

Jalkund: Transforming productivity, cropping intensity, and livelihoods of hill ecosystems in North Eastern Himalayas

M. A. Ansari^{1,2*}, S. S. Roy¹, I. M. Singh¹, N. Prakash¹, Punitha P.¹ and S. Hazarika³

¹ICAR Research Complex for NEH Region, Manipur Centre, Imphal, Manipur 795 004

²ICAR-Indian Institute of Farming Systems Research, Modipuram, Meerut, Uttar Pradesh 250 110

³ICAR Research Complex for NEH Region, Umiam, Meghalaya 793 103

The North Eastern Himalayan Region (NEHR) of India, despite abundant rainfall, faces challenges in utilizing its water resources effectively for agricultural and economic growth. The region experiences significant water loss due to its hilly terrain and inadequate water harvesting infrastructure. In this article, we examine the impact of Jalkund, a rainwater harvesting structure, in improving water management, cropping intensity, and livelihood security in hill ecosystems. Jalkunds provide a reliable water source during the dry rabi season, enabling farmers to diversify cropping systems and increase productivity. Case studies, particularly from the Chandel district of Manipur, highlight the benefits of Jalkund in transforming monocropping systems to more resilient and profitable farming practices, thus enhancing food security and farm income. The study underscores Jalkunds role in addressing water scarcity, promoting sustainable agriculture, and improving community welfare in the North Eastern Himalayas.

Keywords: Crop diversification, Income, Productivity, Rain-water harvesting structure

THE North Eastern Himalayan Region (NEHR) of India is characterized by abundant rainfall, receiving an annual average precipitation of approximately 1500 mm. This accounts for around 7.5% (33.0 million ha-m) of India's total water resources, which is estimated to be 420 million hectare-meters. Despite this rich water resource base, the region has not realized its potential in water resource utilization for agricultural and economic development. Currently, only less than 1% (0.88 million ha-m) of the available water is effectively utilized for productive purposes. A significant portion of the region is hilly and undulating, which contributes to the substantial loss of water through surface runoff. More than 32.0 million ha-m of water is lost annually due to the lack of adequate water retention and harvesting infrastructure, exacerbated by the challenging topography. The steep slopes and high-intensity rainfall events result in rapid runoff, leading to downstream flooding and the erosion of fertile topsoil. Furthermore, the lack of sufficient storage facilities and proper irrigation systems limits the potential for rainwater harvesting and its use during the dry season, which significantly affects agricultural productivity and food security. The region's underutilization of

water resources poses a major challenge for sustainable development, especially in agriculture, which is predominantly rainfed. Improved water management strategies, such as the construction of water harvesting structures (e.g. *Jalkund*, ponds, check dams), terracing, and promoting integrated watershed management approaches, are essential to mitigate the loss of water and enhance its utilization. By harnessing its rich water resources through scientific interventions, the region can improve agricultural productivity, ensure water security, and contribute to sustainable development while reducing the adverse impacts of runoff on the environment.

Importance of *Jalkund* (rain water harvesting) in North Eastern Region

Jalkund, a rainwater harvesting structure, plays a crucial role in enhancing cropping intensity, particularly for life-saving irrigation during the *rabi* season. In rainfed agricultural regions, such as the North Eastern Himalayan Region, where water scarcity limits crop production after the monsoon, *Jalkunds* offer a reliable solution by capturing and storing rainwater. The stored water provides a critical source of irrigation during

the dry months when water availability becomes insufficient for sustaining crops. By making water available during the *rabi* season, *Jalkunds* enable farmers to cultivate an additional crop after the *kharif* season, thus effectively doubling cropping intensity. This water resource supports crucial irrigation needs for crops such as wheat, vegetables, and pulses, ensuring their survival and productivity during moisture-deficit periods. Moreover, *Jalkunds* prevent dependency on uncertain rainfall and erratic water supply, enhancing crop yields, improving farm income, and reducing vulnerability to climate variability. Furthermore, *Jalkunds* contribute to better water-use efficiency by minimizing runoff and conserving soil moisture, particularly in hilly and sloping terrains. By facilitating year-round cultivation and optimizing resource use, *Jalkunds* significantly boost agricultural productivity and ensure food security in regions where rainfed farming dominates.

Jalkund design, construction and functionality

Jalkund is a simple yet effective rainwater harvesting structure designed to store rainwater for agricultural use. It involves the excavation of a pond-like structure, typically lined with high-quality, durable materials such as Silpaulin sheets to prevent water loss through seepage. The structure's design varies in size depending on the available area and water requirements, with dimensions ranging from small, localized ponds to larger water

reservoirs. The construction process includes several critical steps to ensure the longevity and effectiveness of the system

Excavation: A pit is dug in a location that can capture runoff during the rainy season.

Wall plastering: The inner walls are often plastered with a mixture of clay and cow dung to strengthen the structure and provide a smooth surface for water retention.

Cushioning layer: A layer of dry pine leaves or thatch grass is placed to provide cushioning, reducing wear on the lining material.

Lining material: A 250-micron Silpaulin sheet is laid as the final lining to prevent seepage and ensure efficient water storage.

Interventions

Jalkund water harvesting structure was established in several villages of different hill districts of Manipur (Chandel, Churachandpur, Tamenglong, Ukhrul and Senapati). *Jalkund* was established in Chandanpokpi village, Chandel district, on the field of Mr. Kh Samuel. The initial dimensions of the *Jalkund* were 5 m x 5 m x 2 m (length, width, and depth). In 2014, Mr. Samuel requested an additional *Jalkund*, which was combined with the existing structure to form a larger *Jalkund* with dimensions of 14 m x 5 m x 2 m. This expanded structure has a capacity to harvest approximately 1.40 lakh litres

(140 cubic m) of rainwater. The *Jalkund* construction followed a specific method to ensure durability and functionality. Farmers used a 250-micron thick Silpaulin sheet as the lining material. After excavation, the inner walls of the pond were plastered with a mixture of clay and cow dung in a 5:1 ratio, which acted as a protective layer. This was followed by a cushioning layer, 3 to 5 cm thick, made from dry pine leaves or thatch grass applied at the rate of 2 to 3 kg/m². Finally, the Blue Silpaulin sheet was carefully laid as the pond lining. This method provided an effective solution for rainwater harvesting, significantly aiding in water conservation for agricultural purposes.

Insights from case study

The implementation of *Jalkund* technology by the ICAR Research Complex for the North Eastern Hill (NEH) Region, Manipur Centre, has led to significant



Step wise *Jalkund* preparation at farmer's field



Farmers' utilized harvested rain water in nursery raising and crop production (live saving irrigation in *rabi* season)

improvements in water management and agricultural productivity. Under the National Innovations in Climate Resilient Agriculture (NICRA) and Tribal Sub-Plan (TSP) projects, a pilot programme titled “Scaling up of Water Productivity in Agriculture for Livelihood through Training and Demonstration” has been in place since 2011. Numbers of *Jalkund* with capacities ranging from 30,000 to 150,000 L were distributed and established on farmers’ fields, with an associated cost ranging from ₹6,055 to ₹ 15,000. Collectively, these *Jalkund* harvested nearly 10.35 million litres of water annually, mitigating the runoff that would have otherwise contributed to downstream flooding. Insights from case study of Mr. Samuel, who initially practiced monocropping of rice and struggled to achieve more than 4.0 t/ha, benefitted greatly from *Jalkund* adoption. Prior to 2013, limited access to irrigation water hindered the possibility of cultivating *rabi* crops. However, after establishing *Jalkund*, Mr. Samuel diversified his cropping system, cultivating tomatoes (Variety: Amitabh), cabbage, and cauliflower. From a 0.5 ha area, he produced 12 tonnes/ha of tomatoes and generated ₹200,000 annually. Furthermore, the introduction of double cropping resulted in an average rice-equivalent yield of 11.18 t/ha and a net return of ₹225,000/ha. This participatory research initiative illustrates how the adoption of water conservation techniques like *Jalkund* can enhance water productivity, crop intensification, and farmers’ livelihoods in water-scarce regions, contributing to overall sustainable agricultural development.

Cropping intensity and diversification

One of the most notable impacts of *Jalkund* is its role in increasing cropping intensity in hill ecosystems. In the absence of reliable irrigation, farmers in the North Eastern

Himalayas typically struggle to grow multiple crops per year. The adoption of *Jalkund* allows for supplemental irrigation during the *rabi* season, enabling farmers to grow a second crop after the *kharif* season. The ability to diversify cropping systems has been a game-changer for farmers in this region. With *Jalkund*, farmers have successfully transitioned from monocropping systems to diversified cropping systems. For example, in areas where *Jalkund* has been established, farmers are able to grow crops like tomatoes, cabbage, and cauliflower during the *rabi* season, in addition to the staple crops like rice during the *kharif* season. This not only increases the total yield per hectare but also reduces the risk associated with single-crop dependency. The impact on cropping intensity is substantial. On an average, farmers have been able to increase their cropping intensity by 30-40% after the adoption of *Jalkund*. This increase in cropping intensity leads to higher overall productivity, improved soil health due to crop rotation, and enhanced farm profitability.

Livelihood security and economic empowerment

The introduction of *Jalkund* had a significant positive impact on the livelihoods of farmers in the North Eastern Himalayan region. By increasing agricultural productivity and enabling the diversification of crops, *Jalkund* has directly contributed to improving farmers’ income. The supplemental irrigation provided by *Jalkund* allows farmers to cultivate high-value crops, which are more profitable than traditional staple crops. In addition to enhancing farm income, *Jalkund* also provides a buffer against climate-related risks. The unpredictable nature of rainfall, coupled with the increasing frequency of droughts, has made rainfed farming highly vulnerable. By storing water for later use, *Jalkund* reduces the



Jalkund established at Purul Akutpa village, Senapati district of Manipur

impact of water scarcity, providing a more stable and secure farming environment. This stability is critical for ensuring food security in the region and improving overall rural livelihoods. Moreover, the establishment of *Jalkund* structures has contributed to the creation of local employment opportunities. Construction and maintenance of these structures require labour, and farmers often collaborate in community-based efforts to build and maintain *Jalkund* systems. This collaborative approach fosters community engagement, strengthens social ties, and contributes to the overall well-being of rural households.

Environmental and ecological benefits

Jalkund offers several environmental and ecological benefits beyond its impact on agricultural productivity. By reducing water runoff and preventing soil erosion, *Jalkund* helps maintain soil fertility, a critical issue in hilly terrains. The region's hilly landscapes are prone to soil degradation, which is exacerbated by heavy rainfall and unsustainable farming practices. *Jalkund* mitigates this issue by capturing water and reducing the erosion that washes away topsoil, thus preserving the productive capacity of the land. Additionally, the stored rainwater in *Jalkund* helps recharge groundwater levels, which is vital in areas where groundwater resources are depleting. This contributes to the overall sustainability of the region's water resources and promotes long-term ecological balance.

Challenges and limitations

Even though *Jalkund* offers numerous benefits, there are challenges that need to be addressed for its widespread adoption. The initial cost of construction, which includes excavation, material costs, and labour,

can be a barrier for small-scale farmers. Additionally, the proper maintenance of *Jalkund* structures requires ongoing effort and resources, which may be challenging in remote areas where access to technical support is limited. There is also the issue of water distribution within the farm. In some cases, the water harvested may not be evenly distributed across the field, leading to potential inefficiencies in irrigation. This requires the implementation of effective water distribution systems to maximize the benefits of *Jalkund*.

SUMMARY

Jalkund has proven to be a transformative water management solution for farmers in the North Eastern Himalayan hill ecosystems. By providing supplemental irrigation during the critical Rabi season, *Jalkund* enhances agricultural productivity, increases cropping intensity, and contributes to livelihood security. The ability to store and manage rainwater effectively mitigates the impacts of water scarcity and enhances the resilience of farming systems to climate change. However, for the full potential of *Jalkund* to be realized, continued efforts are needed to improve construction techniques, ensure proper maintenance, and promote the adoption of these systems across the region. With ongoing support from government agencies, NGOs, and local communities, *Jalkund* can play a pivotal role in the sustainable development of hill ecosystems in the North Eastern Himalayas, ensuring food security, environmental sustainability, and improved livelihoods for farmers.

*Corresponding author email: merajjari@gmail.com
