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Ground Water Management and Sustainable Development

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ABSTRACT

This paper explores the strategies to strengthen India's water sustainability through policy reforms, innovation, and community participation. Sustainable groundwater management and development is the core of India's socio-economic survival, securing everything from drinking water access to national food security. Groundwater management, as part of integrated water resources management, focuses on understanding aquifers, addressing threats, and ensuring the long-term sustainability of groundwater systems. Factors contributing to groundwater depletion in India include overextraction, poor governance, urbanization, and invisible pollution. The groundwater crisis in India has depicted mixed government responses of increasing supply, demand management and controlling extraction.

Keywords: Sustainable, groundwater, management, natural resources, development, drinking and crisis

INTRODUCTION

Water is one of the fundamental resources required for sustenance of life. But India's huge and growing population is putting a severe pressure on all of the country's natural resources; one of the badly affected of them all is water. Most of the water resources are contaminated by sewage and agricultural run-off. In fact, water related problems in India have reached a crisis point and have given rise to issues of widespread drought, depleting groundwater levels, salinity, and increasing pollution of water bodies. Water resources have become an issue of contest between the states and countries. All these issues relate to an imbalance in demand and supply.

With water pollution on the rise, the day is not far when water will be sold at a premium in our national capital where the situation is far graver than the other parts of the country. It is predicted that potable drinking water will soon be a rare commodity. The Scale of Extraction: India is the largest user of groundwater in the world. With over 240+ billion cubic meters extracted annually, India uses more groundwater than the US and China combined. Groundwater is the backbone of India's agrarian economy and rural livelihood, meeting about 62% of irrigation needs and 85% of rural drinking water. However, as the world's largest consumer of groundwater, India extracts over 230 billion cubic meters annually

Groundwater is the invisible backbone of India's water security, meeting over (60%) of irrigation needs and eighty five percentage of rural drinking water. However, unregulated extraction and climate change are pushing this finite resource to the brink, making sustainable management a critical prerequisite for achieving national development and the Sustainable Development Goals. "Groundwater is the most accessed source of freshwater around the world, including as drinking water, irrigation, and manufacturing. Groundwater accounts for about half of the world's drinking water, 40% of its irrigation water, and a third of water for industrial purposes" (Lall, Upmanu;: 171)

The concept of sustainable development has caused great concern in the backdrop of rising population resultantly leading to unbridled and irrational exploitation of natural resources to gratify our insatiable desire for prosperity and comfort. Adding to the problems arising out of population growth is the economic explosion. During the twentieth century, world economy has witnessed unparalleled growth and has expanded twenty times and industrialization growth has experienced a rise of five times from 1950. Naturally, this remarkable growth has a bearing on natural resources causing an unprecedented depletion in the stocks of ecological capital such as fuel, soils, forest, water, atmosphere, etc. The rate of their depletion has been much faster than such stocks can be replenished. It is here that the root of concern lies.

If the pace of development continues, it may soon exhaust the natural resources and the planet will not be place suitable for the survival of the mankind. Hence, it is high time our people as well as planners realize that there is a finite amount of habitable land and water on this earth which demands rationality in their use. The future generations will have to pay for the wrong-doings of those who are today enjoying the fruits of development by over-exploiting the natural resources and polluting the environment.

Sustainable development constantly seeks to achieve social and economical progress in ways that will not exhaust the Earth's finite natural resources. The needs of the world today are real and immediate, yet it's necessary to develop ways to meet these needs that do not disregard the future. The capacity of our ecosystem is not limitless, meaning that future generations may not be able to meet their needs the way we are able to now if we continue to deplete that resources at an unforgiving pace, for growth that is unmanaged and not sustained will lead to increased poverty and decline of the environment.

Although access to drinking water has improved in India and the country has made progress in supply of safe drinking water to its people, gross disparity in coverage exists across the country. As per the World Bank estimates, twenty-one per cent of communicable diseases in India are related to unsafe water. Diarrhoea, one of the major water-borne diseases alone claims more than 1,600 lives daily in India, which is sufficient enough to prove the severity of the problem.

The provision of safe drinking water. has important equity and development implications. On the one hand, unavailability of potable water in the desired quantities have implications for the quality of life in terms of the time spent in collecting water and the adverse impact of consuming contaminated water on health and productivity.

According to the Central Ground Water Board (CGWB) of India, approximately 70% of the total water used in India is from groundwater sources. However, the CGWB also estimates that around 25% of the country's total groundwater extraction is unsustainable, meaning that it is being extracted at a faster rate than it can be replenished.

Overall, groundwater depletion in India is a serious problem that needs to be addressed through sustainable water management practices, such as improved irrigation techniques and conservation efforts. "Reliance on groundwater will only increase, mainly due to growing water demand by all sectors combined with increasing variation in rainfall patterns" **(United Nations 2022)**

No doubt sustainability can never be absolute. It is not plausible that all natural resources need to be conserved at the cost of development. Development, of course, is the demand of the hour and cannot afford to the ignored. Successful development inevitably involves some amount of land clearing, oil-drilling, river damming and swamp draining which are likely to displace people and add to their miseries, though for some time. But economic development and sound environmental management are complementary aspects of the same agenda. The success lies in proper planning and efficient management of the issue. "Safe use of groundwater varies substantially by the elements present and use-cases, with significant differences between consumption for humans, livestocks and different crops" ( ) .[25]

Sustainability simply implies keeping something going for an indefinite period of time. The idea of sustainable development is not new. It has been talked of and heard for well over 100 years. However, in recent times it has become very common and popular. Almost every major fact of human activities is associated with the word 'sustainable'.

The distribution of fresh water resources in India is uneven over space and time because its availability is largely dictated by precipitation. The lowest rainfall. 0.11 mm occurs at Jaisalmer in Western Rajasthan while the highest. 11.690 mm gets recorded at Cherrapunji in Meghalaya. About 64 per cent of the geographical area of the country accounts for less than 29 per cent of its total water resources. Over 80 per cent of country's annual rainfall is recorded in the summer monsoon, which lasts for 100 to 120 days in a year. With as much as 50 per cent of the annual precipitation taking place in a short period of about 15 days and less than 100 hours all together, about 40 million hectares which is about 12.16 per cent of Indian land is also flood-prone, though all of it is not affected every year.

Contamination of water is a matter of grave concern. Status reports by the pollution monitoring agencies, the Central Pollution Control Board and the Delhi Pollution Control Committee reveal that both surface water and ground water are alarmingly polluted with domestic and industrial water contributing to the maximum. There is a progressive increase in bicarbonate, sulphate and chloride ions with rise in salinity, predominant in ground water from areas with high salinity at deeper levels. Fluoride nitrates concentrations are much too higher than the permissible limits.

The surge in population has come with a corresponding increase in the volume of generated domestic fluid waste. Besides, overuse of pesticides and chemicals in agriculture is the primary cause for pollution particularly groundwater pollution in India. The country consumes about 86,311 tonnes of technical grade insecticides annually to cover 182.5 m hectare of its land. Most Indian rivers pass the high agricultural areas that use pesticides. This makes reaching from agricultural fields the most serious.

Water markets thriving on groundwater have become a lucrative business for all those ranging from the private suppliers selling water, tankers and the big bottled water companies. This over-extraction has found rapid depletion of water tables as well as deterioration of water quality in most of the cities. “Groundwater can be a long-term 'reservoir' of the natural water cycle (with residence times from days to millennia), as opposed to short-term water reservoirs like the atmosphere and fresh surface water (which have residence times from minutes to years). Deep groundwater (which is quite distant from the surface recharge) can take a very long time to complete its natural cycle” (Bethke, Craig M.; Johnson and Gleeson, Tom; 121)

The development of a sustainable and safe drinking water supplies is a global challenge, it is particularly acute in India given its high population density, space and time variability of rainfall and increasing depletion and contamination of its surface and groundwater resources.

The situation of water crisis is most parts of the country is critical and needs serious attention. The demand and supply balance needs to be managed by enhancing supply or by curtailing demand. Besides a general awareness is required to be created towards the judicious use of water. A balanced water management approach, involving radical changes in policies, practices, performance and public behavior apart from changes in constitutional provisions, is required to bridge this gap between demand and supply. This approach alone can solve India’s water crisis.

Water Conservation: In the urban areas (where groundwater is five-six metres below the surface), it is possible to reduce groundwater depletion by creating green corridors, mapping channels for potential recharge zones to store floodwater, and creating artificial groundwater recharge structures. Generally the importance of groundwater is still not understood very well by our policy makers . This is the only reason for the continuous decrease of the ground water level however our dependence on ground water is continuously increasing. There are serious issues of depletion of stored groundwater and deterioration of quality.

India, with a sixth of the world population, faces a rapidly growing water crisis, both in the urban and rural areas. The various reasons responsible for this grim situation include wasteful practices in the use of water, particularly for irrigation, water logging and salinity, and inadequate access to safe drinking water and sanitation. In cities such as Delhi and Chennai, several localities depend on private water tankers for their daily needs. The demand and supply gap is very wide in the country. “Groundwater makes up about thirty percent of the world's fresh water supply, which is about 0.76% of the entire world's water, including oceans and permanent ice” (Gleick, Peter H ,1993)

India with a small share of 4 per cent of world water resources has to support 16.5 per cent of the total world population. This ever-increasing imbalance in the demand and supply position of water is a matter of grave concern which has given rise to a division of people into the ‘haves’ and ‘have-nots’ in terms of their access to quality water. Apart from drawing geographical demarcations, the water crisis has sharpened the dividing line between the urban and the rural, the rich and the poor. Scarcity of water has also affected the performance of several industries including power plants. Reducing the imbalances in demand and supply by managing the demand has not been encouraged so far even though it is a viable alternative for solving water crisis. The absence of a national water vision. lack of centralized planning, inadequacy of water usage laws and the intolerance of stockholders of water resources development projects towards one another constitute various aspects of water crisis.

CONCLUSION

A high percentage of water is contaminated with geogenic substances like arsenic and fluoride, alongside heavy metals.India has vast but regionally varied groundwater resources, which are increasingly stressed due to over-extraction, deteriorating quality, and weak regulation, threatening long-term sustainability.The sharp increase in groundwater extraction has been driven by the availability of affordable drilling techniques and pumping technologies, enabling even small farmers and low-income households to construct and operate private tube wells.Key initiatives collectively strengthen groundwater regulation, recharge, monitoring, and demand management, supported by robust data systems and local institutions, laying the foundation for sustainable, climate-resilient groundwater governance.

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