for future generations, water quality is closely related to SDGs. A major global worry is the deteriorating water quality, which can have negative long-term effects on socio-ecological systems as a whole. Today, we understand that the problem of water scarcity is gradually shifting from one of quantity to one of quality. The goal's sixth target states that we should work to enhance the quality of the world's water by halving the amount of untreated sewage, eliminating dumping, minimising the release of harmful chemicals and materials, and considerably increasing recycling and safe reuse. Although there are many different potential water quality indicators, it is still extremely difficult in many places of the world to determine the quality state of freshwater bodies.

Effective tracking of point and non-point source pollution is required to comprehend the connections between water quality, human wellbeing, and the environment. Science can contribute to a thorough understanding of the connections between the water, phosphorus, nitrogen, and carbon cycles and other pollutants, as well as the size and impact of these pollutants on water quality and the potential for reducing and controlling these impacts. These evaluations, which can be conducted at various sizes, can assist to pinpoint the underlying causes of the issue and close the information gap needed to create effective policies for implementing SDGS.

Numerous worldwide measurements or indicators do not account for actions taken at the household or community level that are in favour of or against sustainability. At the household (micro) level, the sustainability conditions that might be present at the macro level might not hold. In order to take into consideration the multi-scale nature of each objective performance, it is imperative to additionally include assessments of water quality and sanitation at the household and community levels. For instance, the Yale Environmental Performance Index (EPI) has been developed as a national wastewater treatment indicator in order to learn more about wastewater treatment, a key component of sanitation.

The Swachh Bharat Mission (SBM) in India has adopted even more "on the ground" methods. They want to encourage the use and construction of latrines in rural regions with their sanitation campaign. 80% of the toilets recorded could not be verified as existent by the Census 2011, as the prior monitoring approach was dependent on sanitation expenditure rather than actually observing de facto toilet installation. The SBM is establishing a smartphone-based observation system to enhance the monitoring system. A quick and effective way to report the construction and existence of toilets in specific households is to utilise geo-tagged images of latrines.Both of these situations could serve as benchmark examples for SDG monitoring. Both methods, however, fail to close the gap between local and world scale monitoring. Furthermore, the question of an indicator's function is still open. Instead of measuring the number of latrines erected per person or other easily quantifiable accomplishments, an ideal SDG indicator may focus on the sustainability of (i.e., long-lasting and delivering intended value) water management systems.

3.1. UNDERSTANDING THE SDG INTERLINKAGES

Despite being designed as distinct objectives, the SDGs are scarcely autonomous. Water connects many of them, and the aims and indicators pertaining to freshwater systems can be found in other goals and indicators in addition to the specific water goal (goal 6).

Groundwater systems are a good way to show how some of the interconnections work. Aquifers on a local, regional, and continental scale are strategically important because they are the world's largest freshwater storage reserve and serve as a crucial buffer for socioeconomic adaptation to climatic and environmental change. The SDG-6 for water, as well as SDG-2 on food security, SDG-3 on human health, SDG-11 on resilient cities, and SDG-15 on protecting ecosystems and conserving biodiversity, are all potentially hampered by threats to their sustainability brought on by both excessive exploitation and quality degradation over the past 30 to 50 years.

The proposed SDGs frequently "skate around" the important issue of absolute physical restrictions on natural resources, such as groundwater, and how these have been drastically diminished due to historically poor custodianship. Only if underlying groundwater systems are conserved in "excellent status" and not vulnerable to ongoing depletion and quality degradation will the SDGs relating to food production, resilient cities, and aquatic ecosystems be accomplished over the long run.

The SDGs have numerous interconnections, and a thorough understanding of these connections can help policymakers develop interventions and solutions that achieve several SDGs at once. Furthermore, failing to meet water-related objectives increases the likelihood of failing to meet other interconnected objectives. For example, if we completely achieve SDG-6 on clean water and sanitation, it will considerably progress SDG-14 and 15 on protecting land and aquatic habitats, respectively. On the other hand, failure to accomplish SDG-6 will have a detrimental effect on these related SDGs. So, one of the most crucial strategies to maximise the potential stimulus of other SDGs is to prioritise the water targets.

The SDG indicators pertaining to interrelated concerns should be utilised and interpreted with caution. For instance, a variety of factors affect the quality of the water (e.g., land degradation, human health, sanitation, etc.). However, there are no water-related indicators that address this interlinkage in the specific SDGs 2 and 3 targets relating to food security and human health.

3.2. ROLE OF WATER STORAGE INFRASTRUCTURE

Infrastructure serves as a conduit for the movement of water resources both inside and between humanity and the natural world. Therefore, infrastructure is crucial in eliminating current inequities. Water storage is a crucial component of large-scale water infrastructure for mitigating the effects of restricted and unpredictable natural resource availability and its frequent failure to meet even reasonable water needs. Dams and reservoirs are the most contentious examples of large-scale engineering interventions, nevertheless. Dams are a good way to show the potentially divisive discussions surrounding technical solutions.There is ideological motive behind these discussions. Indeed, the effects on freshwater ecosystems, terrestrial ecosystems, and human society are significant. The disparities between the (new infrastructure, and primarily downstream) beneficiaries and the affected (local) population present serious challenges within a country, and even more so in a transboundary context. This is true not only of the displacement of people caused by the impoundment of water.

Despite the debates surrounding this issue, some contend that building significant extra water storage infrastructure is the only way to accomplish the SDGs and adapt to climate change. There is historical proof that the availability and amount of water storage capacity per capita are favourably connected with human water security and other aspects of well-being. In order to meet the rising need for energy, a sizable dam is already being built, largely with money from private sources. Agriculture's potential co-benefits are unlikely to be taken into account.The Kariba and Cahora Bassa dams on the Zambezi River are two significant reservoirs that were built specifically for the development of hydropower. There is much to be learnt about reaching an agreement while building dams to supply human water demands while preventing the river system from becoming an engineered one. According to the IPCC assessment, extremes on both ends of the spectrum will grow as a result of weather and streamflow events throughout time. Longer droughts and worse floods would therefore require again more storage volume to handle them.Reservoir construction as a strategy of adaptation, however, may result in additional adaptation stress that affects both people and the ecosystems around new dams and reservoirs. Reservoirs that are well planned and run as multipurpose facilities can help accomplish a number of SDGs, including those that focus on the environment. Dams and reservoirs can be credited with improved energy, food, and water security, as well as disaster risk mitigation and ensuring environmental flows downstream, however as was already said, this typically comes at the cost of deteriorating the natural features of freshwater ecosystems.

The other primary method of storing freshwater is groundwater reserves, which also have unique (though very distinct) "infrastructure needs" if they are to be used sustainably. In order to determine whether they are being overly drained or becoming increasingly salinized by the current withdrawal regimes for irrigated agriculture and urban water supply, it is important to establish an adequate monitoring network. Most often, their sustainable use will necessitate joint management with surface water resources to benefit from complimentary hydrologic properties in order to increase water supply security and assure ecosystem protection. This in turn frequently necessitates greater initial capital expenditure and always calls for upgrading the "resource governance regime."

3.3. CAPACITY DEVELOPMENT AND MONITORING OF THE SDGS

After the SDGs were adopted, the world was compelled to leave the manifestly unsustainable business-as-usual trajectory and start looking for a sustainable way to fulfil its socioeconomic and environmental objectives. The 169 targets and 17 goals are intended to serve as benchmarks to be attained by 2030. (some of them by 2020 or preferably earlier). Surrogate indications will frequently be required to gauge progress (or the lack of it).Implementing the SDGs necessitates ongoing observation and regular evaluation to determine whether the rate and direction of development are appropriate. It denotes the gathering, archiving, and processing of enormous amounts of data for various scales of evaluation. Monitoring and evaluation have capacity requirements in terms of both professional and monetary resources. Significant capacity gaps must be addressed, especially in emerging nations.Because multi-stakeholder implementation requires informed citizens,

public and private engagement, and a mentality change, professional capacity, educational capacity, and media capacity are needed. It is evident that neither monitoring nor evaluation capacity are at an ideal level as the SDG implementation process gets underway. Thus, in order to execute the SDGs, it is also necessary to concurrently provide the groundwork for its intended success. The "ladder approach," which best describes the method of enhancing monitoring gradually, can be used to accomplish the SDGs in many additional ways.

3.4. LEARNING FROM PAST LESSONS ON GOVERNANCE, TECHNICAL, TRAINING, AND SOCIAL INCENTIVES

Building national capability is crucial for SDG monitoring. Since most senior government officials do not want to see their countries as the "white spot" (blank) on global maps, the increased visibility of global data platforms can encourage countries to provide data. The "tragedy of averages" must be carefully avoided, nevertheless, as natural topography varies greatly across most nations. A substantially distorted characterisation is frequently seen by averaged data. For poorer nations, ideas like monitoring ladders or monitoring stages (with varying levels of complexity) may be helpful and realistic. In systemic approaches, the improved capacity building may aid in identifying the long-term superior solutions.

IV. MULTILATERAL EFFORTS FROM ALL SOCIETAL LEVELS

The SDGs should be monitored by representatives from all spheres of society, including the government, academics, NGOs, and others. How this may be implemented in real life and what obstacles exist for these societal levels to make meaningful contributions are crucial questions. Recognizing that each level of society should focus on its strengths is one strategy.For instance, the public's role should be to pressure policymakers and the government to provide services at reasonable prices and with sustainable practises (such as clean water, a healthy environment, etc.); academics need to engage in data collection and sharing, knowledge creation, and mediation of societal aspirations with sustainable development goals; administrators need to develop efficient mechanisms to implement policies and meet national development aspirations.

Modern digital technologies, which are widely used items like smartphones and hand-held computers, can completely alter the worlds of data collection and monitoring. In some fields, citizen science has a lot of potential. It has limitations, though, and is ineffective in situations where data quality, calibration, and standardisation are issues. However, it still has a significant part to play in promoting awareness and supporting initiatives for both monitoring and implementation.

V. CONCLUSION

Environmental problems have significant short- and long-term effects on the world economy, particularly freshwater supplies. Water requires special consideration because, first, life cannot survive without it, and second, practically every other resource has a substitute, but not for water. Due to the fact that water is so pervasive, every action must adhere to strict environmental criteria for water loss and gain. This applies to state policies, private sector activities, non-governmental sector activities, and those of the entire community. In order to ensure that all policies, to the greatest extent possible, fulfil community, national, regional, and international duties, it is necessary to take climate change and water issues into account alongside other policies.

Some implications of climate change are difficult to forecast, while others are predictable. Governments and communities will have time to plan reactions and establish plans for the foreseeable repercussions. In many cases, the damaging effects of climate change cannot be forecast well enough in advance, necessitating a quick response in order to prevent disruption and suffering. Additionally, all policy responses to such circumstances must, to the extent practical, be consistent with national circumstances and community policy priorities, while in some circumstances, regional or global policy action will take precedence. Given that climate change transcends national boundaries, this issue assumes particular significance in the context of climate change.

Any nation today faces a wide range of policy challenges, including terrorism, globalisation, environmental deterioration, climate change, and the depletion of energy resources. Any remaining uncertainty regarding the nature of interdependencies is unfounded, as demonstrated by the 2008–2009 global financial crisis. Despite the fact that the crisis started in the US, its effects are not limited to that country.

In general, concerns associated to climate change have economic repercussions in terms of costs and benefits. These challenges are neither straightforward nor straightforward to address. The likelihood of internal and regional instability and turbulence will be significant if these concerns are not dealt with promptly and fairly. The global information revolution has given people the means to evaluate what has been occurring elsewhere and how other people and governments are handling problems that their respective populations are facing. In other words, because of the international nature of our environment, it is impossible for us to ignore it.

There are many different aspects of globalisation, including economic, political, and cultural ones. Four million people perished during the Bengal famine of 1943, despite the fact that there was no widespread scarcity

of rice in Bengal under British administration. When informed of the situation, Winston Churchill reportedly questioned why Mahatma Gandhi hadn't already passed away if food was so limited. Churchill's neighbours would be the first to urge that help be delivered right away to lessen the agony and sorrow of the affected population if this happened right now. This simply did not occur in 1943.

In the early years of the twenty-first century, there has been a profound change in how people think about the world. Global citizens' perceptions of topics like human rights, the environment, and governance practises have been transformed, motivating them to organise and mobilise public opinion outside of traditional governmental organisations. It is frequently impossible for even the most recalcitrant governments to disregard such influences.

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