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1. **Introduction**

“Rainwater Harvesting-an alternative water supply in the Future for Pakistan” is a research article written by Ishtiaque Hussian of Department of Civil Engineering, Capital University of Science and Technology, Islamabad Pakistan and published in ”[Journal of Biodiversity and Environmental Sciences](https://www.researchgate.net/journal/2220-6663_Journal_of_Biodiversity_and_Environmental_Sciences)” in January 2016.

In this article the author has explained that Safe drinking water is one of the major issue of countries like Pakistan. The problem becomes more critical where the demand of water is increasing due to population growth and the permeable land is decreasing rapidly due to urbanization. He has provided a statistical data of several district where the water table has been depleted for several hundred feet’s in the past 30 years and the per capita water availability has been reduced to an alarming situation.

The author has explained that about 45%of the domestic water demand is non potable ie we use this water in flushing, washing floors, gardening, car washing and other domestic use. He suggested that this demand can be fulfilled from rain water harvesting. He collected rain fall data of two district is Rawalpindi and Lahore

and with the help of samsam model he proposed the size of collecting or storage reservoirs of single family house (4 persons) and double family house (8 persons) requirements.

He proposed that Samsam model is an effective tool with the help of which we can calculate the minimum size of roof tops for collection of rain water and its later use as our domestic demand of water.

1. **Summary**

This study is carried out in two thickly populated cities of Pakistan ie Rawalpindi and Lahore to work out and suggest number and sizes of family in a particular size of dwelling keeping in view the climatology (rainfall) of the area, and water demands. The study also suggest ways and means to increase the ground water table.

Availability of safe drinking water is one of the biggest challenge all over the world specially in developing countries like Pakistan. The reason is that the availability of fresh water is decreasing day by day with the growing demand of increasing population. It has roughly been estimated that the water demand

doubles after every 21 years. Moreover, due to rapid urbanization the land is being paved and the permeable strata is continuously decreasing resulting into flooding of water and a very less portion of the rain water is absorbed by the soil. This phenomenon give birth to the ground water depletion and the water table is going down rapidly.

Rainwater harvesting is a method of collecting and storage of rainwater and reuse it for various domestic uses later on e.g. flushing, gardening, floor & car washing etc .Rain water is of great value for its pure nature and softness because its pH value is nearly neutral soon after occurrence of rainfall (The Texas Manual for Rainwater Harvesting, 2005). Rainwater harvesting technique has six main elements which include catchment area (roof tops), collection system, filtration equipment’s, storage system, treatment and delivery system (Che-Ani et al., 2009). These elements are low cost to be built, easy to be maintained and more effective if adopted at the scale of an individual house hold level.

Studies have proved that rainwater harvesting techniques are being developed and practiced all over the world to address issues related to water scarcity for human use. These studies (Marcelo and Enedir, 2011) have been carried out in Australia (Fewkes, 1999; Marks et al., 2006), Brazil (Ghisi et al., 2009), China (Li & Gong, 2002; Yuan et al., 2003), Greece (Sazakli et al., 2007), India (Goel & Kumar, 2005; Pandey et al., 2006), Indonesia (Song et al., 2009), Iran (Fooladman & Sepaskhah, 2004), Ireland (Li et al., 2010), Jordan (Abdulla & AlShareef, 2009), Namibia (Sturm et al., 2009),Singapore (Appan,

1999), South Africa (Kahinda et al., 2007), Spain (Domènech & Saurí, 2011), Sweden (Villareal & Dixon, 2005), UK (Fewkes, 1999), USA (Jones & Hunt, 2010), Taiwan (Chiu et al., 2009) and Zambia (Handia et al., 2003), to name a few.

The aims of this study is to suggest how rainwater harvesting can be implemented in major cities of Pakistan. Availability of potable water is becoming a critical issue in Pakistan due to no urban planning in old areas of cities like Rawalpindi and Lahore. Both these cities are thickly populated in the center where are properly planned in the surrounding having newly developed area. The author has referred the study carried out by WASA in 2012 and pointed out that the ground water table in the Potohar region (Rawalpindi district and its surroundings) has depleted by 116m (380 feet) in the last 30 years.

1. **Critique**
2. **Purpose of study**

The aim of this study is to suggest how rainwater harvesting can be implemented in major cities of Pakistan in order to overcome the shortage and crisis of water in big cities like Rawalpindi and Lahore. It also suggests that rain water can also be used for artificial recharge of ground water table.

1. **Methodology**

SamSam Water Foundation has developed tools and methods which can support water and sanitation projects. Samsam model tools has been utilized to worked out the minim size of catchment area/roof top for single family house hold (4 persons)and double family house

hold (8 persons) The efficiency of rain water tanks provided for dwellings with roof areas of 110 m2 (25’x50’), 220 m2 (35’x70’), 280m2 (40’x80’) and 400m2 (50’x90’) with 2, 4 and 8 occupants have been analyzed.

1. **Data collection**

Rain fall data has been collected from metrological department and annual rain fall has bee worked out in this study.

1. **Advantages**

This technique of collection of rain water has the following advantages and disadvantages;

1. The rain water is pure and soft in nature because its pH value is nearly neutral.
2. Its direct collection & storage near the place of use eliminates need of distribution system
3. It helps to reduce run-offs which otherwise cause street-flooding;
4. It reduces the requirement of fresh potable water for uses other than drinking;
5. It decreases the costs of utility bills.
6. It helps to recharge the ground water.
7. **Disadvantages:**
8. Utilization of roof top shall be restricted.
9. Two separate storage system shall be required to store drinking water and rain water.
10. **Strength:**

Samsam model has been used in this study which is a user friendly tool and available in android apps. It can be easily used by an individual to worked out its requirement of space and storage capacity depending upon its daily water demand

1. **Weakness:**
2. The author has described the rain water as pure and soft as its pH value is 7 (neutral) but in in industrial cities the atmosphere contain carbon dioxide (CO 2) in abundance which make the rain water acidic.
3. The author has proposed the minimum size of roof top for single family and double family house but he didn’t discussed the availability of sufficient space for storage tanks to be constructed for storage ,specially in the cities where there is no open space available in the congested houses.
4. The author has not discussed that how his proposal can be implemented on grounds having no such rules and regulation in our building code.
5. **Conclusion**

* About 45% of domestic water requirement is non potable use of water such as gardening ,car washing ,bathing ,floor clearing and other usage except drinking.
* Rain water can effectively be utilize as domestic use.
* The technique of rain water harvesting is simple and low cost.
* No special equipment and construction is required except storage reservoir
* Samsam model can be used as a tool for roof top requirements.
* This method of rain water harvesting is beneficial in areas having more rainfall intensity.
* Appropriate sizes of rainwater harvesting tanks shall be constructed as modeled in SamSam rainwater harvesting model .
* The minimum sizes of plot are required to be increased in new developments so that density of population can be reduced and more rainwater be captured for less use.
* For areas with appreciable rainfall (like Rawalpindi) the minimum suggested size is 35’x70’ for single family (4 persons) and 50’x90’ for two family units (8 persons).
* For areas with lesser rainfall (like Lahore) the minimum suggested size is 40’x80’ for single family (4 persons) and 50’x90’ for two family units (8 persons).
* Additionally, the construction of soakage wells/pits to receive excess rain water during the months of heavy rainfalls and directing this excess rainwater for groundwater recharge would swell the underground water aquifer volume.

**References**

1. Abdulla FA, Al-Shareef AW. 2009. Roof rainwater harvesting systems for household water supply in Jordan. Desalination, n. 243, 195-207 p.
2. Appan A. 1999. A dual-mode system for harnessing roof water for non-potable uses. Urban Water 1, 317321 p.
3. Che-Ani AI, Shaari NA, Sairi MFM, Zain MM, Tahir. 2009. Rainwater Harvesting as an alternative water supply in the Future. European Journal of Scientific Research, ISSN 1450-216X, 34, 1. (2009), 132-140 p.
4. Chiu Y, Liaw C, Chen L. 2009. Optimizing rainwater harvesting systems as an innovative approach to saving energy in hilly communities. Renewable Energy 34, 492-498 p.
5. Domènech L, Saurí D. 2011. A comparative appraisal of the use of rainwater harvesting in single and multi-family buildings of the Metropolitan Area of Barcelona (Spain): social experience, drinking water savings and economic costs. Journal of Cleaner Production 19, 598-608 p.
6. Fewkes A. 1999. The use of rainwater for WC flushing: the field testing of a collection system. Building and Environment 34, 765-772.
7. Fooladman HR, Sepaskhah AR. 2004. Economic analysis for the production of four grape cultivars using micro-catchment water harvesting systems in Iran. Journal of Arid Environments 58, 525-533.
8. Ghisi E, Tavares DF, Rocha VL. 2009. Rainwater harvesting in petrol stations in Brasília: Potential for potable water savings and investment feasibility analysis. Resources, Conservation and Recycling 54, 79-85.
9. Goel AK, Kumar R. 2005. Economic analysis of water harvesting in a mountainous watershed in India. Agricultural Water Management 71, 257-266.
10. Handia L, Tembo JM, Mwiindwa C. 2003. Potential of Rainwater harvesting in urban Zambia. Physics and Chemistry of the Earth 28, 893-896.
11. Jones MP, Hunt WF. 2010. Performance of rainwater harvesting systems in the south eastern United States. Resources, Conservation and Recycling 54, 623-629.
12. Kahinda JM, Taigbenu AE, Boroto JR. 2007. Domestic Rainwater harvesting to improve water supply in rural South Africa. Physics and Chemistry of the Earth 32, 1050-1057 p.
13. Li X, Gong J. 2002. Compacted micro-catchments with local earth materials for rainwater harvesting in the semiarid region of China. Journal of Hydrology 257, 134-144.
14. Li Z, Boyle F, Reynolds A. 2010. Rainwater harvesting and grey water treatment systems for domestic application in Ireland. Desalination 260, 18.
15. Marcelo MC, Enedir G. 2011. Analysis of Potable Water Savings Using Behavioural Models, Water Conservation, Dr. Manoj Jha (Ed.), ISBN: 978-953307-960-8, InTech, Available from: http://www.intechopen.com/books/waterconservatio n/analysis-of-potable-water-savingsusingbehaviouralmodels.
16. Marks R, Clark R, Rooke E, Berzins A. 2006. Meadows, South Australia: development through integration of local water resources. Desalination, v. 188, 149-161.
17. Pandey PK, Panda SN, Panigrahi B. 2006. Sizing on-farm reservoirs for crop-fish integration in rain-fed farming systems in Eastern India. Bio-J. Bio. Env. Sci. 2016 systems engineering 93, 475-489.
18. Sazakli E, Alexopoulos A, Leotsinidis M. 2007. Rainwater harvesting, quality assessment and utilization in Kefalonia Island, Greece. Water Research 41, 2039-2047.
19. Song J, Han M, Kim T. 2009. Rainwater harvesting as a sustainable water supply option in Banda Aceh. Desalination 248, 233-240.
20. Sturm M, Zimmermann M, Schütz K. Urban W. Hartung H. 2009. Rainwater harvesting as an alternative water resource in rural sites in central northern Namibia. Physics and Chemistry of the Earth 34, 776-785.
21. The Texas Manual for Rainwater Harvesting. 2005. Texas Water Development Board, third edition, Austin Texas.
22. Villareal EL, Dixon A. 2005. Analysis of a rainwater collection system for domestic water supply in Ringdansen, Norrköping, Sweden. Building and Environment 40, 1174-1184.
23. Yuan T, Fengmin L, Puhai L. 2003. Economic analysis of rainwater harvesting and irrigation methods, with an example from China. Agricultural Water Management 60, 21-226.
24. Zhe L, Fergal B, Anthony R. 2010. Rainwater harvesting and grey water treatment systems for domestic application in Ireland. Desalination, vol 260, issues 1-3, pages 1-8, 30 sep 2010, http://dx.doi.org/101.1016/j.desal.2010.05.035