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Rainwater Harvesting and Water Resource Management: An impact study in Kothanur (Village), Bangalore.

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1. INTRODUCTION

1.1 Introduction

The water collecting framework is perhaps the best technique rehearsed and followed to help the preservation of water. Today, shortage of good quality water has become a critical reason for concern, Nonetheless, Rainwater, which is unadulterated and of good quality, can be utilized for water system, washing, cleaning, washing, and cooking and furthermore for other animals necessities. Water gathering is the straightforward interaction or innovation used to ration Rainwater by gathering, putting away, passing on and filtering of Rainwater that runs off from roofs, parks, streets, open grounds, and so forth for some time in the future.

1.2 BWSSB Guideline for Rainwater Harvesting

Bangalore Water Supply and Sewerage Board (BWSSB) is the head legislative organization liable for sewage removal and water supply to the city of Bangalore. The BWSSB was comprised under the demonstration of the Karnataka state assembly and the board appeared on October 2, 1964. The BWSSB Act 1964 and BWSS rules 1964 altered now and again. The BWSSB has as of late acquainted a change with its Act and has made water gathering obligatory for specific locales.

1.2.1 The Bangalore Water Supply and Sewerage (Amendment) Act, 2009, 72A

In 2009, the BWSSB has acquainted a change with its Act and has made water reaping compulsory for specific destinations. In the BWSSB Act, 1964 (Karnataka Act No.36 of 1964), Section 72-An Obligation to give water reaping structure has been embedded.

The Bangalore Water Supply and Sewerage (Amendment) Act, 2009, 72A-Obligation to give downpour water gathering structure expresses that "Inside nine months from the date of beginning of the Bangalore Water Supply and Sewerage (Amendment) Act, 2009 each proprietor or occupier of a structure having a sital zone of 2400 square feet or more or each proprietor who propose to develop a structure on a sital territory of 1200 square feet or more will accommodate downpour water reaping structure in such way, with so much conditions as might be given in the guidelines, bombing which the Board may cause such rain water collecting structure and recuperate the expense from the proprietor or occupier, by and large, unpaid debts of land income."

1.2.1 Rainfall of Bengaluru urban district as on 11-09-2019

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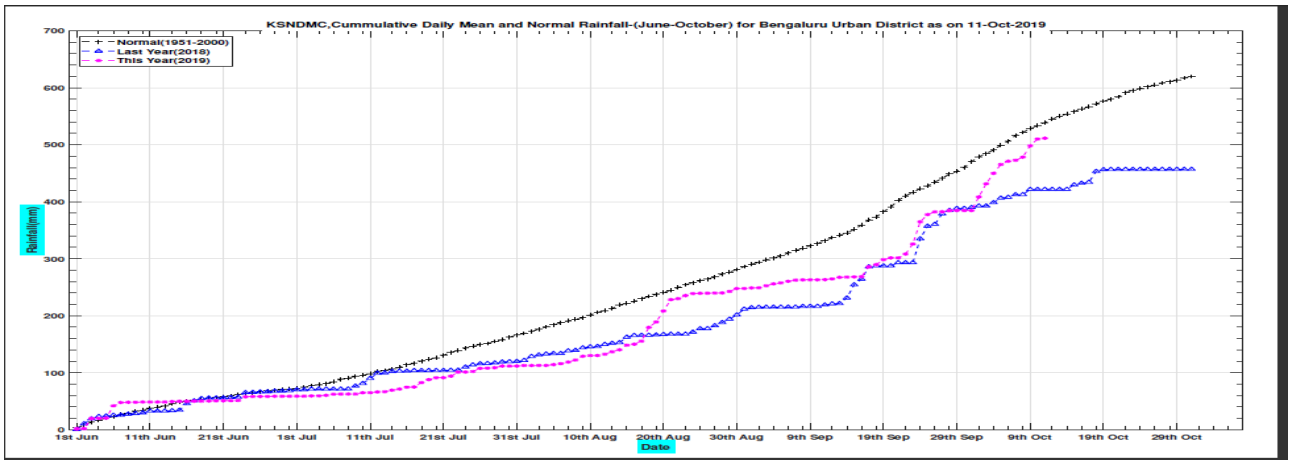
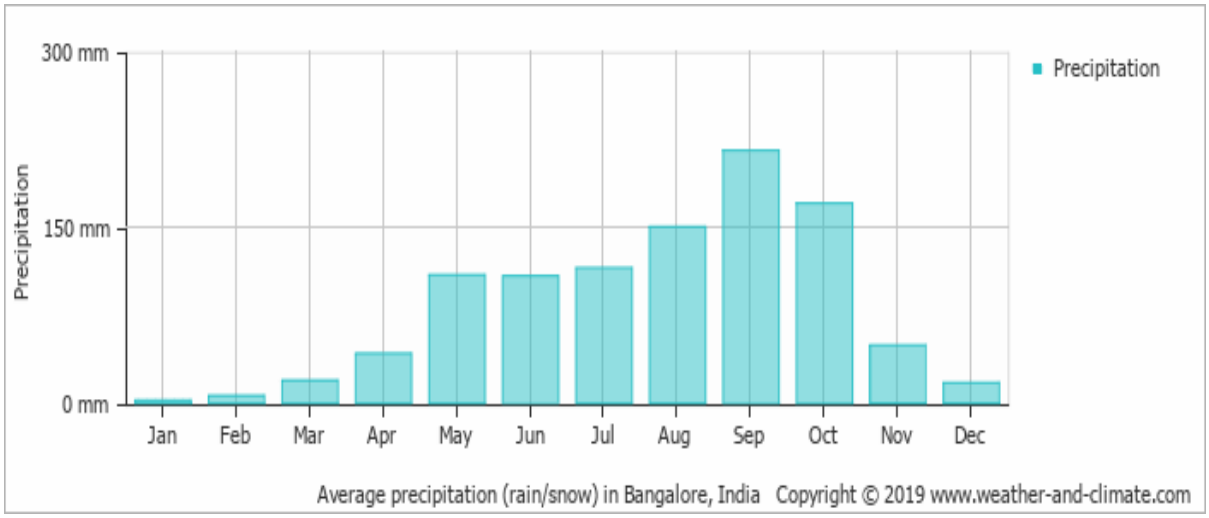
*Data from District, Regional & State Cumulative Normal and Actual Rainfall Graphs



1.2.2 Average *precipitation* (*rainfall*,) in millimeter per month in *Bangalore* (Karnataka)



* Data from nearest weather station: Bangalore (Karnataka), India

A great deal of downpour (stormy season) falls in the months: May, June, July, August, September and October. Bangalore has dry periods in January, February, March and December. All things considered, September is the wettest month. By and large, January is the driest month. The normal measure of yearly precipitation is: 990.0 mm (38.98 in)

Be that as it may, this precipitation happens during short spells of extreme focus. (The majority of the downpour falls in only 100 hours out of 8,760 hours in a year). Due to such brief term of substantial downpour, the greater part of the downpour falling on a superficial level will in general stream away quickly leaving next to no for energize of groundwater. A large portion of the conventional water gathering frameworks in urban areas have been ignored and fallen into neglect, deteriorating the metropolitan water situation. One of the answers for the metropolitan water emergency is water reaping - catching the spillover and this is polished for a huge scope in urban communities like Chennai, Bangalore and Delhi where water gathering is a piece of the state strategy.

1.3 Methods of Rainwater Harvesting

Did you realize that if Bangalore figures out how to energize even 30% of the water it gets, it will have more than what the Cauvery water? This storm, rather than simply playing the cat-and-mouse game and tensely watching the skyline, here's the means by which you can accumulate those valuable drops by making your own water gathering framework at home.

Extensively there are two different ways of gathering water

- Surface spillover gathering
- Roof top water reaping

Water reaping is the assortment and capacity of water for reuse nearby, as opposed to permitting it to run off. These put away waters are utilized for different purposes, for example, cultivating, water system and so forth Different techniques for water reaping are portrayed in this part.

a) Surface overflows collecting

In metropolitan territory water streams away as surface overflow, this overflow could be gotten and utilized for energizing springs by embracing fitting strategies.

b) Rooftop water collecting

It is an arrangement of getting water where it falls. In roof reaping, the rooftop turns into the catchments, and the water is gathered from the top of the house/building. It can either be put away in a tank or redirected to counterfeit revive framework. This technique is more affordable and exceptionally successful and whenever executed appropriately helps in enlarging the groundwater level of the zone.

1.4 How Rainwater Harvesting Solves Water Shortage?

Gathering and assortment of water is an appropriate way that can be utilized to address the issue of the water emergency in different pieces of the world. This straightforward water protection strategy can be utilized to advance a striking arrangement in regions where there is sufficient precipitation yet insufficient inventory of groundwater.

Bangalore is an incredible model where water collecting can turn out to be valuable. Bangalore is a territory with an exceptionally high populace and a zone that likewise needs to manage water deficiencies. Considering these, rehearsing water protection strategies, for example, water reaping is an ideal method to guarantee expanded inventory of water.

Bangalore encounters a significant tremendous measure of precipitation nearly consistently. Thus, water collecting will assume a gigantic part in giving extra wellsprings of water. During the dry season, individuals can have water sources in the event that they have executed the important sort of gathering strategies. With expanded interest for water, water assortment can have the option to meet the necessities.

At the point when developers and planners are planning another home or building, it is significant that they consider executing water collecting strategies. It can decrease dependability on other common assets for groundwater. Over the long haul, there will be energy investment funds, water reserve funds, and asset investment funds.

1.5 Overview of Kothnur study area

Kothnur is a census town in Bangalore district in the Indian state of Karnataka.

1.5.1 Demographics

Starting at 2001 India enumeration, Kothnur had a populace of 20,835. Guys establish 53% of the populace and females 47%. Koththanur has a normal education pace of 67%, higher

than the public normal of 59.5%: male proficiency is 73%, and female education is 61%. In Kothnur, 13% of the populace is under 6 years old.

1.5.2 Locality introduction and neighbourhood

Set apart as one of the quickest developing rural areas of North-Bangalore, Kothanur is a flourishing miniature market enveloping numerous prominent lodging projects. Admittance to Thanisandra Main Road and Hennur-Bagalur Road makes this area exceptionally dynamic for land advancement and venture.

Figure: Kothanur Map

Notable Ferns Residency,
Prakash Hibiscus, BDS Gardens and Galaxy Orchid Woods are some of the residential projects present in Kothanur.

1.5.3 How to reach kothanur

By Rail
Channasandra Rail Way Station , Banaswadi Rail Way Station are the very nearby railway station to Kothanur.
By Road
Bangalore , Yelahanka , Bommanahalli , Krishnarajapura , Kengeri , Hosakote , Dasarahalli , Devanahalli , Dod Ballapur , Magadi , Nelamangala are the nearby by towns to Bangalore having road connectivity to Bangalore and Kothanur
Local Bus
Bds Nagar Bus Station , Geddalahalli (Hennur) Bus Station , Byrthi Cross Bus Station , Kothanur (Hennur) Bus Station , Thanisandra Bus Station are the nearby by Local Bus Stops to Kothanur . runs Number of busses from Kothanur to different Places.

1.6 Objectives of the study

1. To investigate the challenges for implementing the rain water harvesting system.
2. To suggest the suitable ways and means for implementation rain water harvesting system.

1.7 Hypothesis

H1: "There is a significant association in the catchment area and storage of water"
H2: "There is a significant difference in the type of house and storage of water"
H3: "There is a significant impact on increase in ground water level after implementing of RWH system"

2. RESEARCH METHODOLOGY:

1.8.1 Research Design: Exploratory Study

This study intends to explore the impact of rain water harvesting system in Kothanur house hold premises like changes in water availability, changes in ground water level and other social and ecological impacts.

1.8.2 Study Area:
The study was conducted in the Kothanur village. Bangalore City, Karnataka. Various house hold types small, medium and multistore building residents were chosen as respondents.

1.8.3 Sampling:
50 households have been selected through Stratified random sampling method. The various strata are individual houses, group/row houses and apartments. The following table shows the details of strata:

Type of House	**Strata**
Apartment	10
Group house	13
Independent house	27
Total	50

1.8.4 Data Collection:
Data collection for the present project was:

1. Primary Data: A well structures and administrated questionnaire will be prepared and survey method will be used to collect the relevant data from the households.
2. Secondary Data: Will be collected from various magazines, research articles etc.

1.9 Limitation of the Study:

1. The study will be conducted within the geography of Kothanur area.
2. This study will be conducted with few respondents.
3. This study cannot be applied universally.
4. This study is focused only on rain water harvesting.

1.10 Impact of implementing the rainwater harvesting system
This section is designed to analyse the impact of implementing the rainwater harvesting system in the study area.

Table - 1.10.1 Analysis of variance for post RWH period

Sl. No	**Source**	**DF**	**Sum of Squares**	**Mean square**	**F ratio**	**Sig F**	**Sig. level**
1	Regression	5	0.01834	0.00367	32.733	0.0081	0.01 level
2	Residual	3	0.00034	0.00011			
Table Value					28.2		

Variables in the multiple regression analysis after implementation of RWH in whole study area are represented in Table 6.12 and it is found that catchment area, types of house and level of ground water influenced at 0.05 significant level. All other variables do not have significant influence over recharge.

Sl. No	Table - 1.10.2 Variances in the equations Variable	B	SE.B	Beta	T	Sig T	Sig. level
1	Catchment area	-0.1353	0.0812	-4.3235	-1.668	0.1939	0.0546
2	Type of house	0.0634	0.0203	0.7344	3.125	0.0523	0.0578
3	Ground water level	17.0896	9.7096	4.6546	1.76	0.1766	0.0592

t- test is conducted to see whether there is significant difference in rainfall, groundwater recharge , pre monsoon water level, post monsoon water level, groundwater draft and built up area during pre and post RWH period. Tables 6.13 to 6.18 show the t- test for rainfall, recharge, pre monsoon water level, post monsoon water level, groundwater draft and built up area respectively in the entire watershed.

Table – 1.10.3 t- test for catchment area

Type	No. of Cases	Mean(m)	Standard Deviation	Std. Error	t-value	Sig. Level
Ground water Level	50	0.3677	0.058	0.2	2.78	0.0546
		0.3403	0.045	0.018		

On comparing the catchment area of the respondent, it is found that there is a significant difference in the water storage and build-up area. Hence hypothesis is rejected

Table – 1.10.4 t- test for type of the house

Type	No. of Cases	Mean(m)	Standard Deviation	Std. Error	t-value	Sig. Level
Ground water Level	50	0.4854	0.042	0.19	2.89	0.0578
		0.4134	0.037	0.018		

On comparing the type of the house of the respondent, it is found that there is a significant difference in the water storage and build-up area. Hence hypothesis is rejected

Table – 1.10.6 t- test for ground water level

Type	No. of Cases	Mean(m)	Standard Deviation	Std. Error	t-value	Sig. Level
Ground water Level	50	0.3767	0.052	0.02	2.69	0.0592
		0.3043	0.048	0.016		

In the whole study area, the change in groundwater level is analysed. It is found that the water level is higher after implementing the rainwater harvesting system at significant level 0.01.

1.11 Findings

- It was found that catchment area, types of house and level of ground water influenced at 0.05 significant level. All other variables do not have significant influence over recharge.
- t- test is conducted to see whether there is significant difference in rainfall, groundwater recharge , pre monsoon water level, post monsoon water level, groundwater

draft and built up area during pre and post RWH period. On comparing the catchment area of the respondent, it was found that there is a significant difference in the water storage and build-up area. Hence hypothesis is rejected

- On comparing the type of the house of the respondent, it is found that there is a significant difference in the water storage and build-up area. Hence hypothesis is rejected. In the whole study area, the change in groundwater level is analysed. It is found that the water level is higher after implementing the rainwater harvesting system at significant level 0.01.

1.12 Suggestion:

- The research found that respondents of Kothanur were aware of general purpose and utility of RWH system and will to adopt the same for their household usage. At the same time, there is a gap between operational implementation of RWH system and Government policy regarding incentives and subsidies.
- Government can provide and declare the same for maximizing the RWH system installation. Despite of awareness about the RWH system, no of respondents felt inconveniences in implementation of the system.
- Most of them are using the water received through this system for gardening purpose. An awareness program and free distribution of RWH filters can be provided to the public through various Medias and can involve NGOs working in the field of water conservation. Further, the local authority also aware of present water management issues and made policies accordingly to promote water conservation and management, using RWH in buildings. Still, ground level implementation is missing.
- The government needs to take a proactive stand in reaching out to the community for implementation of RWH systems at the household level.

1.13 Scope of future research

- It is suggested that future work on RWH addresses three priority challenges. Firstly, more empirical data on system operation is needed to allow improved modelling by taking into account multiple objectives of RWH systems. Secondly, maintenance aspects and how they may impact the quality of collected rainwater should be explored in the future as a way to increase confidence on rainwater use. Finally, research should be devoted to the understanding of how institutional and socio-political support can be best targeted to improve system efficacy and community acceptance.

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