Original Article

Household "rain water harvesting" – Who are practicing? Why are they practicing? A mixed methods study from rural area of Kolar district, South India

Nagesh Ramya[1], Mahendra M. Reddy[1], Prasanna B. T. Kamath[1]

[1]Department of Community Medicine, Sri Devaraj Urs Medical College, (SDUMC), Sri Devaraj Urs Academy of Higher Education and Research (SDUAHER), Tamaka, Kolar, Karnataka, India

Abstract

Background: "Rain Water Harvesting" is one of the identified strategies to replenish the ground water system in India. Household level of rain water harvesting could serve as an indicator for assessment of participation of local community. **Objectives:** To assess the proportion of household rainwater harvesting and factors associated with it and to find the reasons behind adoption of this practice in a rural area of Kolar district, Karnataka. **Methods:** An exploratory sequential mixed methods study design with an initial cross-sectional quantitative study followed by qualitative in-depth interviews was done to assess the factors affecting household rain water harvesting and reasons behind the practice. Household survey with interview of one person from each household was done. Quantitative data were reported using proportions and qualitative data were reported using categories and verbatim quotes. **Results:** Of the 82 households surveyed, 31 (37.8%, 95% CI: 27.8–48.6) had adopted at least crude method of rain water harvesting. Household belonging to either joint or three-generation family type was practicing rain water harvesting higher compared with nuclear family type. Reasons for adoption were included under the categories - *purity*, *fresh*, *tradition*, *less work*, *passion,* and *why waste*? **Conclusion:** About one in three households practiced rain water harvesting in the rural area under study with households belonging to joint or three-generation family practicing more compared with nuclear families. The reason for adoption was mostly based on beliefs and also felt needs by families.

Keywords: Rain water harvest, sustainable developmental goals, water and sanitation hygiene

Introduction

Water is an essential commodity for both human well-being and sustainability of the environment. Water resources play an important role for sustainable development of state. The Goal 6 of Sustainable Developmental Goals (SDG) to be achieved by all nations by 2030 is focused to "ensure availability and sustainable management of water and sanitation for all." Of all the targets for Goal 6, the target 6.6 is to "protect and restore water-related ecosystems" and is said to be achieved by the year 2020.[1,2]

Address for correspondence: Dr. Mahendra M. Reddy, Department of Community Medicine, 2nd Floor, Administrative Block, Sri Devaraj Urs Medical College, Tamaka, Kolar - 563 101, Karnataka, India.
E-mail: mahendrabmc@gmail.com

Received: 24-05-2019 **Revised:** 26-05-2019 **Accepted:** 24-06-2019

Access this article online

Quick Response Code:

Website: www.jfmpc.com

DOI: 10.4103/jfmpc.jfmpc_417_19

The achievement of Goal 6 of SDG is also dependent on the participation of the local community and this is said to be ensured and is mentioned under target 6b.[1,2] The inadequacy in management of available water resources has resulted in disparities in inter- and intrasectoral allocations leading to water conflicts. In this scenario, diagnosing these problems and providing sustainable solutions and thus helping in formulating policy for efficient water management forms the need of the hour.

There is a trend in decreasing domestic per capita water availability in state of Karnataka, South India. The state is divided into 10 agroclimatic zones on the basis of climate, soil, topography, cropping pattern, and availability of water

How to cite this article: Ramya N, Reddy MM, Kamath PB. Household "rain water harvesting" – Who are practicing? Why are they practicing? A mixed methods study from rural area of Kolar district, South India. J Family Med Prim Care 2019;8:2528-32.

resources.[3] Central Ground Water Board of India identified "Rain Water Harvesting and other Artificial Recharges" as a strategy to replenish the ground water system in India and also pilot tested various methods including two in taluks of Kolar district of Karnataka state.[4]

These projects were tested in university campus or focused on built of point recharge structures.[4] Household level rain water harvesting although was emphasized, actions taken to implement and educate community were far and few. There is no documented baseline data regarding household level rain water harvesting in India. Generating data on this could serve as an indicator for assessment of participation of local community.

In the state of Karnataka, the rules were amended by the Bangalore Water Supply and Sewerage Board, which provides for mandatory provision of rain water harvesting structure by every owner with site dimension of ≥2,400 ft^2, or every owner who proposes to construct new buildings with site area >1,200 ft^2.[4] Considering the fresh water scarcity in the district, the central ground water board of Kolar district called for formulating a comprehensive program to harvest the rain water through roof top, check dams, surface tanks, bunds, and subsurface dykes to use the resources directly from the structures, which, in turn, arrests the subsurface flows and augment the groundwater resources.[5] The SDG India index baseline report, 2018 showed that Karnataka state stands in 13th position in India with a score of 62 out of 100 with just falling short of the national average of 63 points with respect to achievement in SDG6.[6]

Further, a recent study analyzing the progress of SDG6 in India laid stress on creating local data to assess the indicators and also called for public along with the government, together to take more proactive steps toward promotion and utilization of water resources to achieve sustainable development goals in water and sanitation (i.e. SDG 6) in India.[7] Based on this background, this study was planned to assess the proportion of household rainwater harvesting and factors associated with it. The study also tried to find the reasons behind adoption of rain water harvesting practice in a rural area of Kolar district of Karnataka, which belongs to the "Eastern Dry" agroclimatic zone.

Methods

We used an exploratory sequential mixed method study design with an initial cross sectional study (quantitative) followed by in-depth interviews (qualitative) to know the household characteristics influencing rain water harvesting and the reasons for practicing it.[8]

Quantitative

A community-based cross-sectional study was conducted in a rural area of Kolar, Karnataka, South India. The main occupation of people is agriculture. In the absence of surface water irrigation system ground water is the main source of irrigation. The district has highest number of bore wells in the state. Being a semi-arid area, the district is drought prone. Normal annual rainfall ranges from around 650 mm at Gudibanda in the north to around 800 mm at Mulbagal in the east averaging 740 mm in the district. There is a general South to North decreasing trend in annual rainfall. The South-West monsoon contributes around 55% of the annual rainfall. The other monsoon (North-East) yields around 30%. The balance of around 15% results from the pre-monsoon. September and October are the wettest months with over 100 mm monthly rainfall.[5] It has been observed that the frequency of occurrence of drought is once in 5 years at Kolar taluk.[9] This study was conducted in a single village of Kolar district, Karnataka. This was a village with naturally formed two clusters based on caste [Scheduled Caste (SC)/Scheduled Tribe (ST) and Other Backward Caste (OBC's)].

Sample size was calculated keeping that at least 50% of the population will have access to good quality water, which was the primary objective; with absolute precision of 10%, the minimum required sample size was calculated to be 97 households (calculated using OpenEpi Version 3.01). A house-to-house survey was conducted during the period of July to October 2018 to collect the sociodemographic details and details regarding the domestic and drinking water use and other water-related practices at the household. All the households in the village were included in the study. The details regarding the family sociodemography and water related characteristics were collected from an adult female of the household using a pretested semistructured interview schedule after obtaining written informed consent. The household which is locked was again accessed the next two consecutive days and if still found locked on the third day, the household was considered to be "locked" and taken as nonresponse.

We included the practice of rain water harvesting to be present at the household level irrespective of the nature of the practice. This study was part of larger study which also assessed the water, sanitation, hygiene practice, and also the community perceptions and its concurrency with the biochemical findings done in laboratory.

Qualitative

In-depth interview was done among women and men who were the head of the households to find the reasons for practicing rain water harvesting (broad theme). The interview was conducted at their home, and each interview lasted for about 10 min. Convenient sampling technique was used to obtain the sample and the interviews were carried out till data saturation was achieved. The interview was conducted by the trained principal investigator who is a female aged 25 years. The coinvestigator who was also trained in the qualitative research acted as the note taker. All interviews were conducted in local language (Kannada) after obtaining written informed consent. The interviews were noted in English language directly and were later transcribed into word document on the same day of the interview for analysis purpose. At the end of each interview, the investigator read out the notes and confirmed the validity of the same.

This study protocol was approved by the Institutional Ethics Committee for Human Studies (SDUMC/KLR/IEC/20/2018-19).

Data entry and analysis

Quantitative

Data were single entered using Microsoft Excel and analyzed using IBM SPSS Statistics for Windows, version 20 (IBM Corp., Armonk, NY, USA). The outcome variable was expressed as proportion of households practicing rain water harvesting along with 95% confidence interval (CI). Continuous variable such as age were converted to categorical variables and expressed as frequency and percentage. All categorical variables such as gender, occupation, marital status, education, above/below poverty line status (APL/BPL), caste, and religion were expressed using frequency and proportions. Pearson Chi-square or Fischer's exact test were used to test the association. All variables which were significant in bivariate analysis ($P < 0.05$) were included in the model and multivariable logistic regression was done. The model significance was expressed using Nagelkerke R^2 and *P* value and the association was expressed using adjusted odds ratio (OR) with 95% CI.

Qualitative

Content analysis was done using inductive process of grounded theory from the data collected. The results were analyzed under the broad theme – "reasons for practising rain water harvesting."

We used open coding, wherein the data were divided into meaningful phrases. Categories were then identified to suit the central theme. All transcripts were entered in Microsoft word document. These transcripts were then manually coded into different categories by two different investigators. The results were reported using verbatim quotes under categories after reaching consensus between investigators. The differences if any were cleared with the help of third investigator. Investigator triangulation ensured the trustworthiness of qualitative analysis.[10,11]

Results

Out of total 108 households, enlisted a total of 82 households (76%) comprising of 464 individuals were surveyed. Of the 82 households surveyed, 31 (37.8%, 95% CI: 27.8–48.6) had adopted at least crude method of rain water harvesting for either agricultural purpose (18.3%), or household purpose (13.4%) or both (6.1%) [see Table 1].

Table 1: Proportion and purpose of rain water harvesting in a rural area of Kolar (*n*=82 households)

Purpose of rain water harvesting	Number (%)
Household purpose	11 (13.4)
Agricultural purpose	15 (18.3)
Both	05 (06.1)
Total	31 (37.8)

Bivariate analysis showed that family type (joint/three-generation family compared with nuclear family), age of the head of the household (<60 years compared with ≥60 years), education of the head of the household (no formal education compared with having formal education), and caste (SC/ST compared with OBC) showed having significant association with having adopted the practice of rain water harvesting [see Table 2].

Multivariable logistic regression analysis showed that household belonging to either joint or three generation family type were practicing rain water harvesting higher compared with nuclear family type after adjusting for age, education of the head of the household, and also the caste [see Table 3].

Qualitative analysis of transcripts identified reasons for these households to practice rain water harvesting which were represented under the categories - *purity, fresh, tradition, less work, passion*, and *why waste?* [see Table 4].

Discussion

In our study, it was found that about 37% of the households practiced rain water harvesting. Household belonging to joint or three-generation family were practicing rain water harvesting more compared with nuclear family. Reasons for adopting the practice was found to be because of beliefs of rain water being *pure* or *fresh* and also related to *passion* and *tradition*.

This is the first study which is reporting the status of household level rainwater harvesting. This study was conducted in a rural setting and in a single village and thus has limited external validity. About 37% of the households practiced some form of rain water harvesting in our study village. The village chosen was from the neighboring taluk of Mulbagal taluk in Kolar district.[4] Mulbagal taluk was one of the two taluks from Karnataka state, which was chosen for pilot project of rain water harvesting and artificial recharge project by Ministry of Water Resources, India. Thus, effect of this project on the study village cannot be ruled out and may have influenced the study result. This indicator of household level rain water harvesting could further be used as an indicator to measure the target 6b of SDG 6.

Households belonging to either joint or three-generation family type were showed to practice rain water harvesting more compared with nuclear families. This can be attributed to the nature of family functionality and also requirement of water. The higher requirement of water may influence the behavior or attitudinal changes in joint or three-generation families to adopt for other ways of storing water, which could have led to adoption of rain water harvesting.

The qualitative component of the study brought out the reasons for the adoption of rain water harvesting at household level. These were mostly related to beliefs among the household members especially the heads of the household. Belief related to the quality of rain water been "pure" and "fresh" have influenced in adopting in some households. As seen with any practice to be

Table 2: Household characteristics associated with practicing rain water harvesting in a rural area of Kolar (*n*=82 households)

Household characteristic	Total, *n*	Practicing rainwater harvesting, *n* (%)	Pearson Chi-square value	*P*
Family type				
Nuclear	39	06 (15.4)		
Joint	11	07 (63.6)	16.507	**<0.001**
Three generation	32	18 (56.3)		
Head of the household				
Male	71	26 (36.6)	0.316	0.740
Female	11	05 (45.5)		
Marital status of head of the household				
Married	71	24 (33.8)	3.605	0.092
Widow/separated	11	07 (63.6)		
Age of the head of the household				
<60 years	47	13 (27.7)	4.820	**0.039**
≥60 years	35	18 (51.4)		
Education of the head of the household				
No formal education	54	27 (50.0)	10.003	**0.002**
Has formal education	28	04 (14.3)		
Occupation status of Head of the household				
Unemployed	07	04 (57.1)	1.217	0.417
Employed	75	27 (36.0)		
Health status of head of the household				
No chronic disease	57	19 (33.3)	1.590	0.226
Chronic disease present	25	12 (48.0)		
Caste				
Scheduled caste/Scheduled tribe	65	21 (32.3)	4.030	**0.045**
Other backward caste	17	10 (58.8)		
Socioeconomic status				
Above poverty line	12	05 (41.7)	0.089	0.758
Below poverty line	70	26 (37.1)		

Table 3: Multivariable analysis showing household characteristics associated with practicing rain water harvesting in a rural area of Kolar (*n*=82 households)

Household characteristic	Adjusted odds ratio (95% confidence interval)
Family type	
Nuclear	Ref.
Joint	**6.33 (1.32-30.46)**
Three generation	**4.72 (1.29-17.33)**
Age of the head of the household	
<60 years	Ref.
≥60 years	0.96 (0.29-3.17)
Education of the head of the household	
No formal education	Ref.
Has formal education	0.32 (0.08-1.22)
Caste	
Scheduled caste/scheduled tribe	Ref.
Other backward caste	2.12 (0.63-7.16)

Model significance: Nagelkerke R^2=0.318, P=0.001

adopted at household levels, "beliefs" play a major role. In rural settings of India, "tradition" also play a major role in carrying forward few practices and this was also found to play a major role as reported by our study participants. Apart from this individual attributes such as "passion" to rain water harvesting was also seen to play a role in adoption of household rain water harvesting especially if it is of the head of the household.

As shown in quantitative analysis, joint or three-generation family had adopted rain water harvesting more compared with nuclear family and this was supported by the qualitative findings too. Work related to collection of water and storage was felt by the households to be reduced during rainy days if rain water is collected and stored for usage. Few households also felt when water is scarce then there is a need to collect rain water and use rather than waste the water. Thus, it was seen that as with any behavioral adoptions, individual beliefs and also felt needs played a major role in adoption of rain water harvesting in rural areas.

The study has few strengths. We have used a mixed method study design to explore the factors that are associated with household level adoption of rain water harvesting and thus give more credible information. We have used robust statistical methods to find the associated factors in quantitative analysis and also used manual content analysis for qualitative analysis, which is considered gold standard. This is also the first of its kind study from the region to report practices related to rain water harvesting. The study also proposes use of household rain water harvesting as an indicator to assess target 6b of SDG 6.

Table 4: Categories and corresponding verbatim quotes denoting the major theme of "why do you harvest rain water?"

Category	Verbatim quotes
"Purity"	".rain water is pure and it's always good to use it for all…. bathing washing etc." (30 year female)
"Fresh"	"rain water is best and also very fresh… it feels different to have a bath with rain water….(smiles)" (42 year male)
"Tradition"	"…my father always used to do it for his farming…. I just followed him and now my son too does the same… It is good practice know?" (80 year male)
"Less work"	"…oh if it rains then it reduces our burden…. the water can be used for all…washing, bathing… and we need to fetch water only for drinking…" (50 year female)
"Passion"	"….I like this … I mean what I do… from my young like we used to collect in cans….now we have done this…makes me happy (smiles)" (45 year male)
"Why waste?"	"why should we waste water….you know it's not easy to get water over here….if all do this…at least we will have other water use for some more time… what say?" (40 year male)

This study is not without limitations. The study was conducted in one village and thus has limited generalizability. We fell short the coverage by about 15% of the sample size in spite of repeated visits. We also have taken any type of rain water harvesting as a good practice and did not assess the quality of the rain water harvest method, which was outside the purview of the study.

The recent World Health Organization report on vision for primary health care in the 21st century identified water and sanitation as one of the 29 disease control priority projects or interventions and emphasize on community participation in achieving the dream sustainable primary care.[12] In lines with these priority areas, this study emphasize on the need for health advocacy to the community using local examples as models to change in their practice or behaviors related to safe water and sanitation.

Conclusion

About one in three households practiced rain water harvesting in the rural area under study with households belonging to joint or three-generation family practicing more compared with nuclear families. The reason for adoption was mostly based on beliefs and also felt needs by families. There is a need to adopt focussed educational interventions and also education regarding different ways of rain water harvesting, which can be adopted locally and made sustainable in long run.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

References

1. United Nations. Transforming our world: The 2030 Agenda for Sustainable Development [Internet]. New York, United States of America;2015:1-29. Available from: https://sustainabledevelopment.un.org/content/documents/21252030%20Agenda%20for%20Sustainable%20Development%20web.pdf. [Last cited 2019 Jul 10].
2. United Nations. Sustainable Development Goals: Knowledge Platform [Internet]. [cited 2019 Apr 21]; Available from: https://sustainabledevelopment.un.org/sdg6.
3. Central Ground Water Board, South Western Region, Karnataka. Ground Water Year Book of Karnataka, 2016–17 [Internet]. Bangalore, India;2017:1-37. Available from: http://cgwb.gov.in/Regions/GW-year-Books/GWYB-%202016-17/Karnataka.pdf. [Last cited 2019 Jul 10].
4. Central Ground Water Board, Ministry of Water Resources, Government of India. Select case studies: Rain water harvesting and artificial recharge [Internet]. New Delhi, India;2011:1-152. Available from: http://mahenvis.nic.in/Pdf/Report/report_nrmc_water%20harvesting.pdf. [Last cited 2019 Jul 10].
5. Central Ground Water Board, South Western Region, Karnataka. Ground Water Information Booklet, Kolar District, Karnataka [Internet]. Bangalore, India; 2012. p. 1-20. Available from: http://cgwb.gov.in/District_Profile/karnataka/2012/KOLAR_2012.pdf. [Last cited 2019 Jul 10].
6. NITI Aayog. SDG India Index – Baseline Report, 2018 [Internet]. New Delhi, India;2018:1-175. Available from: https://niti.gov.in/writereaddata/files/SDX_Index_India_21.12.2018.pdf. [Last cited 2019 Jul 10].
7. Roy A, Pramanick K. Analysing progress of SDG 6 in India: Past, present, and future [Internet]. bioRxiv 2018;344184. Available from: https://www.biorxiv.org/content/early/2018/06/25/344184.full.pdf. [Last cited on 2019 Jul 10].
8. Creswell JW, Plano Clark VL. Designing and Conducting Mixed Methods Research. SAGE Publications, New York; 2017. p. 1-520.
9. Central Ground Water Board, South Western Region, Karnataka. Kolar Taluk Aquifer Maps and Management Plans, Kolar District, Karnataka [Internet]. Bangalore, India; 2016. p. 1-18. Available from: http://cgwb.gov.in/AQM/NAQUIM_REPORT/karnataka/Kolar.pdf. [Last cited 2019 Jul 10].
10. Corbin JM, Strauss AL. Basics of qualitative research : Techniques and procedures for developing grounded theory. SAGE Publications, New York; 2015. p. 1-456.
11. Corbin JM, Strauss A. Grounded theory research: Procedures, canons, and evaluative criteria. Qual Sociol 1990;13:3-21.
12. World Health Organization, United Nations Children's Fund. A vision for primary health care in the 21st century – towards universal health coverage and the sustainable developmental goals [Internet]. Geneva, Switzerland; 2018. p. 1-40. Available from: https://www.who.int/docs/default-source/primary-health/vision.pdf. [Last cited on 2019 Jul 10].