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Water Management-How Viable Is It?

Reddy PR[1]* and Venkat RD[2]

[1]*CSIR-NGRI, Hyderabad-500007, India*

[2]*Department of Civil Engineering, NIT (Karnataka), Surathkal, Srinivasnagar, Mangalore-575025, D.K, India*

Abstract

We often hear that stringent rules have been promulgated to ensure apt water management, but the reality is that nothing tangible has been achieved, in spite of considerable money and energy spent. Unless those who are associated with water management take into consideration the intricate relation between Man and Nature and the vulnerabilities associated with aberrations in the hydrological cycle in space and time in formulating strategies to address various facets of water management, we invariably end up in a cobweb built by environmental, socio-economic, emotional and political impacts. An effort is made to expose the basics associated with water management and the essential steps to achieve a modicum of success in implementing water management activities. Scenario present in India is discussed to logically expose our limitations in the existing management strategies/ policies. Some viable options to achieve reasonable success are detailed.

Keywords: Water management; Hydrological cycle; Man and nature

Introduction

Sustainable development and efficient management of water is an increasingly complex challenge in India. Increasing population, growing urbanization, and rapid industrialization combined with the need for raising agricultural production generates competing claims for water. There is a growing perception of a sense of an impending water crisis in the country. India with 2.4% of the world's total area has 16% of the world's population; but has only 4% of the total available fresh water. This clearly indicates the need for water resource development, conservation, and optimum use. Fortunately, at a macro level India is not grossly short of water. The problems that seem to loom large can be surmounted if there is a strong will to address the problems, analysing the issues in a holistic way. The water resource potential of the country has been assessed from time to time by different agencies.The different estimates are given below. It may be seen that since 1954, the estimates have stabilized and are within the proximity of the currently accepted estimate of 1869 billion cubic metre (bcm) which includes replenishable groundwater which gets charged on annual basis. The water availability estimates are:

First Irrigation Commission (1902–03) 1443–23%

Dr A.N. Khosla (1949) 1673–10%

Central Water and Power Commission (1954–66) 1881+0.6%

National Commission on Agriculture 1850–1%

Central Water Commission (1988) 1880+0.6%

Central Water Commission (1993) 1869

One can see from these details irrigation potential started decreasing (even though marginally) from 1990s. Within the limitations of physiographic conditions, socio-political environment, legal and constitutional constraints, and the technology available at hand, the utilizable water resources of the country have been assessed at 1123 bcm, of which 690 bcm is from surface water and 433 bcm from groundwater sources CWC (1993). Harnessing of 690 bcm of utilizable surface water is possible only if matching storages are built. Trans-basin transfer of water, if taken up to the full extent as proposed under the National Perspective Plan, would further increase the utilizable quantity by approximately 220 bcm. The irrigation potential of the country has been estimated to be 139.9 MH without inter-basin sharing of water and 175 MH with inter-basin sharing. While the total water resource availability in the country remains constant, the per capita availability of water has been steadily declining since 1951 due to population growth. The twin indicators of water scarcity are per capita availability and storage. A per capita availability of less than 1700 cubic metres (m3) is termed as a water-stressed condition .If per capita availability falls below 1000 m3; it is termed as a water scarcity condition. While on an average we may be nearing the water-stressed condition, on an individual river basin-wise situation, nine out of our 20 river basins with 200 million populations are already facing a water-scarcity condition. Even after constructing 4525 large and small dams, the per capita storage in the country is 213 m3 as against 6103 m3 in Russia, 4733 m3 in Australia, 1964 m3 in the United States (US) and 1111 m3 of China. It may touch 400 m3 in India only after the completion of all the ongoing and proposed dams. Analysing the data on potential created and utilised over different Plan periods, it is observed that irrigation potential created has increased from 22.6Mha in pre-plan era to 123.3Mha by the end of X Plan (2002-07). Out of this 42.3 Mha is from major & medium schemes and the remaining 81.0 Mha from minor schemes. The percentage utilisation of total potential created was 73.9 at the end of 2006-07. It remained around 90 to 95% during different Plan periods up to the end of Annual Plans 1990-92. From IX Plan onwards, the utilisation percentage is around 74%.The decrease since 1992 is perceptible [1].

Projected water demand in 2025 compared to 2010:

- Irrigation 688 (2010) 910 (2025) Billion Cubic Metre
- Drinking Water 56 (2010)73 (2025) Billion Cubic Metre
- Industry 12 (2010) 23 (2025) Billion Cubic Metre

***Corresponding author:** P.R. Reddy, CSIR-NGRI, Hyderabad-500007, India, E-mail: parvatarreddy@gmail.com

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- Energy 5 (2010) 15 (2025) Billion Cubic Metre
- Other 52 (2010) 72 (2025) Billion Cubic Metre
- Total 813 (2010) 1093 (2025) Billion Cubic Metre

Even though the projections point out moderate increase, these figures get substantially changed depending on population growth and availability of water (Global warming related aberrations do not allow us to properly estimate future requirements).

From the details given above it is evident that population growth, monsoon vagaries and increased demand are affecting us significantly and even if all the inter basin transfers are carried out per capita availability will remain more or less same or even go down, as such a transfer of water takes time and by that time population grows exponentially. In nut shell unless we take stringent measures in usage of water and restrict significantly the presently witnessed wastage and all the stake holders voluntarily take steps to conserve the available water, adopting a holistic execution mechanism the water scarcity problem cannot be solved.

In general, both technical experts and administrators state/remark that they are taking steps to ensure proper management of water resources. The same segments of our society correct their statement quoting the limitations of their efforts due to non-implementation of well articulated programs, due to monsoon vagaries and ground level execution lapses. There is no proper co-operation and co-ordination between different segments of water management, resulting in disorganised implementation of developmental programs, starting from planning stage. In the last decade in Andhra Pradesh alone billions of rupees have been spent in establishing major irrigation facilities, using loans given by World Bank and other international banks. While strengthening this segment of irrigation the minor irrigation sector, which has been sidelined during 1990s, has been neglected further. The state government in 2004 constituted Jayathi Ghosh Committee to suggest ways and means to rectify the ills that are plaguing minor and medium irrigation sectors. The committee suggested immediate steps to rehabilitate damaged and ill maintained tanks to address water quantity and purity aspects. Unfortunately, nothing substantial has been done to implement these suggestions, even after accepting the basic recommendations of the committee. Since global warming related aberrations have clearly affected the monsoon pattern it is essential to properly store runoff water, after a heavy spell of rain, in medium and minor irrigation tanks. This was not done as many tanks have been damaged during the last 30 to 40 years and rehabilitation of these tanks in a short span of time requires a large scale focused planning and execution practices. Neither the government nor the administrators took needed measures, making the committee`s suggestions confined to archiving section. Similar is the situation in other states of the country. In spite of spending considerable money we are unable to provide sufficient quantities of water for agriculture sector in a sustainable manner, leading to significant setback to the farming community. In the last 3 to 4 years substantial fall is noticed in our food production. In addition the produced product is not stored properly due to lack of storage facilities. In nutshell our inept water management is basically responsible for such a dismal scenario. This situation should be changed to save and use water in a judicious manner. It can be achieved through co-ordinate efforts by all the stake holders, following well established social and technical norms.

Hydrological Cycle, Monsoon Aberrations, Ecosystem and Use of Water

The Eleventh Plan recognized the special challenges of water resources management facing India and the likelihood that these would only intensify over time due to rising population, expected growth in agricultural and industrial demand, the danger of pollution of water bodies and, over the longer term, the effect of climate stress on water availability in many parts of the country. On reviewing these issues in the course of the Mid Term Appraisal (MTA), problems in this area appear even more serious than originally assessed and solutions are almost certainly more difficult. The central message emerging from the MTA is that we cannot expect to find a solution unless we can come out of the silos into which we have divided water and take a holistic view of the hydrologic cycle. For example, responsibility for ensuring adequate availability of water for agricultural use is divided between the Ministry of Water Resources (MoWR), which is responsible for major, medium, and minor irrigation, the Department of Land Resources, which is responsible for watershed management, the Department of Rural Development, which is responsible for the Mahatma Gandhi Rural Employment Guarantee Act (MGNREGA) that is strongly oriented to deal with water conservation issues, and the Department of Agriculture, which deals with water use efficiency. Similarly, rural drinking water is dealt with by the Department of Drinking Water Supply (DDWS) within the Ministry of Rural Development (MoRD), but rural drinking water overwhelmingly relies on groundwater and the sustainability of this source depends crucially on interventions by other players and schemes that lie outside DDWS's purview. As India urbanizes, issues of urban and industrial water supply will gain in importance and demand action by the Ministry of Urban Development (MoUD). Ideally, this should be in close coordination with rural-centred schemes for very oft en they are both tapping the same source of supply. These examples can be multiplied. They all illustrate a common point that we cannot continue to compartmentalize the different uses to which water is put, as these are competing for the same unitary resource (Courtesy: Report on Mid-Term Appraisal of the Eleventh Five Year Plan) [2].

Even though significant strides have been made in better understanding various components of hydrological cycle, we err as our conceptualisation of the subject is vitiated by the boundary conditions that are fixed taking into consideration existing statistics, which cover an insignificant time span when the earth`s origin and evolution of life on the earth are taken into consideration. Nature controls various processes that contribute to the hydrological cycle. If this is not understood or taken into consideration in planning and executing management programs we invariably end up in over/ under shooting the target. It is paramount to note that Nature behaves in a random way and we need to be pragmatic in estimating the impact of Nature's aberrations on our life and our life-saving natural resources, including water.

There is only 3% of usable water on earth that is essential to quench thirst, to provide food and to make commodities. The major segment of Indian population including the highly educated does not know the value of this elixir (water). People assume water is there to be used and misused. They assume if money is spent on constructing dams/ reservoirs, connecting/linking rivers, drilling bore wells to depths beyond 1000 ft even in a granitic terrain one can have sufficient water. In reality this perception is far from the truth [2].

The atmosphere, hydrosphere, terra-sphere, and bio-sphere constitute the eco-system. Man is at the heart of the eco-system and has to be a reference entity for any action plan for the welfare of him. For his well-being, he needs adequate quantity of good quality water. Due to extreme spatial and temporal variability, unfortunately, in many of the densely populated countries (including India), water storage built or made available is dismally low as compared to the more fortunate developed countries, accentuating the problems associated with water scarcity. The approach in meeting with water scarcity in these densely populated countries continues to be supply-oriented bringing water to the people to help them eke out a minimum livelihood and bring them out of the poverty and hunger trap, while taking care of eco-system. In this context the following details assume importance, as the scarcity problem cannot be solved only through technological interventions. Man, privileged and under privileged, needs to change his way of living, looking at the way water resources are dwindling. The callous way of using water resources has to end to arrest further degradation of quality and quantity.

Eastern philosophy emphasizes the basic unity of the universe, and the principle that everything is dynamically inter-connected. The problem is that most base this understanding on a view of nature that is fundamentally different to that espoused by western science. In the West, it is assumed that the basic substance of reality is the material, physical properties of the Universe and the consciousness is an illusion. In the East the basic fabric of the Universe is consciousness, without which nothing can be conceived or experienced. By contrast, it is the material world, physical nature, which is illusionary. Hence, the Eastern conception (especially the Hindu) of the dynamic connection between the attributes of the environment is based on fundamentally different precepts. The Taoism and Neoconfucian School defined human happiness in terms of following natural order and trusting intuitive knowledge. It also formulated the wisdom: It is better to have too little than to have too much, and better to leave things undone than to overdo them. These perceptions remain as good advices in the protection of natural resources, including water. Unfortunately, with the onset of industrial revolution man/human beings (including the Easterners) got intoxicated with materialistic wealth and started meddling with nature, forgetting that Man is an integral part of nature. With time, many contemporary problems, environmental, socio-economic and political surfaced to further deteriorate nature's wellbeing. Uncertainty concerning the direction, scale, magnitude of impacts, interpretation and management of local environmental changes led to large scale disturbances due to both internal and external factors such as air, soil and water pollution, acidification of ecosystems, global change of the climate. These ill effects have led to the presently witnessed misery. Therefore we need to redefine 'happiness' and restructure our priorities to achieve a modicum of success in reversing the environmental degradation. Once this becomes our motto, we can achieve reasonable success in water management. Generally, like religious tolerance, the responsibility of society to nature has been proclaimed by almost all religions. Moreover, in the last decade, this concept of environmental responsibility has been echoed endlessly in state constitutions and countless environmental regulations. Unfortunately, practical action often differs from proclaimed ideals. The credibility of all these documents and regulations is much sapped by the day-to-day compromises of political life, by adverse socio-economic conditions and by the short comings of scientific knowledge, inter-disciplinary understanding of the relationships between natural ecosystems, socio-economic processes and cultural belief systems. Since, such a change is not forthcoming in the foreseeable future, it is essential for water management practitioners to co-ordinate with all the segments of our society and practically exhibit to ordinary people the value of our changed perception of "happiness" in word and deed (some details have been included from Haig [3]. Even though success of such a strategy could be minimal we need to follow this path hoping that it may pave way for a better managed future. To achieve success in this direction all of us need to sacrifice (especially the privileged) and ensure every human being is provided with at least that much quantity of water that is basically essential to eke out a minimum livelihood. On the part of underprivileged they need to keep in mind that water availability is fraught with many hurdles and to get over these hurdles they need to work in unison with under privileged and privileged. This basic change in our approach to scarcity problem should be the central theme for any water management process. An integrated approach based on equity, efficiency, economy, efficacy would lead the water sector to sustainable development with accepted trade-offs between the three props: financial viability, social acceptability, ecologically conservationist strategy. It is time to conceptualize an 'Action Plan' for achieving the goals through such integrated actions. Given the recognition of the serious stress in water availability per capita with an ever growing population, countries like India face a colossal challenge in the decades to come. One of the major options is to focus on recycling waste-water. However, implementation of this requires proper understanding of local and regional socio-economic and environmental conditions. It is also essential, before we opt for recycling waste-water, to look into the existing management scenario and select proper options to make management strategies viable. In the next sub-section, an effort is made to focus on this aspect.

Water Management-Perceptions and Options

Water resource management is the activity of planning, developing, distributing and managing the optimum use of water resources. It is a sub-set of water cycle management. In an ideal world, water resource management planning takes into account all the competing demands for water and seeks to allocate water on an equitable basis to satisfy all uses and demands, but this is rarely possible in practice.

Since water is mainly available due to precipitation and as global warming has significantly altered the monsoon pattern, the management practitioners need to know in depth about intricate dynamics associated with the hydrological cycle, even though the details are science based. Such knowledge helps them take both short and long term decisions. It is essential to note that we cannot take arbitrary management actions as the hydrological cycle is intricately complicate in nature and no set model can bring out the reality in its true color. So, managers should take measures that can address both higher and lower precipitation related abnormalities. Such a management policy should always assume that abnormalities are part and parcel of management strategy [4].

Water management-present scenario

Climate change and other factors external to water management (such as demography, technology, politics, societal values, governance and law) are demonstrating accelerating trends or disruptions. Yet in spite of these challenges and the increasing complexity of dealing with them, we know less about water resources and how they are being used. This creates new risks and uncertainties for water managers and for those who determine the direction of water actions. Fifty years ago, the common perception was that water was an infinite resource. At this time, there was fewer than half the current number of people on the planet. People were not as wealthy as today, consumed fewer calories and ate less meat, so less water was needed to produce their food. They required a third of the volume of water we presently take from rivers. Today, the competition for water resources is much more intense.

This is because there are now seven billion people on the planet, their consumption of water-thirsty meat and vegetables is rising, and there is increasing competition for water from industry, urbanization, biofuel crops, and water reliant food items. In future, even more water will be needed to produce food because the Earth's population is forecast to rise to 9 billion by 2050. An additional 2.5 or 3 billion people, choosing to eat fewer cereals and more meat and vegetables would require additionally a significant quantity of water.

The fourth edition of the United Nations World Water Development Report, Managing Water under Uncertainty and Risk, brings these issues to the forefront.

In response to this challenge, the United Nations World Water Assessment Programme has launched two parallel initiatives: Indicators and Supporting Monitoring for the United Nations World Water Development Report, a project to gather the data for use in indicators to facilitate the task of decision-makers, and the World Water Scenarios Project, a set of alternative futures of the world's water and its use to 2050.

More than 10 years have passed since the last set of global water scenarios was developed under the sponsorship of the World Water Council, during preparation of the World Water Vision. Since then, technology and socio-economic conditions in the world have altered dramatically, both inside and outside the water sector, and change continues to accelerate. New policy initiatives such as the Millennium Development Goals have also since emerged. Scenarios being developed in other sectors provide new links to explore, and new tools have become available to develop stronger scenarios reinforced by analysis through models at national and sub-national levels. The approach for developing the new set of scenarios will be similar to the method followed for the World Water Vision: an iterative process of building qualitative scenarios and constructing simulation models, in which a Scenario Focus Group (SFG) engages with scenario experts, stakeholders, data experts, modelers and decision-makers. Scenarios will be chosen to be useful to all decision-makers, including those at sub-global levels that present different characteristics in terms of the degree of law and order, financial systems or human and institutional capacity. Contacts will be maintained throughout the three phases with other organizations who may be doing scenario work in parallel [5].

The objectives of the SFG are to:

- Develop a second generation of global scenarios to support linkages between socio-economic anticipatory decision-making and the global water system, including the identification of major risks and opportunities and alternative futures, and to provide a perspective for individual national and sub-national scenario building.
- Provide an interdisciplinary articulation of the current scientific understanding of the global water system, including major uncertainties and principal areas of agreement, using qualitative descriptions and quantitative projections, expert opinion and analysis of available information.
- Support scenario building at the national and sub-national scales, which will inform the global process and stimulate the interchange of experiences, mutual learning and reciprocal capacity-building among the interested groups. (UN Report–2013).

Water management in India

Water is a natural resource, fundamental to life, livelihood, food security and sustainable development. It is also a scarce resource. India has more than 17% of the world's population, but only 4% of world`s renewable water resources with 2.6% of world's land area. As per present estimate, India receives, on an annual average, precipitation of about 4000 Billion Cubic Meter (BCM), which is its basic water resource. Out of this, after considering the natural evaporation-transpiration, only about 1869 (BCM) is average annual natural flow through rivers and aquifers. Due to spatial-temporal variations, an estimated 690 BCM of surface water is utilizable. Add to this we have 432 BCM of replenishable ground water. In total we have only about 1122 BCM of water that is utilizable through the present strategies, if large inter-basin transfers are not considered.

Thus, the availability of water is limited but the demand of water is increasing rapidly due to growing population, rapid urbanization, rapid industrialization and economic development. In addition, there are inequalities in distribution and lack of a unified perspective in planning, management and use of water resources. India's Union Ministry has come up recently with revised national water policy for the Improvement of water use efficiency, urban and rural water supply and sanitation. It is advocated that this revised policy will give a new opportunity to private players for implementation of new technologies in water supply and sanitation. Water is required for domestic, agricultural, hydro-power, thermal power, navigation, recreation, etc. Utilization in all these diverse uses of water should be optimized and an awareness of water as a scarce resource should be fostered. The Centre, the States and the local bodies (governance institutions) must ensure access to a minimum quantity of potable water for essential health and hygiene to all its citizens, available within easy reach of the household. As of now the management at ground level, unfortunately, is chaotic as both the managers and the managed do not have a common platform/ mechanism to weed out deficiencies [4].

What is needed?

- We ought to use the eco-natural resources (especially water) as a gift from nature and use them with prudence. Fresh water as a natural resource is not owned by anybody; there is a very clear need to strike tradeoffs amongst the beneficiaries of the system, and it is the same between the three vital components of sustainable development viz., financial viability, social acceptability in light of livelihood status, and eco-conservation.
- There is a strong necessity for multi-sectorial integrated water resources development and management considering drainage basin as a whole or a sub-basin as a hydrological unit taking into account, both surface and ground water for sustainable development. The optimal conjunctive use of the region's surface and ground water resources would help in minimizing the problems of water logging and ground water mining. The water resources management practices should be based on increasing the water supply managing the water demand under the stressed water availability conditions.
- The planning and management for drought mitigation appear to have a low priority due to associated randomness and uncertainty in defining the beginning and end of droughts. Further, most of the drought planning and management schemes are generally launched after persisting drought conditions – a misguided strategy.

- An environmental flow is the water regime provided within a river, wetland or coastal zone to maintain ecosystem and their benefits where there are competing water uses and where flows are regulated. These loads are known to be massive in many Indian basins.

- It is desirable to accept and show humility in the face of the complexities of nature, admit the limitations of our knowledge, and help the public use this information to make a complex set of choices to which there are no unique or correct answers. This is very essential in water management, as our endeavors should be to lessen the options and help the ordinary people in selecting the best possible rather than creating a situation that is detrimental to the man and the environment.

- Identify the surface water bodies that are feeding the urban population and ensure longevity of such structures by eliminating water inflow obstructions built in the catchment areas in the name of artificial recharging facilities. Evict encroachments that have clogged/ damaged the water bodies. In other words, rehabilitate all the tanks that have been existing prior to urban construction boom. Regularly de-silt such water bodies and ensure pollution-free environment.

- Strict quality control in planning, designing and erecting artificial recharging structures like check dams, sub-surface dykes, percolation tanks, etc. As a first step a monitoring system has to be evolved that can ensure quality control both in planning and executing these works usually taken up as time bound programs. Since human species have a moral duty to protect bio-diversity, through a sufficient water to maintain flora and fauna, it is extremely essential to either allocate a defined quantity of water or at least divert used water (after treatment) for this purpose by developing parks in each and every village as a part of developmental programs.

- Domestic sewage is the major source of pollution in India in surface water which contributes pathogens, the main source of water borne diseases along with depletion of oxygen in water bodies. Sewage, agricultural run-off and industrial effluents contribute large amount of nutrients in surface water causing eutrophication. In view of this, the management strategies should be to give priority to lessen this pollution by technological interventions and educating the common man regarding the negative impacts of these pollutants on the well being of Man and the Environment.

- Reduce water consumption use through better crop management breeding of new plants with traits of lower water consumption and higher drought resistance and salt tolerance. Reduce waste in the irrigation system at the storage, distribution and field application levels through the use of water-saving techniques and devices. Recycle and reuse of water and waste water for irrigation without endangering soil and water quality, human health or habitat bio-diversity. Eradicate salinity and water logging of affected irrigation lands and protect the rest through proper drainage and application of integrated land and water management. Broaden the education of new professionals to induce a multi-disciplinary approach to water management practices by reforming the education system. Practice the devolution of power in water management by empowering the users to manage their systems under proper guidance and training from various institutions. Drainage and flood control practices shall preserve the quality of water discharged and conserve bio-diversity of the habitats. Enhance the capacity to carry out R&D to develop the needed technologies to save water and energy while meeting other objectives.

- Affluent countries regard waste water treatment as vital to protect human health and prevent the contamination of lakes and rivers. For developing countries, this solution is still prohibitively expensive and the 'zero pollutant return' is still a dream. In this case, applying waste water to agricultural lands is a more economical alternative and is a better ecological solution than the 'uncontrolled dumping of municipal and industrial effluents into pits, low lying areas and pits, streams and lakes'. R&D should come up and establish the right choice and meet health standards for quality of produce.

Conclusions

It is evident from the existing water scenario that global warming related monsoon abnormalities have made the water management a difficult exercise. To overcome some of the problems that are within our reach, it is essential to take into consideration the local population in safeguarding the quality of waters, and in better storing the available waters using proper technological interventions. It is clearly established that abnormalities in the hydrological cycle have increased leading to floods, flash-floods and droughts. Since population growth has become exponential in the last couple of decades and various factors are not helping in controlling the population growth, the water management experts have to prepare action-plans taking into consideration the probable degradation of existing water scenario in the coming decades. One of the options is to recycle used water and proper utilization of waste water. If this is done taking all the quality norms into consideration, we can solve the scarcity problem to a reasonable extent. However, waste water management requires a different strategy compared to the normal water management. It is essential to take into account financial, socio-economic and environmental factors in making waste water management a reliable solution. Management experts need to understand the intricate connection between man and nature and finer details of hydrological cycle as such information is vital in planning and executing both short-term and long-term management strategies. It is clearly established that various extraneous factors do influence the management and as such one has to be prepared to take apt on-spot decisions that are relevant spatially and temporally.

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