# Benefits being derived by Roof Water Harvesting structures in Khetikhan, Champawat, Uttarakhand- A case study

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## Abstract:

Realizing that increased frequency of sudden climate events is likely to affect water and livelihood resources adversely. The dependency on water for future development has become a critical constraint for development. Rains are the main source of water and if rain water is harvested, the scarcity of water can be eliminated altogether. This is an ideal solution of water problem. This paper presents the best way of utilizing the stored water. Rainfall harvesting from rooftops can increase the water supply for various uses such as vegetable cultivation and domestic use of cattle. This study is conducted in Champawat district of Uttarakhand. This Rooftop water harvesting tanks are constructed under Climate Change Adaptation project., which is funded by AFB-NABARD and implemented by BAIF Development Research Foundation. Rainwater harvesting is considered as a best alternative to bridge the gap between the demand and supply.

Key word: Rain Water Harvesting Tank,

## Introduction:

The district Champawat is rich with natural perennial rivers and rivulets, but due to uneven geographical conditions the major portion of water drains off through small rivers and rivulets. Only about 9 percent of total land is termed as agricultural irrigated land. The major portion of land is dependent on the rain water only, which has adverse effect on agricultural production. Despite plenty of resources the inhabitants of the area are dependent upon rain water. In the hill villages women usually cover almost 5-6 kms for collection of drinking water each day. Champawat district has average rainfall is of 1,600 mm spread over 100 days (approx.) in a year, even though, because of high rain-water run-off for almost 3-4 months there is low to non-availability of water in the area. For retention of water at an individual household, it is proposed to introduce rain-water harvesting structures, through which a total of 150 families that have concrete houses and rooftops to collect and channel the rainwater will be targeted. (It is proposed to collect water from an area of 100 sq m with proper slopes and water channels with pipes of 150 m. the water thus collected is proposed to be stored in a storage tank having capacity of 15,000 litres). In the selected villages, farmer's field lies in the lower terrain while the houses are on the higher terrain, (terrace like structure), hence water stored in the tank will be transferred to field through gravitational force. The average water that can be collected per household will be around 15,000 litres. This will be used mainly for irrigation and household use. The purpose here is to provide access to water near the household when other sources of water are not available. This is proposed as decentralized intervention for effective rainwater collection, storage and distribution. Each of these structures includes pipelines for collection of water to the main inlet and an underground water capacity of 15,000 liters. The dimensions of underground tank is approximately 4m X 2.5m X 1.5m. The structure will be covered with a tin shed. It is proposed to include the individual family's contribution in the form of labour. The storage tank is filled during the month of July-September (monsoon) and

October-November (Post monsoon), which is used in April to June, when the entire spring and water reservoir in the surrounding area get dried. As this structure is at individual household level, it is up to the family that they want to share it with others or want to use for themselves. Because of availability of water throughout the year, they can actually plan for agriculture activities in all three seasons. The prominent reasons behind are the increasing demand for water due to the increasing population and extensive use of water by agricultural sector, which continues to be the single largest consumer of water (CGWB. 2000, -NLC. 2006). The projected total water demand by year 2025 is around 1050 billion cubic meters BIS (1742-1983) The country‘s annual utilizable water resources are assessed around 1140 billion cubic meter. Thus, almost the entire utilizable water resources would be required to be put to use by the year 2025.

## Study Area:

The present study was conducted in Champawat district of Uttarakhand located at 29º5′ and 29º 30 ′ North and 79º 59′ and 80º3′ East. The district mainly consists of mountain ranges, large valleys, uneven landscapes, rivers and rivulets. Out of 717 villages, only 35 villages falls in terai region (plain area) having altitude of 200-250m, which has abundance of water and good quality soil. Shivalik region (altitude height250-1200 m) represents sloping and uneven topographical land consisting of dense forest. Most of the villages of Champawat district fall in this region. Out of the total geographical area of 1766 sq km, 65 percent of the area is forest. Only 10% of the total geographical area is net sown area, out of which 9% of the area is irrigated. Hill communities mainly practice subsistence farming and only traditional crops are grown. In this district 65 percent of the area is under forest and net sown area is less than 10 percent. Only about 9% of the sown area is irrigated and agriculture is manly rainfed. Main source of irrigation, other than rain-water, is canals and bore wells. Small and scattered land holdings are making agriculture economically nonviable. More than 70 percent of the land holdings are less than one hectare in size and the average land holding is about 0.91 hectare. Due to poor soil health and soil erosion, caused by heavy rainfall and landslides, productivity is affected in the area. Around 82 percent of workers are engaged in agriculture and there are negligible workers in household or non-household industry. It is quite evident that, in just 10% of net sown area 82% of the population is directly or indirectly dependent on agriculture for livelihood.

# Methodology:

Archeological evidence attests to the capture of rainwater as far back as 4,000 years ago. The concept of rainwater harvesting in China is as old as 6,000 years. Ruins of cisterns built as early as 2000 B.C. for storing runoff from hillsides for agricultural and domestic purposes are still standing in Israel (IE-NLC. 2006). Roof becomes the catchment which is the crucial factor in the rain water harvesting system and collected water from roof of the buildings can either be utilized for day to day domestic purposes or for artificial recharge of ground water (Zaizen et all 1999). We have constructed 150 Roof top rai watyer harvesting structure and out of 150 sites, 20% sites i.e. 30 sites have been selected for study. The following data has been collected for assessing the benefits being derived by farmers.

- Data Collection: Roof area, Water used for irrigation, Water used for other purposes, Crop wise production, Change in crops.
- Additional income of farmer’s calculated.

# Data collected

| SN | Name of benificry | Area in sqm | water used in Crops (total 03 crop) in Litre | | | | Crops production (total 03 crop) in Kg | | | | Value of crop (total 03 crop) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | I | II | III | Total water used | I | II | III | Total production | I | II | III | Total (Rs) |
| 1 | Basanti Devi | 400 | 11200 | 4800 | 10000 | 26000 | 700 | 780 | 820 | 2300 | 28000 | 15600 | 20500 | 64100 |
| 2 | Nanda Devi | 300 | 8400 | 3600 | 7500 | 19500 | 400 | 620 | 640 | 1660 | 16000 | 12400 | 16000 | 44400 |
| 3 | Diwan Ram | 200 | 5600 | 2400 | 5000 | 13000 | 350 | 440 | 350 | 1140 | 14000 | 8800 | 8750 | 31550 |
| 4 | Kalavati Devi | 400 | 11200 | 4800 | 10000 | 26000 | 450 | 760 | 780 | 1990 | 18000 | 15200 | 19500 | 52700 |
| 5 | Kamla Devi | 200 | 5600 | 2400 | 5000 | 13000 | 300 | 450 | 230 | 980 | 12000 | 9000 | 5750 | 26750 |
| 6 | Pushpa Devi | 200 | 5600 | 2400 | 5000 | 13000 | 350 | 470 | 400 | 1220 | 14000 | 9400 | 10000 | 33400 |
| 7 | Vikram Singh | 300 | 8400 | 3600 | 7500 | 19500 | 420 | 650 | 650 | 1720 | 16800 | 13000 | 16250 | 46050 |
| 8 | Kamla Kant | 200 | 5600 | 2400 | 5000 | 13000 | 450 | 430 | 400 | 1280 | 18000 | 8600 | 10000 | 36600 |
| 9 | Pushpa Devi | 200 | 5600 | 2400 | 5000 | 13000 | 400 | 440 | 450 | 1290 | 16000 | 8800 | 11250 | 36050 |
| 10 | Tribhuwan Singh | 300 | 8400 | 3600 | 7500 | 19500 | 500 | 600 | 600 | 1700 | 20000 | 12000 | 15000 | 47000 |
| 11 | Shanti Devi | 300 | 8400 | 3600 | 7500 | 19500 | 450 | 640 | 540 | 1630 | 18000 | 12800 | 13500 | 44300 |
| 12 | Govindi Devi | 300 | 8400 | 3600 | 7500 | 19500 | 450 | 580 | 580 | 1610 | 18000 | 11600 | 14500 | 44100 |
| 13 | Ishwari Dutt | 200 | 5600 | 2400 | 5000 | 13000 | 400 | 450 | 420 | 1270 | 16000 | 9000 | 10500 | 35500 |
| 14 | Pushkar Singh | 300 | 8400 | 3600 | 7500 | 19500 | 410 | 600 | 580 | 1590 | 16400 | 12000 | 14500 | 42900 |
| 15 | Lalitmohan Dictiya | 300 | 8400 | 3600 | 7500 | 19500 | 450 | 650 | 640 | 1740 | 18000 | 13000 | 16000 | 47000 |
| 16 | Suresh Chandra | 200 | 5600 | 2400 | 5000 | 13000 | 300 | 400 | 400 | 1100 | 12000 | 8000 | 10000 | 30000 |
| 17 | Rajendra Singh | 300 | 8400 | 3600 | 7500 | 19500 | 450 | 620 | 450 | 1520 | 18000 | 12400 | 11250 | 41650 |
| 18 | Lata Devi | 400 | 11200 | 4800 | 10000 | 26000 | 430 | 820 | 750 | 2000 | 17200 | 16400 | 18750 | 52350 |
| 19 | Ashutosh Singh | 300 | 8400 | 3600 | 7500 | 19500 | 400 | 640 | 600 | 1640 | 16000 | 12800 | 15000 | 43800 |
| 20 | Deepak Kharkwal | 300 | 8400 | 3600 | 7500 | 19500 | 440 | 600 | 560 | 1600 | 17600 | 12000 | 14000 | 43600 |
| 21 | Ram Singh | 400 | 11200 | 4800 | 10000 | 26000 | 750 | 780 | 750 | 2280 | 30000 | 15600 | 18750 | 64350 |
| 22 | Satish Singh | 300 | 8400 | 3600 | 7500 | 19500 | 600 | 640 | 600 | 1840 | 24000 | 12800 | 15000 | 51800 |
| 23 | Om Prakash Kapdi | 400 | 11200 | 4800 | 10000 | 26000 | 700 | 830 | 740 | 2270 | 28000 | 16600 | 18500 | 63100 |
| 24 | Laxmi Dutt | 300 | 8400 | 3600 | 7500 | 19500 | 550 | 600 | 600 | 1750 | 22000 | 12000 | 15000 | 49000 |
| 25 | Daleep Singh | 400 | 11200 | 4800 | 10000 | 26000 | 700 | 750 | 750 | 2200 | 28000 | 15000 | 18750 | 61750 |
| 26 | Bhola Dutt | 300 | 8400 | 3600 | 7500 | 19500 | 650 | 600 | 600 | 1850 | 26000 | 12000 | 15000 | 53000 |
| 27 | Moti Ram | 300 | 8400 | 3600 | 7500 | 19500 | 600 | 620 | 650 | 1870 | 24000 | 12400 | 16250 | 52650 |
| 28 | Sateesh Chandra | 400 | 11200 | 4800 | 10000 | 26000 | 750 | 750 | 780 | 2280 | 30000 | 15000 | 19500 | 64500 |
| 29 | Bablu Kumar | 300 | 8400 | 3600 | 7500 | 19500 | 600 | 650 | 650 | 1900 | 24000 | 13000 | 16250 | 53250 |
| 30 | Panni Ram | 300 | 8400 | 3600 | 7500 | 19500 | 550 | 600 | 650 | 1800 | 22000 | 12000 | 16250 | 50250 |
| | **Total** | **9000** | **252000** | **108000** | **225000** | **585000** | **14950** | **18460** | **17610** | **51020** | **598000** | **369200** | **440250** | **1407450** |
| | **Average** | **300** | | | | **19500** | | | | **1701** | | | | **46915** |

**Findings**

- Water security for critical stage of crop growth, domestic uses and Reduction in Women Drudgery.
- The vegetable production continued throughout the year in Backyard area of 300 to 400 sq.m area.
- The average vegetable production of a family per year is 17 qtl.
- The average annual income of a family increased by over Rs 46900/- .

**Results**

- The capacity of Tank was taken as 15000 litre which has been found quite appropriate to fulfill the requirement of 19500 litre.
- Average value of crop in 15 yrs (age of Tank) – Rs. 7,03,725.
- Cost of structure – Rs. 55000.
- The cost benefit ratio is 1:12 which is acceptable and may be recommended for replication.

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