

Rooftop rainwater harvesting:

An innovative approach towards resource conservation

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Rainwater harvesting system (RWS) is also known as rainwater collection system or rainwater catchment system technology that collect and stores rainwater for human and livestock use. RWS range from simple rain barrels to more elaborate structures with pump, well, tank and purification system. Rainwater harvesting significantly contributed to cause of ecological and environmental preservation. By capturing and storing runoff, which can immediately reduce soil/water erosion, rainwater harvesting is itself a valuable strategy for soil and water conservation. Ground water recharge is the main objective of this technology. By ground water recharging, irrigation water is sufficient for raising crops and production increases. Actual demand will depend on several lifestyle choices.

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Rainwater harvesting is a technology that uses both straightforward methods, like pots, and more intricate methods, such as subsurface check dams, to collect and store rainwater from roofs, the ground, or rock catchments. In rural areas, the methods commonly used by ancient civilizations continue to be a key source of drinking water supply. At the edge of the roof, rainwater is collected in uncomplicated containers. A few variations on this fundamental strategy include collecting rainwater in gutters that drain to the collection vessel through downpipes made for the job and/or diverting rainwater from the gutters to containers for settling debris before being conveyed to the storage container/well for domestic use. The area and kind of roofing material affect the quantity and quality of rainfall collected on the rooftop. Galvanized corrugated iron, aluminum, or asbestos cement sheets, tiles, and slate roofs can collect rainwater that is reasonably pure, but thatched roofs tied with bamboo gutters and placed on the right slopes can almost equally

provide the same amount of runoff for less money.

Primary consumers of water, worldwide are agricultural ecosystems, which are also primary producers of food. Depending on climate and level of regional economic development, these systems consume between 60 to 90% of the water that is available. With an annual growth rate of 1.3%, the predicted total area used for irrigated agriculture is 275 million hectares. Just 23% of farmland is used for this, while these kinds of crops account for 45% of all food production. According to estimates, worldwide food production must increase by 70% by 2050 in order to meet demand; this implies a 53% increase in global water usage. There are serious water shortages in an increasing number of areas around the world. Many factors, including effects of global climate change, rapid population growth, changes in land use, agricultural and urban expansion, rise in demand for water from various productive sector, inadequacy of water resource distribution, regional hydro political

conditions, degradation of water quality due to over-exploitation, scarcity of rainwater, and high rate of evaporation, contribute to severe degradation of water resources. Agriculture is the foundation of rural development, making water scarcity a constraining factor. Agriculture and other productive sectors are impacted directly and indirectly by climate variables, particularly precipitation and temperature. This in turn has an impact on economic development and primarily the poorest communities' means of subsistence. Throughout the coming decades, increases of up to 5°C are predicted due to changing climate. A loss in agricultural output is a result of frequent and severe droughts, extended dry-spells, heat waves, storms, and other meteorological events that are generating significant water stress. In this context, more resource-efficient food production technologies are essential, particularly with regards to water. Construction of infrastructure for provision of non-conventional water sources; considering this, one of best solutions is to use improved



Roof top rainwater harvesting structure in Banka



Open well in NICRA adopted village, Banka

rainwater management to adapt to effects of climate change. Hence, rainwater collection was suggested as a solution to the problem of scarcity.

Interventions of roof-top RWS for livelihood improvements

National Innovations on Climate Resilient Agriculture (NICRA) village Merha selected from ICAR, New Delhi for rainfed condition in 2015–16 as undulated topography, delayed on set of monsoons and no alternative facility to conserve runoff water on there. It is in Katoriya block of Banka district and surrounded by seasonal rivers from three sides on hill and one side have road to come. Rainwater drained out from village by their slope after receiving heavy rain due to undulated topography. It is most critical situation at mid-summer season; water is a challenge to take drink for human as well as animals. Diagnostic survey was undertaken in NICRA village for formulation of top water harvesting and soak pit water conservation from hand pump project. Due to NICRA adopted village KVK, Banka team visits day by day for execution of the project which was related with water conservation. At starting period, we have done Participatory Rural Appraisal survey to know history of village to implement project. We got the result of water scarcity from starting period in PRA as the village is situated on hill and surrounded by seasonal river in three sides. If intensive rainfall occurs in village river flows water for an hour after that the rivers are dry for a long time. Rainwater of

village is suddenly drained out from village after stopping of rain. Village dries for a long time and in summer even drinking water is a challenge for villagers. Keeping above facts after survey, conservation of water by development of rain water harvesting structure (Roof top rain water harvesting and Soak pit water harvesting methods in hand pump) was done in this village for farming practices and drinking water. It is a method for enhancing recharge of groundwater that involves storing rainwater locally, using rooftop water harvesting, developing soak pit connected to hand pumps, filling dug wells, refueling hand pumps, building percolation pits, trenches around fields, and building bunds or dams on small rivulets. It was difficult to water crops and dairy animals because of the drought from March to July. So, farmers were not able to rear summer season annual crops and dairy animals. Module structure of rainwater harvesting was developed in backyard seasonal vegetables and dairy farm of NICRA village. Harvesting rainwater in well and preserve water and easily rear dairy animals without facing any problem of water, this technology have adopted by more than 62 farmers of Banka district.

Importance of harvested rainwater

Average rains at Katoriya were >800 mm only and it counts very low from normal annual rain, hence 800-litre water/meter². Average house having roof of 225 m² hence raining more than 1,80,000-litre water which pass away to nearby river. When villagers

plan to preserve this water so after connecting roof through well this village have preserved 90 lakh litre water/year. It affects water level of village. Water harvesting prevents water evaporation from soil surface. Villagers having ~30 m² at the back or side portion of house, but due to scarcity of water were unable to provide water to that land if planned for seasonal vegetables as kitchen garden. After application of this technology, kitchen garden completely managed from rainwater harvested. Village water level improved so; hand pump maintains water level. Also Soak pit prepared at each hand pump and water resources so not any single drop of water goes outside but recharge village ground water. Seven wells connected with filter chamber for drinking purpose water.

Merha village has total 26 non-functional wells. First, we renovated the entire well through NICRA project then connected drainage of roof of nearby house to well through plastic irrigation pipe. So, all rainwater goes to well and recharge ground water level. One of best techniques used and followed to help water conservation is rainwater collection system. Today, lack of high-quality water is a major source of worry. KVK, Banka explained work on rooftop water harvesting and soak pit water harvesting structure in hand pump system of NICRA village and increasing the area of cropping through kitchen garden, as roof top water harvesting, water is conserved in well, situated in house. Stored water in well near to house used for

kitchen gardening, drinking water for human and animal, livestock management, dairying at all season and one of most important thing villagers have got drinking water in peak summer season. Before project implement, villagers have problems of drinking water and only one well was support of whole village. Farmers were not able to done farming and dairying before project intervention in NICRA village for livelihood security. According to data analysis, there are many ways to collect and manage floodwaters and surface runoff under umbrella of water harvesting. We aggregated techniques as flood water harvesting, pit water harvesting, and rooftop water harvesting. Water harvesting's introduction generally has a favourable short-to extremely positive long-term impact, and its maintenance has a very positive short-and long-term impact. Yet, perception is influenced by local environment and manner of water collecting.

Water harvesting structures raises water table for drinking purpose and farming. Most relevant socio-economic benefit from water harvesting are increased crop yield and farm income. Its application enhances social network, knowledge of soil erosion/conservation and improves food security. Multitude of regulating (flood control), provisioning (food production), supporting (nutrient cycling), and cultural (aesthetic value) ecosystem services are positively impacted by this effect. Greatest barriers to local adoption of water harvesting technique are labour shortages,



Jalkund for life saving irrigation

implementation costs and loss of productive crop lands, despite the techniques' many perceived potential benefits. This demonstrates requirement for political solutions, such as incentives for adoption of most efficient water collecting technology adjusted to local environmental and socio-economic conditions. Due to RWH changes of agricultural and technological impact increases in area of farming as a kitchen garden due to sure facility of irrigation, because of round year water available in wells. Polythene mulching has done for vegetable production in NICRA village to avoid evaporation of water from soil surface which has been taken from harvesting structure.

Benefits of roof top-RWS

Rainwater harvesting is the practice of collecting and storing

rainwater rather than letting it flow off. Rainfall is collected from a surface that resembles a roof and channeled via percolation to a tank, cistern, deep pit, aquifer, or reservoir.

- Harvested rainwater helped environment in several ways. For starters, it reduced erosion around downspouts and in gardens. It also controlled storm water run-off. As opposed to hard water, rainwater does not cause scale and corrosion. Collection of rainwater reduced flooding.
- Deeper wells are receiving total rainwater after connection of pipes from floor and not only drop of water is loosed, hence the water table rises due to continuous receiving of water from rains and this practice is cost effective and best.
- Large amounts of water are needed for everything from bathing to washing clothing and dishes. As rainwater is gentle, less detergent may be needed for washing clothes and dishes.
- Rainwater collection is often devoid of various pollutants and man-made toxins. Spending less on general property upkeep and landscaping requirements can be accomplished by using water that is pure and healthy for plants and trees.



Roof top rainwater harvesting in Banka



Soak pit water harvesting methods in Banka

Way forward

This is likely to be most complicated part of system and consist of several components. Design will depend on factors related to intended use water demand, relationship of the harvested water system to supplementary sources of water. Disinfection may include UV sterilization, ozonation, chlorination and filtration systems such as Nano-filtration and reverse osmosis. Water treatment may take place at the point-of-entry into the house, at point-of-use taps or combination. This technology is spreading horizontally in other villages by the seeing effect of NICRA village.

SUMMARY

Implementing a low-cost roof top Rainwater Harvesting System in residential property is one of the solutions proposed by KVK, Banka for rising of water table. Main aim of this study was to investigate the level of understanding of rainwater harvesting system among villagers and their socio-economic changes. This includes investigating barriers that occur in implementing the system and identifying key drivers that will courage them to implement the system. The amount of rain that can be harvested by a roof depends on the roof footprint (horizontal projection of roof surface) and

amount that is lost by evaporation, diversion by roof washer and leakage. A perfectly flat roof would have the largest possible footprint but would be suboptimal because it would not allow for effective draining or roof washing. The amount of water that can be harvested and stored must be large enough to supply water during period of drought. The sources of information for average rainfall often can be used to estimate the number of continuous drought days in an area.

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