Low cost polytanks

for higher water productivity in hills

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Agriculture is the main source of livelihood for the the North Western Himalayan (NWH) farmers who predominantly, being marginal farmers, pursue rain-dependent agriculture and face serious water-related constraints. Therefore, an efficient technique for conservation and scientific management of harvested water is essential for the profitable crop production especially for high-value crops like fruits and vegetables. The hilly soils are light in texture which results in higher seepage and percolation losses which renders construction of Kaccha pond, a non-feasible option for runoff conservation. In such a situation, low cost poly-tank can be a useful strategy to harvest the rain water in hilly region. This article describes the successful implementation of low cost poly-tank (LCP) in agri-horti system in higher hills of Uttarakhand.

Keywords: Agri-Horti, Polytanks, Topography, Undulating, Water management

AGRICULTURE in hill and mountain ecosystem is predominantly rainfed with common occurrence of moisture stress. This increases risk to success of hill farming in general and cultivation of high value crops like fruits and vegetables in particular. Development of water harvesting structure is the key to higher production by mitigating water stress and fulfilling crop water requirement particularly during critical crop growth stages. Water harvesting structure not only conserves the water but also ensure its efficient distribution in the field. Since, the cost of creating water resources in hills is very high, thus, storage and application losses must be reduced to minimum by utilizing scarce water efficiently. However, the major portion of the rain water in hilly areas goes waste as runoff. In addition to water losses, runoff enhances the erosion of fertile top soil layer and ultimately, diminishes the productivity of agriculture.

In order to address this problem, ICAR-Vivekananda Parvatiya Krishi Anusandhan Sansthan, Almora has adopted Darima village of Nainital district in Kumaon division of Uttarakhand under Jal Shakti Abhiyan (JSA). The areal extent of this region is 806.57 ha out of which 406 ha is under forest. The topography of the area varies between 1,793 and 2,123 m above mean sea level. The major crops

Testimonial

Name of Farmer: Mr. Dhan Singh, S/o Daleep Singh

Age: 52

Experience: 32 years

Village: Darima

District: Nainital

State: Uttarakhand

His words

''पॉलीटैंक से हमें काफी सहायता मिली। हम जैसे गरीब किसान के लिए पॉलीटैंक से गर्मी के दिनों में फसल को बचाया जा सकता है और इससे फसल के उत्पादन में बढ़ौतरी होती है।''

(Polytank has helped me a lot. Poor farmers like me can get irrigation water during summer period which will not only save the crops but will also increase the productivity of crops).

General view of Darima village

Field survey, site selection and measurement

Earth work

Compaction and measurement of polyfilm

Laying of polyfilm

Harvested water ready for use

Step by step process for construction of LCP.

grown in the area include vegetables and fruits, viz. potato, vegetable pea, cauliflower, cabbage, pear, peach, apple, apricot, plum, etc. Nainital district, particularly its villages have major limitation of agricultural water during the lean period, which reduces the profitability of vegetable crops and sometimes, results in complete crop failure. This area receives an average of 1,277 mm rainfall annually and has good potential for the harvesting of runoff water. To provide location specific water conservation measure, for collecting unused runoff or water from spring in undulating topography where runoff is not collected, Low Cost Polytank (LCP) structure was made. Considering the slope of field and area (16 m × 7 m × 1 m), an appropriate location (29 28' 3.8" N, 79 38' 2.3" E) was identified in the field of. Mr. Dhan Singh, S/o Shri Daleep Singh who was struggling for the availability of irrigation water during the lean season and was able to cultivate only vegetables that too on a limited area.

When Mr. Singh was apprised about the benefits of the proposed intervention regarding water conservation, he was convinced and agreed to get the LCP in their field.

After constructing the LCP in his field, due to better water availability,

Before monsoon on 10 June 2019.

Polytank full of water on 2 February 2020.

he followed the model of agri-horti system and was able to irrigate additional 0.5 acre in which he cultivated field crops, vegetable crops and fruit trees collectively.

Economics of agri-horti system

The Agri-horti system being followed by Mr. Dhan Singh was evaluated for economics under rainfed as well as polytank irrigated condition. The price of crops varies with physical appearance, quality of fruit at farmer field and prevailing market status. The economic analysis was done for 1 acre area based on information provided by the farmer. The vegetable pea crop was sown in the space available between fruit trees. The row-to-row spacing for vegetable pea was 30 cm while plant-to-plant distance was 10-15 cm.

Impact

Farmers realised a significant yield increase in the vegetable pea after constructing low cost polytank which had increased the availability of irrigation water to the crop. The yield of vegetable pea under irrigated polytank condition increased by 140% than rainfed which helps to meet his consumption need, apart from bulk marketing of vegetable. The income from 1 acre of pea with the irrigation from polytank increased from ₹ 14,250 to ₹ 45,000 with net benefit of ₹ 30,750 due to better availability of irrigation water during lean period at the critical growth stages (pre-flowering, pod development). With these interventions, benefit-cost ratio increased from 1.93 to 2.61 and provided viable alternative to manage the irrigation water crisis in the farmer's field. Through enhanced vegetable farm income, Mr. Dham Singh restored his self-confidence with higher productivity and profitability. Now, he is known as a

Table 1. Economics of agri-horti system under rainfed condition

Crop	Cost of cultivation (₹/acre)	Crop yield (kg/acre)	Price (₹/kg)	Gross returns (₹/acre)	Net returns (₹/acre)	Benefit cost ratio (B:C)
Vegetable Pea (MAXIMA3636)	35500 (including land	750	19	14,250	-	-
Peach	preparation, seed,	1,145	17	19,465	-	-
Plum	spraying of insecticides	625	23	14,375	-	-
Apple	and manure)	589	45	26,505	-	-
Total	35,500			74,595	39,095	2.10

Note: No of fruits plant per acre: Peach 15; Apple 50; Plum 50.

Field view of agri-horti system.

Table 2. Economics of agri-horti system under irrigated condition (with polytank)

Crop	Cost of cultivation (₹/acre)	Crop yield (Kg/acre)	Price (₹/kg)	Gross returns (₹/acre)	Net returns (₹/Acre)	Benefit cost ratio (B:C)
Vegetable Pea (MAXIMA3636)	43,000 (including land	1,800	19	34,200	-	-
Peach	preparation, seed, spraying	1,575	17	26,775	-	-
Plum	of insecticides, manure and	1,000	23	23,000	-	-
Apple	pond construction)	800	45	36,000	-	-
Total	43,000			119975	76,975	2.79

Note: No of fruits plant per acre: Peach 15; Apple 50; Plum 50

successful vegetable growing farmer in the village and many farmers from the neighbouring villages visit his field to see the LCP technology.

This has raised the enthusiasm of the farmers of this area and reluctant farmers have come forward to get the farm LCP on their land in coverage with ongoing JSA. This successful case has demonstrated the value and usefulness of LCP technology for potential runoff harvesting in the undulating topography and importance of convergence of research and development brought out by the institute. The above success story of use of technological intervention may also be replicated in other hilly areas of the country.

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Rejuvenation of Haveli system for drought proofing in Bundelkhand Region

"*Haveli* system", earthen bunds across the stream built to impound water during the monsoon, was developed to overcome water scarcity during the period of Chandelas and Bundelas (nearly 400 years back). The water harvested during the monsoon period recharges open wells and also serves as an irrigation source during the critical stage for *kharif* crops in the surrounding areas of *Haveli*. The impounded water is drained-out during the month of October and the *Haveli*-bed is used for cultivating *rabi* crops. The drained water from *Haveli* system is also used for the pre-sowing irrigation by the lower reach farmers. Wheat and chickpea are generally cultivated in *Havelis* using the residual soil moisture. Over the period, *Havelis* have become defunct due to damaged outlet, leakage in embankment, excessive siltation, breaching of embankment, etc.

The *Haveli* system that existed at Parasai-Sindh watershed in Jhansi district of Bundelkhand region was rejuvenated through community participation. A drop spillway (rectangular weir) outlet was constructed to drain excess runoff during the rainy season. The weir was constructed at a height of 1.45 m from the bed level. The earthen embankment along with core wall was constructed in 50 m breached area. To control seepage, 147 m stone masonry wall was constructed along the embankment of *Haveli*. Submergence area of the structure is about 8.0 ha with harvesting capacity of 73,000 m^3. Due to multi filling, about 1.5–2.5 lakh m^3 runoff is now being harvested during normal monsoon season that completely resolved the water scarcity issues of Parasai village. The cost of rainwater harvesting in *Haveli* is about ₹ 4.53/m^3 of storage. Renovated *Haveli* with due support from series of check dams in ephemeral streams resulted in 1,15,000 m^3 surface water storage besides saturation of weathered zone in the watershed. Increased groundwater level (2–5 m) and base flow (2 to 3 times) and reduced stream flow made it drought resilient even in years with 25–30% deficit rainfall. About 176 ha *rabi* fallow was brought under cultivation. Productivity of different crops increased in the range of 20–70%.

Rejuvenated *Haveli* system

Rainwater harvested in *Haveli* system

Teak based agroforestry intervention

Guava based agroforestry intervention