International Journal of Farm Sciences **2(1)** : 124-130, 2011

Benefits and economic viability of domestic rooftop rainwater harvesting

PS GOTUR and S DEVENDRAPPA*

Economics Department, Karnatak University, Dharwad, 580003 Karnataka
***University of Agricultural Sciences, Dharwad 580005 Karnataka**
Email for correspondence: sdevuasd@rediffmail.com

ABSTRACT

The government of Karnataka in the year 2005-06 implemented domestic rooftop rainwater harvesting (DRWH) programme through the Rural Development and Panchyati Raj Department in all the 176 Talukas (sub-divisions) of 27 districts (divisions) of the state. This programme covered one village in each Taluka of the state with at least 20 household level rooftop rainwater harvesting systems. The main objective of the present study was to analyze the benefits of DRWH programme and examine the economic viability of DRWH structures. The study revealed that the DRWH systems were very much beneficial to the sample households in terms of saving time for water fetching and supplying water for different economic activities like pottery, hotel management, kitchen garden, sericulture and silk sarees weaving in the study area. This led to increase in the income of the people and reduction in the production cost. The study on economic viability of investment in DRWH technology revealed that the Net Present Worth (NPW) was positive, B:C ratio more than unity and Internal Rate of Returns (IRR) more than that of referenced bank rate and Pay Back Period (PBP) was very low. These all indicated that the investment in DRWH was financially more feasible and adoption of DRWH technology in the study area was economically attractive.

Keywords : Agricultural labour, domestic rooftop rainwater harvesting

INTRODUCTION

Water conservation is a central issue in achieving sustainable development. Water conservation means planning, protecting and managing of water resources to overcome the major problems of drought and water scarcity (Mohan and Sarkar 2005). In India Karnataka state is endowed with limited surface and ground water resources. At present increasing population, water pollution problems, mismanagement of water resources, over extraction of groundwater, high level of fluorides, nitrates and arsenic in the groundwater are creating water related problems in the state. In this situation it is essential to propagate the rainwater harvesting technology in the water resource development strategy of the government. Hence the government of Karnataka has given top priority to development of rainwater harvesting methods and has implemented various programmes to promote rainwater harvesting in the state. The government of Karnataka in the year 2005-06 implemented domestic rooftop rainwater harvesting (DRWH) programme through the Rural Development and Panchyati Raj Department in all the 176 Talukas (sub-divisions) of 27 districts (divisions) of the state. This programme covered one village in each Taluka of the state with at least 20 household level rooftop rainwater harvesting systems. The Rajiv Gandhi Navagrama housing colonies (habitations) that were allocated to the poor families were selected for this project. The main objective of the present study was to analyze the benefits of DRWH programmes and examine the economic viability of DRWH structures.

METHODOLOGY

For the present study 12 Navagrama housing colonies (habitations) of 12 villages from 12 Talukas of Bangalore urban and rural districts, Karnataka state were selected which covered total 240 DRWH systems implemented by the government. Out of the 240 beneficiary households 216 were randomly selected for the present study. Bangalore rural and urban districts are situated in the heart of the South-Deccan Plateau in peninsular India to the South-Eastern corner of Karnataka between the latitudinal parallels of 12^{o} 39' N and 13^{o} 18' N and longitudinal meridians of 77^{o} 22' E and 77^{o} 52’E at an average elevation of about 900 meters. The annual average rainfall of the Bangalore urban district is 936 mm and Bangalore rural district is 879. The case study method of research was employed for the present study. The primary data on household composition, socio-economic aspects, management, impacts and benefits of DRWH structures were collected from the selected 216 sample beneficiaries using well-structured and pre-tested interview schedules. Secondary data relevant to the present study were obtained from the various official sources. In the present study the financial feasibility of DRWH structure was studied to determine whether the technology was economically viable or not by using four measures viz Net Present Worth (NPW), Benefit Cost Ratio (BCR), Pay Back Period (PBP) and Internal Rate of Returns (IRR).

RESULTS AND DISCUSSIONS

Rainwater harvesting programmes

During 2005-06 government of Karnataka under the centrally sponsored Acceralated Rural Water Supply Programme organized various programmes to promote rainwater harvesting in the state through the Rural Development and Panchyati Raj Department. The main objectives of rainwater harvesting programmes were to conduct awareness programmes through various workshops and trainings on rainwater harvesting in rural and urban areas, to establish Rain Centers to provide detailed technical guidance on rainwater harvesting to the public and to implement DRWH structures in the selected Navagrama housing colonies in all the 176 talukas of the state (Anon 2006).

Description of domestic rooftop rainwater harvesting technology

In general DRWH technology refers to collection of rainwater from rooftop for domestic purposes. DRWH system has three main components (i) the catchment surface to collect the rainwater (roof) (ii) the delivery system to transport the water from the roof to the storage reservoir (gutters and drainpipe (iii) the reservoir to store the rainwater until it is used (tanks). The historical evidence of DRWH systems dated back to early Roman times 2000 BC and Roman cities were designed to use rainwater as the principal water source for drinking and domestic purpose (Andrew 2003). In Australia the use of domestic rainwater tanks is common practice and as per the survey about 13 per cent of Australian households use rainwater tanks as a source of drinking water (Cunliffe 1998). In the present DRWH system the rainwater from 25 square meter cement sheet roofs was collected using PVC gutters of appropriate dimensions and slope then filtered through sand bed filter and collected into the 2000-2500 l capacity masonry surface tanks. Each DRWH system received a grant of Rs 5000/- from the government. Hence the total investment on DRWH systems in the study area was Rs 12,00,000/- (Anon 2005).

Profile of the sample households

As per the survey 83 per cent of the sample households lived as nuclear families and only 17 per cent households lived as joint families, 45 per cent of them being males and 55 per cent females, 11 per cent below six and 18 per cent above sixty years of age. The average size of the household was 4.5. The education status of sample households revealed that out of total population 66 per cent were illiterate, 21 per cent educated up to primary level and 8 per cent up to high school level, 4 per cent had PUC education and only 1 per cent were educated up to degree level. In total 97 per cent of the households belonged to Hindu religion and only 3 per cent were Muslims. The main occupation of them was agriculture. The majority (88%) of the sample households were agricultural laborers and marginal farmers and remaining 12 per cent households were engaged in other occupations like pottery, sericulture, hotel management and silk saree weaving.

Water supply and water fetching system in the study areas

In the study area water supply system for domestic use was very poor. Some areas were remote villages and water resources were located at a distance of 1 to 2 km. Here the water was being supplied through public taps for 2-3 h daily and through public mini-tanks. Since supply of water mainly depended on electricity there was always water shortage problem due to disruption and irregular power supply. Due to this people had to spend more time in collecting or queuing for water. The total daily demand for water by sample households was 76,455 l for all domestic purposes. People generally used about 15 l capacity metal or plastic pots (locally called Bindagi) for carrying water. Taking into consideration these factors the time used for collecting water was calculated in the study area and the data are given in Table 1. The data revealed that time for one trip of water carrying with a pot capacity of 15 l was around 12 min. Hence total time spent by sample households per day for fetching water for domestic requirement was about 1,020 h with average daily time spent for water fetching per household 4.7 h.

Utilization of water from domestic rooftop rainwater harvesting system

As per the survey drinking, cooking, bathing, flushing toilet, washing clothes and utensils, lives stock, kitchen gardening, pottery, hotel management etc were the main activities for which collected rainwater was used in the study area. All the beneficiaries used the collected water for their basic necessities. Apart from their

Table 1. Time required for fetching of water in the study area

S No	Factors/Particulars	Units	Quantity
1.	Water pot capacity	l	15
2.	Average distance between residence and to water point	km	0.76
3.	Average time required to cover the distance between residence and to water point	min	6 *
4.	Average time for queuing	min	5
5.	Time for filling pot	min	1
6.	Total required to collect one pot of water	min	12
7.	Time for fetching 1 liter water	min	0.8
8.	Time spent per day by sample households for water fetching	h	1,020**
9.	Average time spent for water fetching per day per household	h	4.7

*Walking speed 8 km per hour, **Total daily demand of water 76,455 litres basic necessities some of the households used this water for other purposes like kitchen gardening, livestock, pottery, sericulture, hotel management etc.

Benefit to agricultural labour community in the study area

Generally the area received main rainfall from the southwest monsoons during June to September. During this period the area experienced sufficient rainfall and the village households used this rainwater collected through DRWH for their day-to-day requirements for nearly 120 days showing thereby that DRWH systems were very beneficial to the people in terms of saving their time they spent on fetching water besides supplying water for different economic activities like, pottery, hotel management, kitchen garden, sericulture and silk sarees weaving. This has also increased their income and reduced the production cost. As per the survey 596 persons were involved daily in water fetching in the sample households. Out of them 74 per cent (440) were agricultural laborers who spent 753 hours (95 man days) per day. Thus on an average annual benefit to agricultural labour was Rs 3,887/- (Table 2).

Economic viability of domestic rooftop rainwater harvesting technology

Economic viability of investment in DRWH technology for agricultural labour community was calculated by using four measures viz Net Present Worth (NPW), Benefit Cost Ratio (BCR), Pay Back

Table 2. Benefit to agricultural labour community in the study areas

S No	Details	Unit	Quantity
1.	Total farm labourers	Number	440
2.	Daily time spent by agriculture labour for water fetching	h	753
3.	Per day opportunity cost	Rs	14,250*
4.	Opportunity cost of saved time due to the DRWH	Rs	17,10,000**
5.	Average annual benefit to agriculture labour from DRWH	Rs	3,887.00

* Wage rate Rs 150 / man day (8 hours) in the study area. **Water for 120 days/ 4 months of rainy season in a year

Period (PBP) and Internal Rate and Return (IRR). The economic life of DRWH system was assumed to be 15 years. Cash flows were discounted at 10 per cent discount rate as this rate represents prevailing bank rate. The construction cost per DRWH structure Rs 5000/- was considered as an initial investment and average Rs 100/- was taken into account for annual maintenance cost of the DRWH structures. The data on economic viability of investment in DRWH technology are presented in the Table 3.

The data reveal that the calculated annual average benefit (value of time saved) to agricultural labour due to the DRWH system was Rs 3,887/-. On this basis the Net Present Worth (NPW) of investment on DRWH works was Rs 28,895.13/- and was found positive. For agricultural labour the BCR was 5.67 greater than unity which means the adoption of DRWH structure was economically sound. The calculated IRR was as high as 50.24 per cent which was greater than the reference rate (10 per cent) and this measure also indicated the economic viability of DRWH systems for agricultural labour. The calculated Pay Back Period (PBP) was found to be 13 months and was very low. It revealed that the investment in DRWH was economically attractive for the agricultural labour.

CONCLUSION

DRWH systems were found to have positive impact on productivity, employment and income of the rural households. All the economic indicators of investment on DRWH technology justified with positive NPW, B: C ratio of more than unity, the IRR of investment with high per

Table 3. Economic viability of investment in DRWH technology

S No	Details	
1.	Annual Benefit (Rs)	3,887.00
2.	Net Present Worth (Rs)	28,895.13
3.	Benefit Cost Ratio	5.67
4.	Internal Rate of Return (%)	50.24
5.	Pay Back Period (months)	13.00

cent and payback period very low. It indicated economical viability of the DRWH technology in the study area. Hence the rural households need to be encouraged to follow this technology particularly in the areas where groundwater level has declined and surface water supply was not adequate.

REFERENCES

Andrew LoKF 2003. Rainwater harvesting and utilization : an introduction. International Training course on Rainwater Harvesting and Utilization, Government of Gansu Province, China, pp 1-24.

Anonymous 2005. Status of rainwater harvesting project. Rural Development and Panchyath Raj Department, Government of Karnataka, Bangalore.

Anonymous 2006. Documents and reports of rainwater harvesting project. Karnataka State Council for Science and Technology office, IISc, Bangalore.

Cunliffe DA 1998. Guidance on use of rainwater tanks. National Environmental Health Forum, Australia, p8.

Mohan D and Sarkar S 2005. River interlinking and rainwater harvesting: a comparison in Indian perspective. Proceedings of 12th International Rainwater Catchments Systems Conference, New Delhi.

Received: 24.5.2011 *Accepted: 28.9.2011*