



## STUDIES ON DETERMINATION OF PURITY OF HARVESTED RAIN WATER & NON HARVESTED GROUND WATER: BACTERIOLOGICAL ASSAY

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### ARTICLE INFO

#### Article History:

Received 18<sup>th</sup> June, 2017  
Received in revised form  
19<sup>th</sup> July, 2017  
Accepted 24<sup>th</sup> August, 2017  
Published online 30<sup>th</sup> September, 2017

#### Key words:

Water scarcity,  
Rain water Harvesting,  
Bacteriological Analysis E. Coli,  
Thermotolerant Bacteria.

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Citation: Dr. Suparna Deshmukh. 2017. "Media prejudice against women: impact on gender narrative.", *International Journal of Development Research*, 7, (09), 14942-14947.

### ABSTRACT

All over the country Rain Water Harvesting has been made mandatory since 1996 as over extraction of ground water and wastage of rainwater have led to severe water crisis. Hydrogeologists says that, it makes ecological and financial sense to harvest rain water or roof top water, for short term use and long term improvement of the water table. It is in Delhi, Andhra Pradesh, Chennai, Kerala, Maharashtra, Gujarat and Madhya Pradesh where its implementation has become successful in water conservation. Kada is a village which lies in district Beed of Maharashtra, and is famously known as a strong drought prone area. It is in this concern, present studies have undertaken for conservation of natural rain water and its storage in surface water or in tubewells. By constructing Rain Water Harvesting systems at five different locations in Kada, which includes schools and public places. Researcher has found successful rise in water levels of borewells and people are enjoying the results. The researcher tried out to find the water quality and its purity of harvested rain water as well as non harvested ground water. Researcher assessed potability as per IS 15200 for drinking water quality assessment, and comparative studies have shown that water gets more purified naturally when rain water is harvested.

### INTRODUCTION

Nature has blessed earth generously with the gift of water. About 3/4<sup>th</sup> part of the earth is covered with water. Out of total availability of water for mankind, only a meager 1% is available for drinking, irrigation and industrial purposes. 97% is found as sea and salty water, while 2% is entrapped by the polar ice caps. Due to overpopulation, there is always overexploitation of water available for drinking and irrigational or industrial purposes. Water scarcity has been prime concern at present as water is the main source of livelihood. Over past 100 years, the consumption of fresh water has increased by more than 500%, resulting in fresh water scarcity. It is estimated that by 2025 two third of population will live in water stressed areas. Rain is natural source of water which is known to all of us but most have ignored it for years together. Importance of rain water harvesting has gained momentum because of depletion in the

groundwater levels on account of rapid urbanization, industrialization & massive population growth. The Water Act, (1974), for prevention and control of Pollution, was put forwarded which was amended later in 1981 and 1986. This Act, centers round the effective prevention, control, and abatement of water pollution in the country. Rapid industrialization and urbanization have resulted in degradation of the environment which is the cause of several diseases, mental tensions, and other miseries. Therefore, efforts should be made to ensure that common man gets sufficient pure water, pure air, and pure food. Seven billion people on the earth today are dependent on ground water for irrigation, industrial, environmental and domestic applications. If some efficient, scientific and cost effective ways and means are provided to people then it will be helpful to harvest, conserve, reuse and recharge our aquifers by rain water. Rain water harvesting is a technique of collection and storage of rain water into natural reservoirs or tanks, or the infiltration of

surface water into subsurface aquifers( before it is lost as surface runoff). One of the most efficient method of rain water harvesting is Roof Top Water Harvesting. Implementing this fact , it has been decided to procure Rain Water Harvesting system at some public places in Kada town, in district Beed of Maharashtra state in India.

## RATIONALE BEHIND CHOOSING THE PROBLEM

Kada is a village in Ashti Tahsil of Beed district of Maharashtra State, in India This region is known to be adversely drought prone area. The total population of the village is about 15,000, and there are near about 3000 houses.. It belongs to Marathwada region and also Aurangabad division. It is located 83 Km towards west from district head quarters of Beed and 6 Km from Ashti, as well as 274 Km from State capital, Mumbai. Its height from sea level is 552 meters above sea level. There is a Lignius type of rock, all over in the town, which is a Primary rock, and thus water does not get percolated properly. Total rainfall per annum in the village and vicinity is very less and is near about 500-600 mm only. The main source of water supply in the village is Borewell or Tube-well which are about 400 to 700 feet in depth. Among these more than 80% of Bore-wells gets dried out completely during the months of November or December only. Villagers have to pay Rs.5 to Rs. 7 per five litres of water during the period of January to June. At maximum places water tankers supplies this water. Looking towards the severity of problem of water scarcity in village KADA, situated in District Beed of Maharashtra State, INDIA .Rain water harvesting will improve water supply, food production and ultimately food security. Water insecure households or individuals in rural areas will be benefited the most from Rain Water Harvesting system. Since rainwater harvesting leads to water supply which leads to food security, this will greatly contribute to income generation. If 80% of total rain water can be collected then 40,000 litres of rain water is available for collection. Depending on the size of the rain water collecting tank, & the distribution of rainfall it is easy to collect all this 40,000 litres of rain water. The existing roof is made use of to collect rainwater.

Many schools do not have a reliable source of water for drinking and other use. The school rooftop rainwater harvesting system seeks to provide a source of water for all purposes such as domestic uses, water for hygienic uses, and finally treated water if the rainwater is required for drinking purposes. On the basis of advantages of Rooftop Rain Water Harvesting System, the researcher has constructed Rain Water Harvesting System on buildings of all schools, at some public places like Police Station in the town and also on a bank situated in the village Kada. The main purpose behind selection is that all these areas are always crowded and are facing water scarcity badly. Bacteriological analysis has been carried out to prove the utility of rain water harvesting.

## OBJECTIVES OF THE STUDY

The objectives of the present study are as under.

- To carry out studies on Rain Water Harvesting for water conservation and water management.
- Rain water harvesting(RWH) system is to be constructed on the crowdly public places suffering badly from water crisis.

- To know the results of Rain water harvesting system.
- To make a comparative study of Bacteriological status of harvested rain water and non harvested water to know their purity.
- To educate and aware people about the problem of water crisis.

## METHODOLOGY

Roof top rain water harvesting is the process of collecting rain water falling on rooftops in a tank or sump for future productive use. Thus in brief, the methods of rain water harvesting consists of two types: 1. is the method in which rain water is stored in the above ground or underground sumps or overhead tanks and is used directly for flushing, gardening, washing , and all likewise domestic purposes, while in another method rain water is recharged to ground through recharge pits, dug wells, borewells, soak pits etc. In the present study the researcher used the method of ground water recharge in which 5x5ft. pit was dug, plasterd with concrete and pipeline connecting all the roof outholes has been introduced in it. Water storing in this pit is directed to enter into borewell through drilled holes and through the percolations. The tank is sealed from the top either with Cuddappah slabs or Concrete slabs or any local stone. Since rainwater is pure as it falls from the sky, it is necessary that the roof be kept clean for it to remain pure when it is collected.

The only precaution to be taken is the roof needed to be swept and cleaned daily during the rainy season in the district. The gutters of PVC collect the rainwater from the roof and transfer it to filter. On sloping roofs, PVC gutters can pick up leaves, dust, small twigs, and other organic matter. The gutters should be inspected and cleaned daily. The entry point of water from roof to gutter is provided with a filter or the pit is filled with gravels so that water entered gets naturally filtered. The filter is very important in keeping rain water clean before entering to storage tanks. The researcher has selected five public sites which includes schools, college, bank and police station situated in Kada town. For understanding the biological purity, after six months, the researcher has collected the samples from five sites where rain water was harvested and also from non water harvested sites in the vicinity. The researcher has also interviewed the concerned authorities of the sites of study to understand how much water level has been increased. After six months comparative study on bacteriological analysis was carried out to assess potable quality of harvested and non harvested rain water at 10 sites.

**Sites at which RWH is done :** 1.Bhagini Nivedita Kanya Vidyalaya, Kada, 2.Z. P. School, Kada; 3.Rasiklal Dhariwal Pharmacy College, Kada; 4.Police Station, Kada; 5.State Bank Of India, Kada.

**Water Sample Collection sites :** 1.Bhagini Nivedita Kanya Vidyalaya, Source : Borewell, 2. Z. P. School, Source Borewell 3.Residence of Mrs. Anita Takale Source :Main Stream Of Water supply, Tap Water; 4. Residence Besides Z.P. School: Source : Tap water; 5. Gram Panchayat Office Main Stream; 6.S. B. I, Kada, Source: Borewell; 7.Restaurant at S.T. Stand Source: Tanker water which is supplied throughout town; 8. Motilal Kothari Vidyalaya, Source: Drinking Water Tank; 9.Police Station; Source: Borewell 10. R. D. College Of Pharmacy: Source: Borewell. Among these

sites at above stated 5 sites only RWH was done while other sides are their neighbouring sites.

**Table 1.**

| Disease                                       | Causal bacterial agent  |
|---|---|
| Cholera                                       | <i>Vibrio cholerae</i> , serovarieties O1 and O139  |
| Gastroenteritis caused by vibrios             | Mainly <i>Vibrio parahaemolyticus</i>   |
| Typhoid fever and other serious salmonellosis | <i>Salmonella enterica</i> subsp. <i>enterica</i> serovar Paratyphi<br><i>Salmonella enterica</i> subsp. <i>enterica</i> serovar Typhi<br><i>Salmonella enterica</i> subsp. <i>enterica</i> serovar Typhimurium |
| Bacillary dysentery or shigellosis            | <i>Shigella dysenteriae</i><br><i>Shigella flexneri</i><br><i>Shigella boydii</i><br><i>Shigella sonnei</i>   |
| Acute diarrhoea and colitis                   | <i>Escherichia coli</i> , particularly serotypes such as O148, O157 and O157H   |

The main bacterial diseases transmitted through drinking water. ([Int J Environ Res Public Health](#), 2010 Oct).

## RESULTS AND DISCUSSION

After completion of the work, researcher has conducted the interviews of the beneficiaries to ascertain or to get feedback of the project, the beneficiaries opined that they are enjoying the increase in water levels of borewells. At all of these sites 5 persons at each site were interviewed and questions were asked regarding the increase in levels of water of borewell where RWH was done. The sites were where RWH was not done they are still facing the problem of water scarcity. Z. P. School authorities, who are enjoying now the results of RWH, told that till now they were facing lot of shortage of water and the only source was Tanker water which was supplied on either alternate days or twice a week. After RWH has been implemented there is absolutely no need remaining for using tanker water. Authorities at B.N.Vidyalaya said that; they are enjoying ample use of water, even in the month of March, as otherwise their water in the borewell gets dried in the month of November itself. People at Police Station said they did not have the water at all for their regular use like for using toilets, washing purposes etc. but now after applying RWH not only the daily requirements of water are fulfilled, but also, water can be used for gardening purposes etc.

All the methods used for bacteriological analysis of harvested rain water and non harvested one, are according to Water Quality Monitoring –Edited by J. Bartram and R. Balance, A Practical Guide to the design and implementation of Fresh Water Quality Studies And Monitoring Programmes, Published on behalf of United Nations Environment Programme and the World Health Organisation@ 1996 UNEP/WHO. The discharge of wastes from municipal sewers which contains human faeces forms the important basis of bacteriological pollution of water. Water contaminated with such effluents may contain pathogenic microorganisms which cause health hazard to human health. Such faecal contamination of water is routinely determined by conducting microbiological analysis. The contamination is supposed to be severe when the indicator organisms are present in large numbers. Such bacteria are present in clumps in large numbers and do not present as individual bacteria. Hence the number of clumps of bacteria are to be counted while

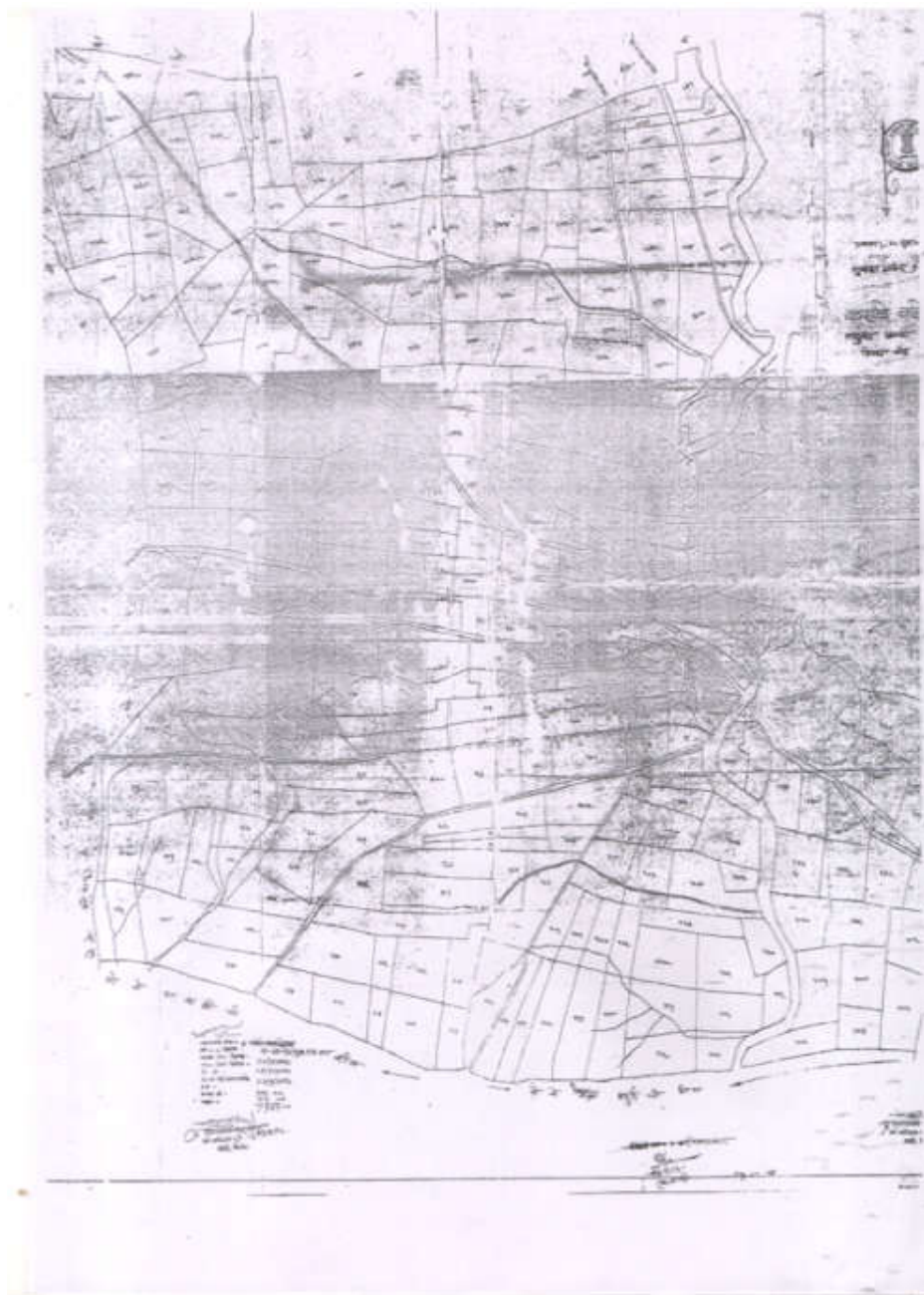
enumerating bacteria. Total coliforms refers to a large group of Gram negative, rod shaped bacteria that share several characteristics. The group includes Thermotolerant coliforms and bacteria of faecal origin, as well as some bacteria that may be isolated from environmental sources. Hence the presence of coliforms may or may not indicate faecal contamination. Total coliforms including E. Coli, is the working name of a small class of gram – negative Enterobacteriaceae that ferment lactose to produce gas and acid when incubated at 35°C for 24 – 48 hours. Faecal coliform is the heat inhibited thermotolerant form of E. Coli bacteria that continue to ferment some lactose to produce some gas and acid when incubated at 44.5°C for only 24 hours. Thus more than 95% of thermotolerant coliforms isolated from water are the gut organisms. According to WHO, it is observed that the mortality rate of water associated diseases exceeds 5 million per year. In general, the greatest microbial risks are associated with ingestion of water that is contaminated with human animal faeces.

The major source of faecal microorganisms is the discharge of wastewaters in fresh water resources. An adequate and accessible water resources must be available to all as water is an essential entity for life. Improving access to safe drinking water can result in significant benefits to health. Thus to achieve safe drinking water quality, all efforts should be taken. To improve water quality, Rain water harvesting could be a possible way. In the present research, an effort has been made to carry out comparative study on Bacteriological analysis of harvested rain water and a non harvested one.

To detect the presence of coliforms in water, two techniques are commonly used. In these studies, “Multiple Fermentation Tubes also called as MPN,” technique is used as it can be easily applicable to all types of waters. In this method portions of a water sample are placed in test-tubes containing a culture medium. The tubes are then incubated for at 27°C for 48 hours. Faecal coliform bacteria, or thermotolerant bacteria are studied, for their presence, in the laboratory by their ability to ferment lactose, with production of acid and gas at 44.5°C, for 24 hours by using Brilliant Green Lactose bile broth media. Confirmatory tests were repeated by following ring tests using Covax Reagent. All the results obtained were compared with permissible limits laid by WHO-UNEP-1996. The results obtained are given in Table 2

**Table 2. Bacteriological Analysis Data At Ten Different Sites**

| Sample Description                    | Coliforms/100ml | Thermotolerant Coliforms/100ml | E. Coli /100ml |
|---------------------------------------|-----------------|--------------------------------|----------------|
| Bhagini Nivedita Vidyalaya(B.N.V)     | 00              | 00                             | 00             |
| Residence beside B.N Vidyalaya        | More than 16    | 16                             | 16             |
| Zilla Parishad School,                | 03              | 00                             | 03             |
| Residence beside Z. P school          | 09              | 06                             | 06             |
| Mainstream Of Gram Panchayat Office   | 09              | 06                             | 06             |
| State Bank Of India                   | 00              | 00                             | 00             |
| Motilal Kothari Vidyalaya             | More than 16    | More than 16                   | 16             |
| Police Station Office                 | 03              | 00                             | 00             |
| Hotel at S. T stand                   | More than 16    | More than 16                   | 06             |
| Rasiklal Dhariwal College Of Pharmacy | 00              | 00                             | 00             |



Map Of Kada; (source: Department of Land Records, Ashti)



Zilla Parishad School, Kada.



**Underground Collection Tank for collecting Rain Water**

**RWH AT State Bank Of India, Kada**



Among these ten sites at only 5 sites RWH was done. The water supply at MK Vidyalaya was suggested to stop immediately as students of this school used to drink it everyday. Immediate cleaning of the water tank was done followed by standard dosing of chlorination to purify the water. At two residences, and at Gram Panchayat office also immediate actions were taken. Tanker water users were also educated and asked to do Chlorination immediately. It can be seen that the borewells where RWH was done, the sources get diluted and disinfected naturally.

### Conclusion

- After completing the Project, the researcher has conducted interviews of the beneficiaries to ascertain or to get feedback of the Project, the beneficiaries opined that the water level in their borewells has been increased substantially.
- These borewells were providing water upto the month of Dec- Jan only. After completion of Rain Water Harvesting project, these borewells provided the water upto the month of May. These people faced the scarcity of water in the month of May only. The researcher has not carried out scientific calculations for measuring increase in water level as the data for previous years for water level was not available.
- It is found out that water gets naturally purified by effective means of Rain Water Harvesting as the Total Coliforms, which are main indicators of water contamination decrease to negligibility.

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