J. Farm Sci., 31(3): (329-332) 2018

RESEARCH PAPER

Roof -top rainwater harvesting in Dharwad and Hubballi cities

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(Received: July, 2017 ; Accepted: September, 2018)

Abstract: Water is one of the vital natural resource supporting human health, economic development and ecological diversity. Many parts of Karnataka have continued to experience drought conditions with an alarming consistency. The rivers are getting contaminated and drying up, while underground water table is shrinking swiftly. The municipality water supply system meets only a part of the household requirement while the remaining part is addressed by water from bore wells or purchased from uncertain sources. In this concern Roof-top rainwater harvesting (RRWH) has proven to be cost effective technology in mitigating water scarcity. Rainwater is the purest form of water and is a boon for arid and semi-arid regions, if harvested accurately then it can eliminate problems of water scarcity and droughts. Hubballi-Dharwad Municipal Corporation (HDMC) has provided corporation water facility to all the residential areas yet people face acute water scarcity problems which increases in summer season. Hence, to solve water scarcity they made adoption of RRWH mandatory for all residential and commercial buildings constructed in Dharwad and Hubballi cities. This study was conducted in order to analyze the reason for adoption and utilization for RRWH systemin some selected areas of Dharwad and Hubballi cities. The results of the study revealed that majority of the people adopted the system because of drying up of surface and ground water resources. They utilized the harvested rainwater for recharging their bore wells, while only five houses used it for drinking. Majority of the non-adopters did not adopt it because of insufficiency for their use. But showed interest to adopt if they were granted a subsidy or concession in their monthly water bills. This study concludes that along with compulsion for adoption of RRWH public should also be thoroughly educated about this sustainable self-reliant technology for encouraging adoption and utilization.

Key words: Adopters, Rainwater, Residential, Roof-top

Introduction

As said by the UN Secretary General, Ban Ki-moon "Water is central to the well-being of people and the planet". Water is one of the vital natural resource, supporting human health, economic development and ecological diversity. Dharwad district receives relatively good rainfall, but the other side of the story is: many parts have continued to experience drought conditions with an alarming consistency. The rivers have been getting contaminated and drying up. The underground water table is shrinking swiftly. Water is being used at a much faster rate than it could be replenished by rainfall. The municipality's water supply system meets only a part of the household requirement (Bhutani and Seghal, 2014).

Many countries are showing a resurgent interest in Rainwater harvesting (RWH) techniques. It can be part of a new urban water management paradigm that is more sustainable than the traditional methods (Villarreal and Dixon, 2005). Despite of a rich traditionof RWH in the past in India, the art has been put in back drop by the populace. Rainwater harvesting is a technology that can be used for collecting and storing rainwater from rooftops, open land surfaces using simple storage structures such as tanks, pits and cistern and help to combat the chronic national water shortage scenario.

Harvested rainwater is a renewable source of clean water that is ideal for multiple uses. The greater attractions of a Rainwater Harvesting system (RWHS) are its accessibility and easy maintenance features. Rainwater quality is always better than the surface and ground water because it does not contaminate with soil and rocks, hence does not dissolve salts and mineral which are harmful for potable and non-portable uses (Anonymous, 2005). It improves the quality of ground water through dilution when ground water is recharged and also reduces soil erosion and flooding in urban areas.

Increasing population and economic growth rate, demands for the increased supply of surface water in Dharwad and Hubballi cities. The rainwater harvesting is a simple and financially efficient way of managing water resource guaranteeing sustained and long-term source of water to the community. Based on the above rationale the study was carried out with the objectives to study the reasons for adoption and non-adoption of roof- top rainwater harvesting and to explore the purpose of usage of harvested rainwater.

Material and methods

The present investigation was conducted during the year 2016-17 in selected areas of Dharwad and Hubballi cities. Through purposive random sampling technique 120 houses were selected for the study from 15 localities of Dharwad city and 16 localities of Hubballi city. The total sample was divided into 60 adopters and 60 non-adopters for the purpose of comparative analysis. Structured interview schedule was used to elicit the necessary information. The discrete data were presented as proportions (percentages), while continuous

variables such as age and size of the family were expressed as mean ± standard deviation. The variables such as Education, Occupation and monthly income were classified according to Gururaj and Maheshwaran (2014) while Type of family was classified according to Bhutani(2014).

Results and discussion

The data on socio economic characteristics of the selected adopters and non-adopters of rainwater harvesting system of Dharwad and Hubballi cities presented in the Table 1 reveals that more than half of the selected adopters from Dharwad and Hubballi cities (56.67%) belonged to the Young age group (Less than 40 years) and contradictorily less than half of the selected non-adopters (46.67%) belonged to the Old age group (More than 47 years). This may be due to the experience of water scarcity and awareness of water conservation among youngsters. The findings of the present study are inline with the study conducted by Bhutani (2014) who found that selected adopters from Hisar district of Haryana state majority (43.00%) belonged to age group 25 to 40 years. The trend in type of family of all the selected respondents is nuclear family *i.e.,* 78.33 per cent among adopters and 63.33 per cent among non-adopters with majority of the families having 3-4 members in each family. In case of education of head of the family 91.67

Table 1. Socio economic characteristics of selected adopters and non-adopters of RWHS (N=120)

Sl. No.	Variables	Dharwad (n=60)		Hubballi (n=60)		Total (N=120)	
		Adopters (n=30)	Non-adopters (n=30)	Adopters (n=30)	Non-adopters (n=30)	Adopters (n_1=60)	Non-adopters (n_2=60)
1	Age (in years of Head of the family)						
	Young age (< 40)	16 (53.33)	5 (16.67)	18 (60.00)	10 (33.33)	34 (56.67)	15 (25.00)
	Middle age (40–47)	4 (13.33)	10 (33.33)	4 (13.33)	7 (23.33)	8 (13.33)	17 (28.33)
	Old age (> 47)	10 (33.33)	15 (50.00)	8 (26.67)	13 (43.33)	18 (30.00)	28 (46.67)
2.	Type of family						
	Nuclear Family	22 (73.33)	17 (56.67)	25 (83.33)	21 (70.00)	47 (78.33)	38 (63.33)
	Joint Family	8 (26.67)	13 (43.33)	5 (16.67)	9 (30.00)	13 (21.37)	22 (36.67)
3.	Family size						
	Small (< 3)	1 (3.33)	3 (10.00)	3 (10.00)	1 (3.33)	4 (6.67)	4 (6.67)
	Medium (3-4)	21 (70.00)	18 (60.00)	22 (73.33)	16 (53.33)	43 (71.67)	34 (56.67)
	Large (> 4)	8 (26.67)	9 (30.00)	5 (16.67)	13 (43.33)	13 (21.37)	22 (36.67)
4.	Education (Head of the family)						
	Primary school	-	-	3 (10.00)	5 (16.67)	3 (5.00)	5 (8.33)
	High school certificate	-	-	-	1 (3.33)	-	1 (1.67)
	Post high school	-	-	4 (13.33)	5 (16.67)	4 (6.67)	5 (8.33)
	Graduate and Post graduate	30 (100.00)	30 (100.00)	25 (83.33)	17 (56.67)	55 (91.67)	47 (78.33)
5.	Occupation (Head of the family)						
	Professional	19 (63.33)	21 (70.00)	17 (56.67)	16 (53.33)	40 (66.67)	33 (55.00)
	Semi-professional	11 (36.67)	9 (30.00)	13 (43.33)	14 (46.67)	20 (33.33)	27 (45.00)
6.	Family Monthly income (rupees)						
	≥ 36017	14 (46.67)	11 (36.67)	25 (83.33)	26 (86.67)	25 (41.67)	51 (85.00)
	18000–36016	16 (53.33)	19 (63.33)	5 (16.67)	4 (13.33)	35 (58.33)	9 (15.00)
7.	Socio economic status						
	Upper middle class	30 (100.00)	30 (100.00)	30 (100.00)	30 (100.00)	60 (100.00)	60 (100.00)

Note: Figure in the parenthesis indicates percentage.

per cent of adopters and 78.33 of non-adopters were graduates and post graduates and had professional occupations such as Engineers, Doctors and Chartered Accountants etc. The trend in family income varied among both categories with more than half of the adopters earning ₹18,000/- to ₹ 36016/- monthly while majority (85.00%) of non-adopters earning more than or equal to ₹ 36017/- monthly. According to the classification of socio economic status by Gururaj and Maheshwaran (2014) all the selected respondents belonged to Upper middle class.

Table 2 depicts the reason for adoption of RWHS by selected adopters. Thirty adopters each from Dharwad and Hubballi cities were selected for exploring the reason for adoption of RWHS. The adopters from Dharwad city state the reason that compulsion by local municipality made 63.33 percent of them to adopt RWHS while in case of Hubballi city Self-interest was the major reason (56.67%) for adoption.The adopters who quoted self-interest as the reason for adoption of RWHS told drying up of surface and ground water source (40.00%) as major reason for adoption of RWHS, followed by other reasons such as convenient to use at home (28.33%), low quality of other water resource (13.33%), preference towards usage of rainwater (11.67%) and reduces water bill (3.33%) for self-interest in adoption of RWHS. The results of the present study are contradictory to the findings of Umamani and Manasi (2012) who found that among selected respondents 79.00 per cent adopted mainly because of force exerted by Bangalore Water Supply and Sanitation Board rather than self-interest.

The data presented in Fig. 1 depicts various purposes for which harvested rainwater was used. The purposes for which the harvested rainwater was used were recharging bore wells, recharging aquifers, used for domestic purposes, drinking and cooking, personal hygiene, washing clothes and utensils, toilet flushing and cleaning and gardening and washing vehicles.

Table 2. Reason for adoption of Roof-top rainwater harvesting system

(n_1=60)

Sl. No.	Particulars	Adpoters		
		Dharwad (n=30)	Hubballi (n=30)	Total (n=60)
1.	Reason for adoption of RWHS			
	Self interest	11 (36.67)	17 (56.67)	28 (46.67)
	Compulsion by local municipality	19 (63.33)	13 (43.33)	22 (36.67)
2.	Reason for interest in adoption of RWH			
	Reduces water bill	2 (6.67)	—	2 (3.33)
	Drying up of surface and ground water sources	11 (36.67)	13 (43.33)	24 (40.00)
	Convenient to use at home	7 (23.33)	10 (33.33)	17 (28.33)
	Prefer to use rainwater over other water sources	4 (13.33)	3 (10.00)	7 (11.67)
	Low quality of other water sources	1 (3.33)	7 (23.33)	8 (13.33)

Note: Figure in the parentheses indicates percentage

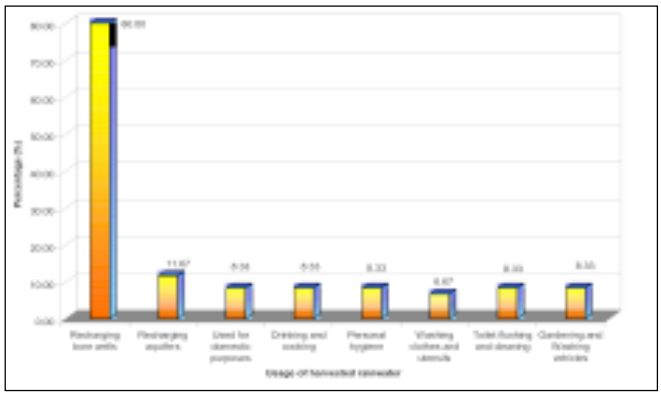

Fig. 1. Usage of harvested rainwater

Among the selected adopters irrespective of the locale of the study a majority (80.00 %) of the selected adopters used harvested rainwater for the purpose of recharging bore wells, while 11.67 per cent of the adopters used harvested rainwater for the purpose of recharging aquifers. Meanwhile an equal percentage *i.e.,* 8.33 per cent of the selected adopters used harvested rainwater for the purpose of domestic purposes, drinking and cooking, personal hygiene, toilet flushing and cleaning and gardening and washing vehicles. Similarly Umamani and Manasi (2011) from their study concluded that majority of them used harvested rainwater for recharging groundwater.

Table 3 reveals that irrespective of the study area majority (91.67%) of the selected adopters did not use harvested rainwater for drinking purpose. This was followed by 6.67 per cent of the adopters used harvested rainwater for drinking because of the assurance of quality and only 5.00 per cent used because of the ease of access. Among the rest of the adopters an equal percentage (3.33 %) said they used harvested water for drinking because it was clean and unpolluted. Among the selected adopters, cent per cent of them used same tank for storing both municipality and rainwater. About 60.00 per cent of the adopters coated inner walls of storage tank with limestone, while 40.00 per cent of them used electrolyte formula as precautionary measures before drinking harvested rainwater. The majority (60.00 %) of the selected adopters did not experience any health impacts because of drinking harvested rainwater. Whereas rest them experienced cold as well as cough (20%) and throat infection (20%) because of drinking harvested rainwater.

Fig. 2 depicts the multiple reasons cited for non-adoption of RWHS.From the figure it is evident that major reason for non-adoption (46.67%) was 'harvested rainwater will not be sufficient for usage'. Furthermore about 40.00 per cent of them had pipe born water /municipality water supply facility and hence they did not install RWHS, while 36.67 per cent of them cited 'entry of fauna into the storage tank' as the reason non-adoption.The other reasons for non-adoption were 'not interested to install RWHS' by 28.33 per cent, 'not like to use rainwater' by 13.33 per cent, 'colour of harvested rainwater is unacceptable' by 11.67 per cent and 'have tube well' by 3.33 per cent and hence they did not adopt RWHS.

Table 3. Reasons for using harvested rainwater for drinking purpose (n_1=60)

Sl. No.	Variables	Adopters		
		Dharwad (n=30)	Hubballi (n=30)	Total (n_1=60)
1.	Reasons for drinking harvested rainwater			
	Easy access of water	2 (6.67)	1 (3.33)	3 (5.00)
	Cleanliness of water	1 (3.33)	1 (3.33)	2 (3.33)
	Quality assurance of water	2 (6.67)	2 (6.67)	4 (6.67)
	Water is unpolluted	1 (3.33)	1 (3.33)	2 (3.33)
	Not used for drinking	27 (90.00)	28 (93.33)	55 (91.67)
2.	Precautionary measures before drinking rainwater			
	Use electrolyte formula	1 (33.33)	1 (50.00)	2 (40.00)
	Coat inner walls of storage tank with limestone	2 (66.67)	1 (50.00)	3 (60.00)
	Use same tank for storing municipality and rainwater	3 (100.00)	2 (100.00)	5 (100.00)
3.	Health impact of using rainwater			
	Cold and cough	1 (33.33)	-	1 (20.00)
	Throat infection	-	1 (50.00)	1 (20.00)
	None	2 (66.67)	1 (50.00)	3 (60.00)

Note: Figures in the parentheses indicates percentage. Multiple responses

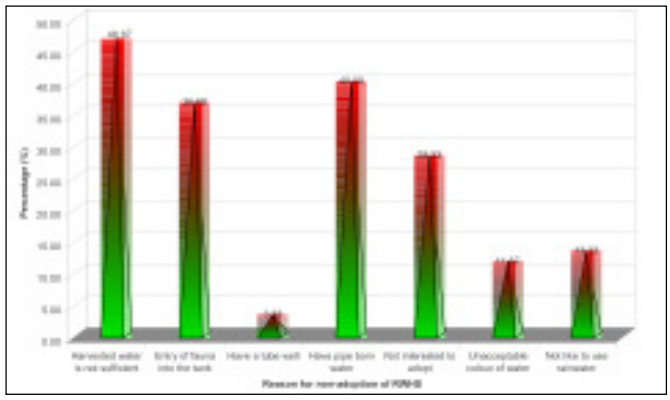

Fig. 2. Reason for non-adoption of Roof-top rainwater harvesting system

Conclusion

Among the selected adopters majority of them adopted RWHS with self-interest.The selected adopters of RWHS used harvested rainwater for the purpose of recharging bore wells and aquifers. Cent per cent of the selected adopters used same tank for storing both municipality and harvested rainwater. The adopters coated inner walls of storage tank with limestone or used electrolyte formula as precautionary measure before using it for drinking. Furthermore majority (60.00 %) of the adopters did not experience any health impacts because of drinking harvested rainwater, while less than half of the adopters suffered from cold, cough and throat infection because of drinking harvested rainwater. The reason behind this is filtration component was absent in the RWHS and they were not trained about operation and maintenance, hence suffered from water borne infections. By making RWHS as a part of a new urban water management paradigm, hopefully we can attain water sustainability. The state government and local municipality must bring subsidy and concession in water bills as measures for promoting adoption of RWHS, then the day will not be far when water will be seen as a renewable resource.

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