International Journal of Advance Research and Innovation
Vol. 5(2), Apr-Jun 2017, pp. 69-74
Doi: 10.51976/ijari.521713

Article Info
Received: 25 Jan 2017 | Revised Submission: 20 Feb 2017 | Accepted: 28 Feb 2017 | Available Online: 15 Jun 2017

Ecological Benefits of Reviving Urban Water Bodies using Rainwater Harvesting

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ABSTRACT

Water bodies across India are facing a myriad of ecological challenges due to rapid industrialization and urbanization. As India continues to develop, focus is shifting from preservation and conservation of natural resources to greater economic growth. Issues likeloss of watershed, increasing pollution levels, deteriorating water balance, encroachment and illegal constructions have led to a reduction in the number of urban water bodies and a dire lack of groundwater recharge has impacted the health of existing water bodies over time. Such issues coincide with an influx of population in India's cities leading to an increase in demand of water resources for personal consumption and for industry. To cater to this rising demand for water across India, augmenting the number of water bodies and improving their health is crucial from a public health and ecological perspective. Water bodies like ponds and lakes provide various ecosystem services that are required to manage microclimate, biodiversity and nutrient cycling. In the Indian context, millions rely on these ecological services provided by water bodies and historically rainwater harvesting has been used as an easy, low-cost and locally adoptable technique to maintain water storage. Its application to revive water bodies can help revitalise water bodies and provide ecological benefits in the process. Implementation of community water management schemes with maximum people's participation is crucial to ensure the success of such schemes. Similar studies across India and the world lay precedent for such practices and can ameliorate the water shortages faced at a micro level in today's day and age.

Keywords: *Rainwater Harvesting; Ecosystem services; Groundwater Recharging; Integrated Water Resource Management (IWRM).*

1.0 Introduction

Urban Indian cities are facing a water crisis due to loss of watershed, increasing levels of pollution, deteriorating water balance, lowering of water table and a dire lack of groundwater recharge [1]. Such issues have become a great concern in the Indian context which motivated the Indian Government's Twelfth Five Year Plan to launch a completely revamped programme on Repair, Renovation and Restoration (RRR) of water bodies [2]. Increasingly, the government and civil society are rediscovering the ecological benefits provided by healthy water bodies and there is a growing movement to revive urban water bodies. Water determines the full potential of any country [3]. Optimum development and efficient utilization of water resources becomes paramount in a country like India which has an ever-rising populace and a seemingly insatiable water demand. However, today the biodiversity of lake and pond ecosystems is increasingly threatened by anthropogenic activities – may it be due to industrialization by-products, pollution or urbanization[4].

Even before tackling the sustainability conundrum, there is a lot of debate about how to best define a water body such as ponds and lakes. Any depression in the ground which collects and retains adequate precipitation can be considered as a lake or pond based on the size of the water body. Both ponds and lakes catch and conserve rainwater, which can percolate into the soil and help in recharging the groundwater level. The water from ponds and lakes can be used for a variety of purposes for both human and animal consumption, for irrigation, recreational purposes etc. Water

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bodies can be formed due to geological and ecological events of different varieties. They can also be artificially created to induce the positive effects of water bodies, such as sustaining life at many levels and helping to maintain the biodiversity of a region.

In rural areas, ponds and lakes perform significant environmental, social and economic functions, ranging from being a source of drinking water, recharging groundwater, acting as sponges to control flooding, supporting biodiversity and providing livelihoods. These water bodies, whether manmade or natural, fresh water or brackish play a vital role inmaintaining environmental sustainability[5]. Although the role of water bodies in urban spaces is less clearly defined, there is scientific consensus that they provide invaluable ecosystem services and any urban space must have a balance between urbanisation and green and blue spaces to be

2.0 Status of Water Bodies in India

India is known for its diversity and houses a wide range of water bodies across its length and breadth in a vast variety of climates. The water impoundments include natural lakes, wetlands and coastal lagoons, as well as constructed reservoirs and tanks. The enormity of conducting a thorough survey of the lakes and ponds across India isn't lost on city planners and there isn't conclusive data on the same on a national level. However, it is possible to discuss the general conditions in which water management is carried out in India in the recent past and its current status. Water bodies all over the country are exhibiting varying degrees of environmental degradation caused by encroachments, eutrophication and siltation. High population density places direct pressure on the catchments of water bodies. While there are efforts to address these issues, the ground reality points toward a decline in the number of water bodies. Local people lack the knowledge to restore water bodies and delays in restoration cause irreparable damage to the health of water bodies. A lack of coordination among different governmental agencies, ineffectiveness of legislation and the over compassing lack of an integrated approach to water management are the challenges that are faced in reviving water bodies in urban areas. Encroachment is a major reason for loss of water bodies. In the process, water bodies are drained and the area is reclaimed for constructional purposes. Such activities contribute to a loss of heritage and a loss of biodiversity including disappearance of plant, avian and fish species. In the case of lack of maintenance of existing water bodies there is a dire impact on public health. Incidences of waterborne diseases like jaundice, typhoid and gastroenteritis rise and vector transmitted diseases like malaria also increase among the population living near the area. Additionally, in many Indian lakes that are considered famous, uncontrolled pressure and pollution from tourists has resulted in disturbance to the biodiversity of flora and fauna, which thrive on the lake [6].

2.1 Importance of Water Bodies in the Indian Context

Historically in India, tanks (tankas), ponds (johads, taalab) and lakes (taal) have always played an important role in irrigation, supplying drinking water, ecology, tourism/culture and domestic use. Over the centuries, people India have used basic engineering skills to develop a wide variety of techniques to meet their water needs. Over time, there has been a shift away from traditional knowledge and traditional water management practices in both rural and urban areas.Perhaps, in part decades of British rule is to blame for negatively impacting water based knowledge leading to a severe disruption of water management structures.

In countries where poverty and inequality are rampant such as developing and least developing countries, people are more directly dependent on ecosystem services as their lives are more intimately related to nature and natural resources. Such a scenario makes them highly vulnerable when natural ecosystems are degraded [7]. Increased water stress has a profound impact on food production and India is already struggling to be food secure. In such a scenario there is a pressing need to revive traditional water management systems to reduce social vulnerabilities and safeguard agricultural and environmental cycles. To achieve this, restoration of streams in urban areas and study and management of such designed ecosystems as unique ecosystems are advocated, with the aim of optimizing services to urban populations [8].

3.0 Rainwater Harvesting in India

The practice of rainwater harvesting and reusing stored water for domestic purposes has been prevalent in India since ancient times[3, 9]. Historically, settlements grew around temples, and over time temples and tanks became nearly inseparable. Evidence of tank irrigation in Tamil Nadu dates back to the Sangam period of 150 BC to 200 AD, and by the early medieval period (750−1300), tank irrigation was thriving throughout the region[10].

Efficient management of water in traditional farming systems like Kattas and Surangams in North Kerala and Karnataka, Zabo system of Nagaland and Bamboo drip irrigation of Meghalaya and Apatani valley in Arunachal Pradesh can be found all through India [11], where rainwater harvesting and water resource management has been an integral part of communities since centuries.

Usage of rainwater harvesting in recent times in areas like North East India [12] and Kerala [3] have shown immense potential for its applications in other parts of the country and proven its importance in ecosystem revival [13]. In fact, rainwater harvesting in South Asia differs from the rest of the world as it has a history of continuous practice for at least the last 8000 years [14]. Further, an integrated perspective of traditional knowledge on adaptation strategies, such as the rainwater harvesting system is particularly useful to comprehend vulnerability and adaptation to environmental stresses at the local scale.

Rainwater harvesting and storage are important mechanisms for adapting to climate change and are in use in parts of Africa that are currently experiencing high variability of rainfall [15]. Climate change stands to affect India adversely in the coming years due to our sizable population and rising demand for resources and hence revival and rejuvenation of water bodies in Indian cities is crucial. As climate extremes increase, rainwater harvesting can be used as mechanism to build the resilience of societies towards uncertainties. Utilizing sound knowledge of historical adaptive processes can help in learning and developing future tools to combat climate vulnerabilities [14].

In the light of such evidence, organisations are increasingly engaged in promoting 'traditional' water harvesting systems for enhancing sustainability, reducing vulnerabilities or even drought-proofing semiarid regions of the countryside [16]. This approach needs to be introduced to India's urban spaces to replicate the positive impacts on communities and ecology.

3.1 Use of rainwater harvesting to revive water bodies

Recent initiatives, both at community and government level, have made use of long neglected water harvesting traditions. The results show that reviving water harvesting systems stimulate rural development and restores local ecosystems[17]. The positive effects of such schemes have found to surpass economic benefits as they impact the public health positively. Further, helping people become self-reliant by improving their local natural resource base is a viable and effective strategy for poverty alleviation.

In urban areas, rainwater will have to be harvested using rooftops and open spaces. Harvesting rainwater not only reduces the possibility of flooding, but also decreases the community's dependence on groundwater for domestic uses.

Apart from bridging the demand–supply gap, recharging improves the quality of groundwater, raises the water table in wells/bore-wells and prevents choking of drains. Energy to pump groundwater is also saved as the water table rises [18].

Use of rainwater harvesting in Sukhomajri village in Chandigarh wherevillagers built small tanks to capture rainwater, erstwhile drought-struck Ralegan Siddhi village in Maharashtra where locals constructed storage ponds, reservoirs and gully plugs to combat drought and River Arvari in drought-prone Rajasthan which was brought back to life by rainwater harvesting are instances of water bodies being revitalised by the power of rainwater harvesting [17].

Achieving such success in urban spaces is a different ballgame but has been attempted by different methodologies. The restoration of HauzKhas lake in New Delhi lays precedent that water bodies in urban areas can be restored and developed into functional ecosystems [19]. The success of HauzKhas lake has shown that restoration

of ecosystem services garners public support and necessitates public participation. Such restoration efforts could be extended to other water bodies in Delhi and to urban water bodies across the country.

4.0 Ecosystems and their Services

Ecosystem services are the benefits people obtain from ecosystems. These include provisioning services such as food and water; regulating services such as flood and disease control; cultural services such as spiritual, recreational, and cultural benefits; and supporting services, such as nutrient cycling, that maintain the conditions for life on Earth[20]. These services are more than just goods, and include critical life-supporting services or processes, which are commonly neglected or taken for granted by society as an economic valuation isn't granted to them [21].

Economic valuation of ecosystem services and biodiversity can make explicit to society in general and policy making in particular, that biodiversity and ecosystem services are scarce and that their depreciation or degradation has associated costs to society. If these costs are not imputed, then policy would be misguided and society would be worse off due to misallocation of resources [22]. In fact, restoration costs more in the long-run than using resources judiciously.

Ecosystem services are valuated in a manner of ways and it has been found that hybridising methods leads to removing an individual method's drawbacks.

While social, economic and cultural parameters are considered for finding appropriate valuations, involving the viewpoints of stakeholders in the process leads to more meaningful results. An assessment of the condition of ecosystems, the provision of services, and their relation to human well-being requires an integrated approach. This enables a decision process to determine which service or set of services is valued most highly and how to develop approaches to maintain services by managing the system sustainably [20].

In a nutshell, economies of the worldare reliant on ecological life-support systems and in that manner the value of ecological services can be considered asinfinite. As natural resources and ecosystem services become more stressed and scarce, their value is bound to increase. If and when (judging by the current trend of consumption) tolerable thresholds for irreplaceable ecosystem services are breached, their value will tend to infinity. Owing to such dependence on current and future trends and practices, huge uncertainties are involved in the precise estimation of the value of ecosystem services[23].

4.1 Ecosystem services provided by water bodies

Ecosystem services are categorised primarily as provisioning and regulating services. Provisioning services are products directly or indirectly obtained from an ecosystem. Water bodies provide fresh water which can be used for a variety of purposes. Regulating services on the other hand, are benefits obtained from regulation of ecological processes. Fresh water can be considered an example of linkages between provisioning and regulating services [23], as fresh water is both a product and a regulating factor.

Water bodies participate in core ecosystem processes likewater cycling and carry outecosystem functionssuch as water provisioning, purification and regulation[22]. They also provide regulating services like climate regulation, water regulation, erosion control, etc. One of the crucial services is water purification and waste treatment. Ecosystems can be a source of impurities in fresh water but also can help to filter out and decompose organic wastes introduced into inland waters and coastal and marine ecosystems. They can also help in the regulation of human diseases. Changes in ecosystems can directly change the abundance of human pathogens, such as cholera, and can alter the abundance of disease vectors, such as mosquitoes.

In addition to these services, water bodies also provide a range of invaluable cultural services These are the nonmaterial benefits people obtain from ecosystems through spiritual enrichment, cognitive development, reflection, recreation, and aesthetic experiences.

To encompass the above, supporting services are those that are necessary for the production of all other ecosystem services. They differ from provisioning, regulating, and cultural services in that their impacts on people are either indirect or occur over a very long time, whereas changes in the other categories have relatively direct and short-term impacts on people.

5.0 Conclusions

As new environmental threats are predicted to become threats to all freshwater systems, it is necessary to augment the water quantity available in urban cities through natural methods like rainwater harvesting. For a model like this to work, it is crucial for local people to collaborate with other stakeholders to successfully utilise resources and ensure the protection and conservation of green and blue spaces in cities. Further, implementation of integrated water resource management strategies are essential to maintain, augment and manage India's water resources.

Ecosystem restoration has proven critical in returning ecosystem goods and services, when there is positive recovery (Bosire, 2010), and hence there is hope that carrying out pond and lake revival still has innumerable merits for biotic and abiotic components of an ecosystem. The ecological benefits of such an undertaking and substantial and civil society and governmental agencies should join forces to ensure such activities are promoted.

References

[1.] R Singh. Conserving Waterscapes in Context of Urban Delhi. Natural Heritage Division, Intach, 2012.

[2.] M Shah. Water: Towards a Paradigm Shift in the Twelfth Plan'. Economic & Political Weekly, XLVIII (3), 2013.

[3.] MP Samuel, A Mathew. Rejuvenation of Water Bodies by Adopting Rainwater Harvesting and Groundwater Recharging Practices in Catchment Area- A Case Study. The 12th World Lake Conference, 1997, 766–776.

[4.] L Christer, B Hansson. Environmental Threats to Lake and Pond Ecosystems, 2002.

[5.] R Reddy, VB Rao, C Sarala. Proceedings of 4th International Conference on Hydrology and Watershed Management (ICHWAM-2014): With a focal theme on ecosystem resilience-rural and urban water requirements, 29th October - 1st November, 2014.

[6.] MS Reddy, NVV Char. Management of Lakes in India'. Ministry of Water Resources, 2004.

[7.] World Resources Insitute. The Wealth of the Poor: Managing Ecosystems to Fight Poverty. United Nations Development Programme United Nations Environment Programme World Bank World Resources Institute, 2005.

[8.] NB Grimm, SH Faeth, NE Golubiewski, CL Redman, J Wu, X Bai, JM Briggs. Global change and the ecology of cities. Science New York, 319 (5864), 2008, 756–760.

[9.] Ministry of Water Resources, GOI. Guidelines for the Continuation of Scheme on Repair, Renovation and Restoration (RRR) of Water Bodies in XIIth Plan, 2013.

[10.] KJ Van Meter, NB Basu, E Tate, J Wyckoff. Monsoon harvests, The living legacies of rainwater harvesting systems in South India. Environmental Science and Technology, 48(8), 2014, 4217–4225.

[11.] S Narain, A Agarwal. Dying wisdom : rise, fall and potential of India's traditional water harvesting systems. Center for Science and Environ, 1997.

[12.] SV Ngaachan. Rainwater Harvesting and its Diversified Uses for Sustainable Livelihood Support in NEH Region of India, ICAR Research Complex for NEH Region 2005.

[13.] M Armar-Klemesu. Urban Agriculture and Food Security, Nutrition and Health. Urban Agriculture and Food Security, Nutrition and Health, 2000, 99–117.

[14.] DN Pandey, AK Gupta, DM Anderson. Rainwater harvesting as an adaptation to climate change. Current Science, 85(1), 2003, 46–59.

[15.] E Boelee, M Yohannes, M Mccartney, P Cecchi, S Kibret, F Hagos, H Laamrani. Options for water storage and rainwater harvesting to improve health and resilience against climate change in Africa 2020, 2013, 509–519.

[16.] S Gupta. Demystifying 'Tradition': The Politics of Rainwater Harvesting in Rural Rajasthan, India. Water Alternatives, 4(3), 2011, 347–364.

[17.] Agarwal, A., & Narain, S. (2000). Water harvesting : community-led natural resource management. International Institute for Environment and Development.

[18.] R Kumar,RD, Singh, KD Sharma. Water Resources of India. Current Science, 89(5), 2005, 794–811.

[19.] R Singh, M Bhatnagar. Urban Lakes and Wetlands: Opportunities and Challenges in Indian Cities-Case Study of Delhi. In 12th edition of the World Wide Workshop for Young Environmental Scientists-Urban Waters: Resource or Risks? 2012

[20.] J Alcamo, EM Bennett. Ecosystems and their Services'. Ecosystems and Human Well-Being: A Framework for Assessment, 2003, 49–70.

[21.] J Bosire. Scientific Understanding of Ecosystem Services. Western Indian Ocean, 3(1), 2010, 21–23.

[22.] U Pascual, R Muradian, L Brander,E Gómez-baggethun, B Martín-lópez, M Verma, RK Turner. The Economics of Valuing Ecosystem Services and Biodiversity. The Economics of Ecosystems and Biodiversity: Ecological and Economic Foundations, (March), 2010, 183–255.

[23.] R Costanza, R Arge, R De Groot, S Farberk, M Grasso, B Hannon, P Suttonkk. The Value of the World's Ecosystem Services and Natural Capital'. Nature, 387, 1997, 253–260.