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STUDIES OF WATERSHED MANAGEMENT

Pagar Ajay[1], Shelke Ashish[2], Ghule Pavan[3], Prof.Sanap S.T[4]

Student of Department of Civil Engineering,S.N.D College of Engineering & Research Center,Yeola[1]

Student of Department of Civil Engineering,S.N.D College of Engineering & Research Center,Yeola[2]

Student of Department of Civil Engineering,S.N.D College of Engineering & Research Center,Yeola[3]

Professor, Department of Civil Engineering,S.N.D College of Engineering & Research Center,Yeola[4]

Abstract: Watershed management can be said as a concept which recognizes the judicious management of three basic resources of soil water and vegetation, on watershed basis, for achieving particular objective for the wellbeing of the people. It includes treatment of land most suitable biological as well as engineering measures. The watershed aims, ultimately, at improving standards of living of common people in the basin by increasing their earning capacity, by offering facilities such as electricity, drinking water, irrigation water, freedom from fears of floods, droughts etc. One of the important aspects of watershed development is increasing groundwater recharge. For effective watershed development it is important to look at the manner in which water flows below the ground in aquifers, which are layers of rock in which groundwater is stored and through which it moves to wells and springs. Understanding aquifers helps locate water conservation structures appropriately.

Keyword- Rainwater harvesting, first flush mechanism, Roof water system, Gutter for conveyance, Underground RCC tank, Methods of distribution of harvested rainwater.

1. INTRODUCTION

A watershed can be defined as an independent hydrological unit based on the principle of proper management of all the precipitation by way of collection, storage and efficient utilization of run-off water and use of groundwater that discharge to and receive discharge from streams, wetlands, ponds and lakes. A watershed may vary from a few hectares to several thousands of hectares. Watershed is thus the land and water area, which contributes runoff to a common point. It comprises of a catchment area (recharge area), a command area (transition area) and delta area (discharge area). A watershed is, thus a logical unit for planning optimal development of its soil, water and biomass resources. Watershed could be described as fan shaped (near circular) or fen shaped (elongated). Hydro logically, the shape of the watershed important because it controls the time taken for the runoff to concentrate at the outlet.

Watershed management can also be said as a concept which recognizes the judicious management of three basic resources of soil water and vegetation, on watershed basis, for achieving particular objective for the well being of the people. It includes treatment of land most suitable biological as well as engineering measures.

Water is an important element for all human beings in the world. Our body consists mostly of water. We need water for drinking, cooking, washing, agriculture and to run our industries. We usually take it for granted because of its availability; but when in scarcity it becomes our most precious resource. Every raindrop that falls from the cloud is very soft and the cleanest water sources in this world. Rainwater is a part of hydrologic cycle; the never-ending exchange of water from the atmosphere to the ocean and back again as rainwater. The precipitation like hail, rain, sleet, snow and all the consequently movement of water in nature forms are from part of this cycle.

Rainwater can be captured by using the rainwater harvesting system. Generally, rainwater harvesting system is the direct collection of rainwater from roofs and other purpose built catchments, the collection of sheet runoff from man-made ground or natural surface catchments and rock catchments for domestic, industry, agriculture and environment use. The systems can be categorized as small, medium and large scale

Rain is a definitive wellspring of new water. With the ground zone around houses and structures being solidified, especially in urban communities and towns, water, which keeps running off from patios and rooftops, was depleting into low-lying territories and not permeating into the dirt Consequently, valuable water is wasted, as it is depleted into the ocean in the end. Rain water gathering is a framework by which, the water that gathers on the rooftops and the region around the structures is coordinated into open wells through a channel tank or into a permeation load, constructed

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particularly for this reason. Water is gathered straightforwardly or revived into the ground to enhance ground water stockpiling. Water that isn't removed from ground amid blustery days is the water spared.

2. LITERATURE SURVEY

Sjon van Dijk et.al (2020) (1) Many cities are confronted with both water scarcity and urban flooding as centralized water infrastructures becoming increasingly inadequate in a changing climate Decentralized infrastructures like rainwater harvesting (RWH) can ease both issues. Yet, most studies find RWH offers limited infrastructure capacity at high cost. Previous assessments, however, fail to consider two critical advantages: multi-functionality and high adaptability. By improving the incorporation of these advantages in our analysis of 1.06 million buildings with distinct design and water demand characteristics and 20-year hourly precipitation records in New York City (NYC), we demonstrate, contrary to existing studies, that strategically designed, financed and implemented rooftop RWH systems in all or a subset of the buildings can meet large-scale infrastructure development needs for water supply and storm water management. RWH implementation featuring public-private partnerships (PPP) in 43e96% of the buildings can serve 17e29% of the city's non-drinking water demands while reducing the public expenditure per unit of water supply by 13e85%. The distributed citywide RWH implementations prevent 35e56% of rooftop runoff from entering the sewage system, rivers, and/or waterways per month, with observed rooftop runoff reductions as high as 90% for a single rain event.

Luigi Piemontese et.al (2020) (2) Water harvesting has been widely applied in different social-ecological contexts, proving to be a valuable approach to sustainable intensification of agriculture. Global estimates of the potential of water harvesting are generally based on purely biophysical assessments and mostly neglect the socioeconomic dimension of agriculture. This neglect becomes a critical factor for the feasibility and effectiveness of policy and funding efforts to mainstream this practice. This study uses archetype analysis to systematically identify social-ecological regions worldwide based on > 160 successful cases of local water harvesting implementation. We delineate six archetypal regions which capture the specific social-ecological conditions of the case studies. The archetypes cover 19% of current global croplands with hotspots in large portions of East Africa and Southeast Asia. We estimate that the adoption of water harvesting in these cropland areas can increase crop production up to 60–100% in Uganda, Burundi, Tanzania and India. The results of this study can complement conventional biophysical analysis on the potential of these practices and guide policy development at global and regional scales. The methodological approach can be also replicated at finer scales to guide the improvement of rainfed agricultural.

Milan Onderka et.al (2020) (3) Rainwater harvesting can reduce vulnerability of urban areas to climate change by storing water for rainless periods and by reducing surface runoff. The efficiency and reliability of water harvesting systems depends on the local climate. Analysing rainfall characteristics is therefore essential for a proper sizing of any rainwater collecting project. A total of 84 rainfall records from climatologically distinct regions of Slovakia were separated into statistically independent episodes to derive event-based statistical characteristics. New hydrological insights for the region: A considerable spatial and seasonal variability has been observed in the statistics of rainfall events. Inter-event times decrease with elevation, whereas event volume and annual incidence of rainfall events increase with elevation. The applicability of the derived rainfall statistics was illustrated by simulations for a typical residential house using the analytical probabilistic approach. Empirical relationships between tank size and site elevation have been a developed to estimate tank sizes for un-gauged locations. The simulations show that rain barrels in the southern parts of Slovakia require larger storage capacities than those located in the mountainous regions. The presented annual and seasonal estimates of rainfall characteristics are published for the first time

Seyed M.K. Sadr et.al (2020) (4) Emerging threats such as climate change and urbanisation pose an unprecedented challenge to the integrated management of urban wastewater systems, which are expected to function in a reliable, resilient and sustainable manner regardless of future conditions. Traditional long term planning is rather limited in developing no-regret strategies that avoid maladaptive lock-ins in the near term and allow for flexibility in the long term. In this study, a novel adaptation pathways approach for urban wastewater management is developed in order to explore the compliance and adaptability potential of intervention strategies in a long term operational period, accounting for different future scenarios and multiple performance objectives in terms of reliability, resilience and sustainability. This multi-criteria multiscenario approach implements a regret-based method to assess the relative performance of two types of adaptation strategies: (I) standalone strategies (i.e. green or grey strategies only); and (II) hybrid strategies (i.e. combined green and grey strategies). A number of adaptation thresholds (i.e. the points at which the current strategy can no longer meet defined objectives) are defined to identify compliant domains (i.e. periods of time in a future scenario when the performance of a strategy can meet the targets). The results obtained from a case study illustrate the trade-off between adapting to short term pressures and addressing long term challenges. Green strategies show the highest performance in simultaneously meeting near and long term needs, while grey strategies are found less adaptable to

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changing circumstances. In contrast, hybrid strategies are effective in delivering both short term compliance and long term adaptability. It is also shown that the proposed adaption pathways method can contribute to the identification of adaptation strategies that are developed as future conditions unfold, allowing for more flexibility and avoiding long term commitment to strategies that may cause maladaptation. This provides insights into the near term and long term planning of ensuring the reliability, resilience and sustainability of integrated urban drainage systems

Mary Semaan et.al (2020) (5) In this paper, we conduct a systematic literature review to assess the state-of-art in the field of optimization of domestic rainwater harvesting systems. Sizing of storage is identified as the most important objective of optimization, yet sizing for cost is the most frequently implemented outcome of optimization. Optimizing for a local maximum is often favoured over simulation-based optimization methods that produce global maxima. To derive more realistic sizing estimates, future optimization studies will have to take into account greater variation in water demands as well as various climate change scenarios, especially given that rainfall frequency and quantity are critical design variables of a rainwater harvesting system.

Hessam Tavakol-Davani et.al (2016) (6) Combined Sewer Overflow (CSO) infrastructure are conventionally designed based on historical climate data. Yet, variability in rainfall intensities and patterns caused by climate change have a significant impact on the performance of an urban drainage system. Although rainwater harvesting (RWH) is a potential solution to manage storm water in urban areas, its benefits in mitigating the climate change impacts on combined sewer networks have not been assessed yet. Hence, the goal of the present study was set to evaluate the effectiveness of RWH in alleviating the potential impacts of climate change on CSOs. To do so, first, future rainfall was achieved through the Coupled Model Intercomparison Project Phase 5 (CMIP5) based on modified historical record. Then, rainfall-runoff modelling was employed using the U.S. EPA Storm water management model (SWMM) to study the response of CSO outfalls to future rainfall. The study site was the combined sewer network of the City of Toledo, Ohio. Results showed that under the maximum impact scenario in the near future, climate change might cause up to approximately 12–18% increase in CSOs occurrence, volume and duration in Toledo. However, an RWH plan with the capacity of 0.76 m3 (200 gal) implemented on half on the buildings throughout the area, appeared to be able to mitigate the potential future impacts, and showed a remarkable controlling performance in the peak flow periods. This plan also met toilet flushing demands.

3. RESEARCH METHODOLOGY

3.1 LOCATION

A metropolitan non-commercial WDN of Pune is taken for review. The system is situated around Pune region that is near Mumbai highway and also flood plains of river Mutha, Western portion of Pune as displayed within the fig 3.1. And then fig 3.2 . The size of this area is twenty four hectares. For providing water for this area, water is initially obtained within a subterranean reservoir (UGR) coming from water remedy plant that is around 7.0 kms far from the non-commercial region. The UGR is attached to water remedy plant by a pipeline of 700mm diameter. The topography of general area is dull with slope between 1 % to 2 % the spot Pune city is situated at longitude 77˚12 '22.9"E as well as latitude 28˚46 '08.4" N. Fig 3.1.3 shows satellite perspective of the city.

3.2 Runoff Water Harvesting

The rainfall runoff flowing from the roads and open grounds is substantial during rains, which ultimately flows out of the city unutilized. This water if conserved and utilized properly for recharging the ground water reservoir may bring much needed relief to the water scarcity areas of the city. A scheme suitable for artificial recharge in urban area was prepared by C.G.W.B and was successfully implemented and operated at Nagpur Municipal Corporation ground. In this scheme about 15000 sq.m of residential catchment was intercepted and runoff generated was diverted into the specially constructed recharge well in the public garden.

The runoff water was filtered silt free by providing a filter pit. Number of such locations can be identified within city areas where such structure may be constructed to provide a sustainable ground water based water supply in the city. It is estimated that in 537 urban areas of Maharashtra around 8995 schemes would be needed with an average of 15 schemes per town/city, except Mumbai and Mumbai Sub-urban where 100 schemes each are proposed considering its dense urban set-up and vast areas, whereas in other 24 major cities/town coming under Municipal Corporations like Navi Mumbai, Thane, Kalyan-Dombivali, Vasai-Virar, Pune, PCMC, Nashik, Aurangabad, Nagpur etc 50 schemes each are proposed. The cost estimate of these schemes would work out to be Rs 674.63 cr at unit cost of Rs 7.5 lakh. It is estimated that about 9 lakh additional urban population would get adequate water supply round the year by implementing this scheme

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4. RESULT AND DISSCUSSION

4.1 OPTIMISTIC DETERMINATION OF SIZE & TYPES OF TANK

The total rooftop area for the rainwater harvesting is 2,609m² The cumulative runoff that can be captured from the paved area is calculated using Indian Meteorological Department. The cumulative rainfall runoff at the end of the year is calculated to be 3600m3. The tank capacity can be estimated to be a lower value accounting for the continuous consumption going on during period of rainfall.

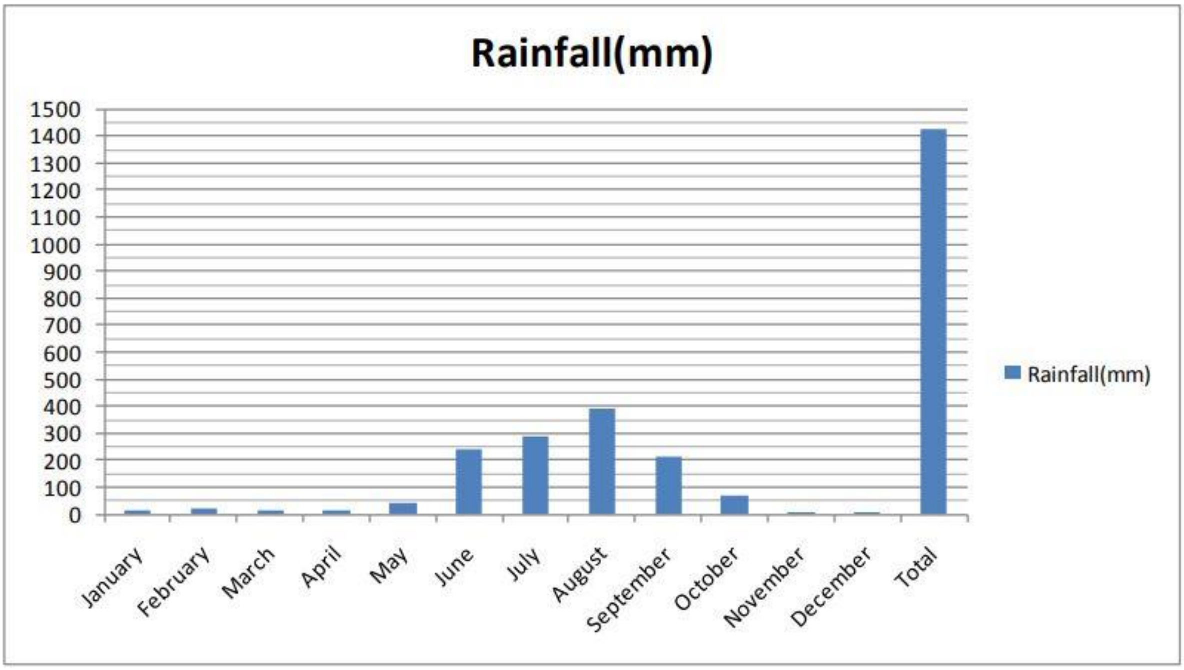

Fig.4.3: Showing Amount of Rainfall collected in throughout the year

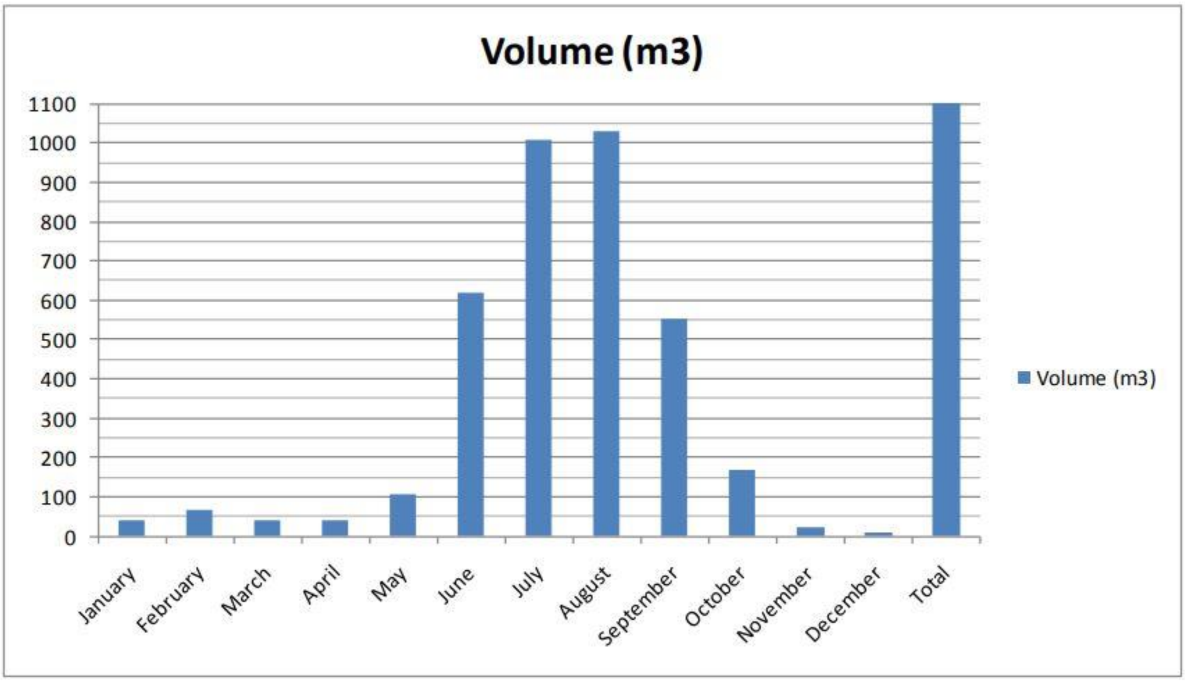

Fig.4.4: Showing Volume of water Collected from Rainfall throughout the year

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5.CONCLUSION

Watershed management tries to bring about the best possible balance in the environment between natural resources on the one side, and human and other living beings on the other. Watershed management is an emerging concept for the efficient use of rain run-off in the areas in India, The approach to watershed management should be participatory in nature, people friendly, location specific, process based and geared to cater to the problems and needs of the rural community. It involves sustainable utilization of available water and has further promoted agriculture and allied operations making it economic viable and enhancing socio economic development by achieving overall development of the City, With scope for further surface and ground water irrigation sources utilization in India getting narrowed, watershed management particularly in rain fed area becomes highly important. Protecting environment and sustaining living conditions in poor rain fed areas also would depend upon how efficiently the watersheds are managed.

6.FUTURE-SCOPE

1- In Future various location for rain water harvesting should be tested
2- Any alternative for the storage of water is suggested.
3- To improve ground water quality by dilution.

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