

Water Resources, Agricultural Water Use and Water Conservation Practices in Chamba block of Tehri Garhwal district, Uttarakhand

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INTRODUCTION

Water is a crucial input for agricultural production and socioeconomic development in the mountains. The Himalayan region is also known as “Water Tower of India” and is an important source of fresh water for mountain and downstream people (Liniger *et al.*, 1998). Uttarakhand has seasonal water scarcity despite of having abundance of water resources due to erratic rainfall, high surface runoff and decreasing spring discharge.

The Chamba block of Tehri Garhwal district (30°8'52"N to 30°24'32"N and 78°15'22"E to 78°36'21"E) is characterized by rugged topography, steep slopes and fragile ecosystems. Agriculture is mainly rain-fed and dependent on local water resources. The steep slopes and lack of water storage result in surface runoff, leading to a significant portion of monsoon rainfall in the region to be lost, leading to water scarcity during pre-monsoon and winter seasons.

This pressure on water supplies is compounded by increasing impacts of climate change, population growth, changing land use patterns and deforestation. Kumar and Tiwari (2019) examined the effect of changes in rainfall patterns on ground and river flow. Sustainable water management is now heavily dependent on achieving food security, protecting the environment and improving livelihoods in the area.

Water resources in Chamba block

The Chamba block of Tehri Garhwal has diversified water resources for supporting rural life style and agriculture (Table 1). The main sources of water are Bhagirathi River, seasonal and perennial streams (gad and gadheras), traditional springs (Naula and Dhara), little ground water and monsoon rain. Chahals or mountain ponds, gather rainwater that seeps through the hills to feed springs and keep perennial streams flowing. However, in recent years, the springs have seen a substantial decrease in discharge (NITI Aayog, 2018).










Population growth and socioeconomic changes have challenged the traditional water management practices leading to over exploitation of natural resources (ICIMOD,

2007). As a result, seasonal water scarcity has become a serious problem in the region (Ohlsson, 2000).

Table 1: Major water resources

Water resource	Availability	Main uses
Rivers	Perennial	Irrigation, domestic use
Streams	Seasonal & perennial	Irrigation
Springs	Perennial	Drinking and irrigation
Groundwater	Limited	Domestic use
Rainfall	Seasonal	Agriculture and recharge

Table 2: Water Conservation techniques, methods and their advantages

Technique	Method / Practice	Major advantages
Rainwater Harvesting	 Rooftop harvesting, farm ponds, storage tanks, community reservoirs	Water storage and groundwater recharge
Spring Rejuvenation	 Recharge pits, percolation trenches, contour trenches, afforestation	Improved spring discharge and groundwater recharge
Check Dams	 Small barriers across streams and drainage channels	Groundwater recharge and erosion control
Watershed Management	 Afforestation, soil conservation, water harvesting, community participation	Sustainable land and water management
Terracing	 Construction of stepped fields on hill slopes	Soil and water conservation
Drip Irrigation	 Water supplied directly to plant roots through emitters	Improved water-use efficiency
Sprinkler Irrigation	 Water applied through sprinkler nozzles	Uniform water distribution
Mulching	 Covering soil with crop residues, straw, or leaves	Reduced evaporation and moisture conservation
Afforestation	 Planting trees and protecting catchment areas	Increased infiltration and groundwater recharge

Agriculture and water use

The main occupation of the people in Chamba block is terrace farming, which is practised by majority of the farmers. The main crops are rice, wheat, maize, finger millet (mandua),

bajra, rajma, potato, mustard and seasonal vegetables. Horticulture crops such as apple, peach, plum, walnut and citrus are also important. Finger millet and mustard require less water compared to wheat, maize and

potatoes but rice and vegetables require a lot of irrigation.

Irrigation practices

Traditional irrigation: The Gul (Kuhl) irrigation method involves diverting water from streams and springs to fields through gravity channels.

Modern irrigation: To improve irrigation efficiency and regular water supply, farmers of Chamba block are increasingly adopting modern water conservation techniques such as drip irrigation, sprinkler irrigation, storage tanks and poly-lined ponds. These techniques increase sustainable agricultural production by reducing water losses and increasing water-use efficiency especially during the dry periods and during periods of water scarcity.

Water conservation techniques: Water conservation is critical for sustainable agriculture and water security in Chamba block where climate change, deforestation and growing water demand have worsened water scarcity (Gupta, 2025). Efficient management of water resources is necessary for sustainable economic development (Yadav et al., 2003). Farmers practice traditional as well as modern conservation practices to increase the recharge of groundwater and efficiency of water use. While contemporary techniques like rainwater

harvesting, spring rejuvenation, check dams, watershed management, drip and sprinkler irrigation and mulching are used to reduce runoff, retain soil moisture and improve water availability, traditional techniques like terraced farming and community irrigation systems are still important (Dorjee and Singh, 2006). Table 2 presents the methods, strategies and benefits of water conservation.

Challenges and management measures

Chamba block is facing seasonal water scarcity even after receiving adequate rainfall annually due to decreasing springs, irregular rainfall, quick surface runoff, soil erosion, no proper irrigation facilities, degradation of recharge zones, climate change and increasing demand of water for agriculture. These problems have an impact on both agricultural production and water security. Table 3 explains the concerns associated with water and the management strategies to address these concerns. Sustainable water management includes afforestation, rejuvenation of springs, rainwater harvesting, integrated watershed management, and efficient irrigation techniques. Community water conservation has also been recognized as an effective way to enhance water security (Gururani, 2023).

Table 3: Water-related challenges and management measures in Chamba block

Challenge	Management measure / solution
Drying of springs	Spring renewal and recharge structures
Unequal rainfall distribution	Rainwater harvesting and water storage
High surface runoff	Check dams and contour trenches
Soil erosion and landslides	Terracing, vegetative barriers, and afforestation
Limited irrigation infrastructure	Drip and sprinkler irrigation
Degradation of recharge zones	Afforestation and watershed management
Climate change impacts	Climate-resilient water conservation practices
Increasing agricultural water demand	Efficient irrigation and improved water-use planning

Future strategies

The following strategies can improve water security in Chamba block:

- Rainwater harvesting system expansion.
- A rise in the amount of woodland.
- Preserving spring recharge areas.
- Supporting sprinkler and drip irrigation.
- Boosting initiatives for watershed development.
- Community involvement in water management.
- The use of agriculture that is climate resilient.
- Water resources are monitored scientifically.

CONCLUSION

Water resources are fundamental to agriculture, livelihoods and ecosystem sustainability in Chamba block. However, dependence on rainfall and spring-fed irrigation makes the region vulnerable to climate variability and seasonal water scarcity. Integrating traditional practices with modern water conservation measures, such as rainwater harvesting, watershed management and micro-irrigation, can enhance water security and agricultural resilience. Sustainable, community-based water management is essential for long-term environmental and socio-economic development.

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