New Challenges in Water Management By Introducing Concept of "Cycle Capacity"

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Rainwater Harvesting And Utilisation

1] Introduction

Water is a scarce but essential resource that is under increasing pressure. According to the UN, the global water consumption will increase by 30 per cent by 2030 due to population growth and increased wealth. It has therefore never been more important to find new solutions, and climate changes only increase the need for proper management of water resources.

In most urban areas, population is increasing rapidly and the issue of supplying adequate water to meet societal needs and to ensure equity in access to water is one of the most urgent and significant challenges faced by decision-makers.

With respect to the physical alternatives to fulfil sustainable management of freshwater, there are two solutions: finding alternate or additional water resources using conventional centralised approaches; or better utilising the limited amount of water resources available in a more efficient way. To date, much attention has been given to the first option and only limited attention has been given to optimising water management systems.

Among the various alternative technologies to augment freshwater resources, rainwater harvesting and utilisation is a decentralised, environmentally sound solution, which can avoid many environmental problems often caused in conventional large-scale projects using centralised approaches.

Rainwater harvesting, in its broadest sense, is a technology used for collecting and storing rainwater for human use from rooftops, land surfaces or rock catchments using simple techniques such as jars and pots as well as engineered techniques. Rainwater harvesting has been practiced for more than 4,000 years, owing to the temporal and spatial variability of rainfall. It is an important water source in many areas with significant rainfall but lacking any kind of conventional, centralised supply system. It is also a good option in areas where good quality fresh surface water or ground water is lacking. The application of appropriate rainwater harvesting technology is important for the utilisation of rainwater as a water resource.

1.1 Advantages of Rainwater Harvesting

Rainwater harvesting systems can provide water at or near the point where water is needed or used. The systems can be both owner and utility operated and managed. Rainwater collected using existing structures (i.e., rooftops, parking lots, playgrounds, parks, ponds, flood plains, etc.). has few negative environmental impacts compared to other technologies for water resources development. Rainwater is relatively clean and the quality is usually acceptable for many purposes with little or even no treatment. The physical and chemical properties of rainwater are usually superior to sources of groundwater that may have been subjected to contamination.

1.2 Some Other Advantages of Rainwater Harvesting Include:

a. Rainwater harvesting can co-exist with and provide a good supplement to other water sources and utility systems, thus relieving pressure on other water sources.
b. Rainwater harvesting provides a water supply buffer for use in times of emergency or breakdown of the public water supply systems, particularly during natural disasters.
c. Rainwater harvesting can reduce storm drainage load and flooding in city streets.
d. Users of rainwater are usually the owners who operate and manage the catchment system, hence, they are more likely to exercise water conservation because they know how much water is in storage and they will try to prevent the storage tank from drying up.
e. Rainwater harvesting technologies are flexible and can be built to meet almost any requirements. Construction, operation, and maintenance are not labour intensive.

2] General Description of the Technology

Historical Development of Rainwater Harvesting and Utilisation

Rainwater harvesting and utilisation systems have been used since ancient times and evidence of roof catchment systems date back to early Roman times. Roman villas and even whole cities were designed to take advantage of rainwater as the principal water source for drinking and domestic purposes since at least 2000 B.C. in the Negev desert in Israel, tanks for storing runoff from hillsides for both domestic and agricultural purposes have allowed habitation and cultivation in areas with as little as 100mm of rain per year. The earliest known evidence of the use of the technology in Africa comes from northern Egypt, where tanks ranging from 200-2000m^3 have been used for at least 2000 years - many are still operational today.

2.1 Types of Rainwater Harvesting Systems

Typically, a rainwater harvesting system consists of three basic elements: the collection system, the conveyance system, and the storage system. Collection systems can vary from simple types within a household to bigger systems where a large catchment area contributes to an impounding reservoir from which water is either gravitated or pumped to water treatment plants. The categorisation of rainwater harvesting systems depends on factors like the size and nature of the catchment areas and whether the systems are in urban or rural settings. Some of the systems are described below.

(i) Simple roof water collection systems
(ii) Larger systems for educational institutions, stadiums, airports, and other facilities
(iii) Roof water collection systems for high-rise buildings in urbanised areas
(iv) Land surface catchments
(v) Collection of storm water in urbanised catchments

3.0 How Can Rainwater Harvesting and Utilisation Contribute to a Sustainable Water Strategy?

Many cities around the world obtain their water from great distances often over 100 km away. But this practice of increasing dependence on the upper streams of the water resource supply area is not sustainable. Building dams in the upper watershed often means submerging houses, fields and wooded areas. It can also cause significant socio-economic and cultural impacts in the affected communities. In addition, some existing dams have been gradually filling with silt. If not properly maintained by removing these sediments, the quantity of water collected may be significantly reduced.

3.1 Restoring the Hydrological Cycle

Due to the rapid pace of urbanisation, many of the world's large cities are facing problems with urban floods. The natural hydrological cycle manifests itself at different scales, depending upon climatic, geographic and biological factors.

Concrete and asphalt have a profound impact on the ecology of the city. These include:

- Drying of the city- This happens as rivers and watercourses are covered, natural springs dryup, and greenery is cut down.
- Heat pollution- In some cities during the hot summer, an asphalt road at midday can reach temperatures of over 60°C. The heat expelled from air conditioners can further aggravate this.

This dramatically alters the city's natural hydrological cycle and ecological environment.

In order to achieve a comprehensive solution to this problem, new approaches to urban development are required emphasising sustainability and the restoration of the urban hydrological cycle. Traditionally, storm sewer facilities have been developed based on the assumption that the amount of rainwater drained away will have to be increased. From the standpoint of preserving or restoring the natural water cycle, it is important to retain rainwater and to facilitate its permeation by preserving natural groundcover and greenery.

3.2 Introducing the Concept of "Cycle Capacity"

In thinking about sustainable development, one must view environmental capacity from a dynamic perspective and consider the time required for the restoration of the hydrological cycle. "Cycle capacity' refers to the time that nature needs revive the hydrological cycle. The use of groundwater should be considered from the point of view of cycle capacity. Rain seeps underground and overtime becomes shallow stratum groundwater. Then, over a very long period of time, it becomes deep stratum groundwater. For sustainable use of groundwater, it is necessary to consider the storage capacity for groundwater over time. If this is neglected and groundwater is extracted too quickly, it will disappear within a short time.

3.3 Case Study of Upper Wardha River Project for concept of "Cycle Capacity" :

Case study of Upper Wardha Project Dam (Major) for Rain Water harvesting though irrigation canal for increasing the existing ground water level gradually during the raining season.

Upper Wardha River Dam is situated in Simbhora Village Tahasil Morshi, Dist. Amravati 55.0 Km. from Amravati (M.S.) on Topo-Sheet No. 55/K/3,

Latitude	210-16'-18" (N),
Longitude	780-03'-27" (E)
Catchment Area	4302 Sq.Km. (Mah. 2957 Sq.km. + M.P. 1345 Sq.Km)

Water Storage

i)	75% Dependability	500.72 Tmc.
ii)	U/s water Reservation	368.152 Tmc. (M.P. – 156.548 Tmc M.S. – 161.604 Tmc.)
iii)	Total yield	327.468 Tmc.
iv)	Water Utilization	
	Irrigation	200.203 Tmc.

Drinking purpose	77.329 Tmc.
Industrial use	24.735 Tmc.
+ Thermal Power Project	123.52 Tmc.
Evaporation Losses	68.535 Tmc.
Total	370.802 Tmc.

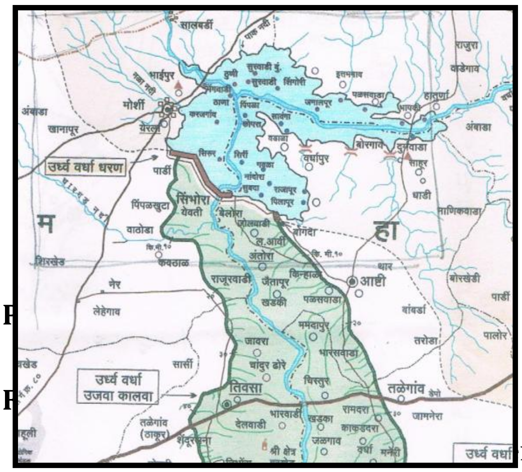
v) Water Storage Capacity

Total Storage	678.27 Tmc
Live Storage	564.05 Tmc.
Dead Storage	114.22 Tmc.

Type of Dam	Earthen + Masonry + Concrete (Composit) Dam.
Length of Dam	5588.5 m + 331.50 m
Height of Dam	39.90 m

Water supply to following village

Morshi, Warud, Amravati, Badnera, Railway Station, Hiwarkhed + 11 villages, Loni + 14 villages, Amravati Industrial area (Nandgaon Peth), Thermal Power Station at Nandgaon Peth.



me inevitable consequence of climate change.

Mast natural disasters associated with climate change will be water related either too little, resulting in droughts; or too much, resulting in widespread flooding. The question is, how do we learn to live with these events, not to mention minimizing the inherent environmental and social damages.

The technological innovation needed to respond lo disasters such as flooding include tools for early warning, prediction, planning and monitoring. Although it may be impossible to avoid floods entirely partly. We developed solutions for preparing for and mitigating the effects of these natural disasters.

During the raining seasons and heavy flood situation the excess rain water instead of passing through the waste weir the same should be controlled and discharge through the main canal of the project before increasing the water level to the F.T.L. of the weir which indirectly controlled the heavy flood situation on D/s side village and over flooding the streams and local nalla on D/s river which controls and safe guards the situation during the disaster position. The open well + field tanks and other low lying small ground pockets will be refilled with rainy water which charges the ground water level through water harvesting.

By adopting the water saving procedure which will be useful during the hot weather period for drinking and irrigation purposes and changes to green revolution, through water resources in National Development and thus contribute to poverty reduction, human health and economics prosperity.

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