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GROUNDWATER DEPLETION AND AGRICULTURAL SUSTAINABILITY IN PUNJAB HARYANA AND WESTERN UTTAR PRADESH

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The northwestern plains of India particularly Punjab, Haryana, and Western Uttar Pradesh form the heart of the country's agricultural output. These regions, known for their high-yield production of wheat and rice, were pivotal to the success of the Green Revolution in the 1960s and 70s. However, this agricultural boom came with a heavy ecological cost. One of the most critical consequences has been the alarming degradation of the groundwater table, posing serious threats to the sustainability of agriculture, drinking water security, and long-term ecological balance in the region.

Groundwater is the primary source of irrigation in these states. Over the years, an increasing reliance on tube wells and submersible pumps has led to the over-extraction of this invisible resource. According to data from the Central Ground Water Board (CGWB), several districts in Punjab & Haryana have experienced annual declines in groundwater levels of over one meter, with some areas reporting even steeper drops. In Western Uttar Pradesh, the situation is increasingly mirroring this pattern, especially in the upper Ganga-Yamuna Doab region.

The root causes of this depletion are multifaceted. The predominant cropping pattern especially the widespread cultivation of water-intensive paddy during the kharif season is a major driver. Paddy requires standing water for extended periods, and in the arid to semi-arid climates of Punjab and Haryana, this demand is met almost exclusively through groundwater irrigation. Despite monsoon rainfall, the natural recharge of aquifers has not kept pace with extraction rates. Traditional rainwater harvesting structures have either vanished or fallen into disuse, further exacerbating the problem.

In addition to cropping choices, the electricity subsidy for agricultural pumps has unintentionally incentivized unchecked extraction. Free or highly subsidized power for farmers has led to inefficiencies in water use and reduced the motivation to adopt water-saving technologies. Consequently, even shallow aquifers have been overdrawn, forcing farmers to invest in deeper and more expensive bore wells. This not only raises the cost of cultivation but also affects the water quality, as deeper layers often contain higher

concentrations of salts, fluoride, and heavy metals.

Climate change adds another layer of complexity. The frequency of erratic monsoons, prolonged dry spells, and delayed rainfall has disturbed the recharge cycle of groundwater. Moreover, rising temperatures have increased evapotranspiration, thereby intensifying the water demand of crops and stressing already overdrawn aquifers.

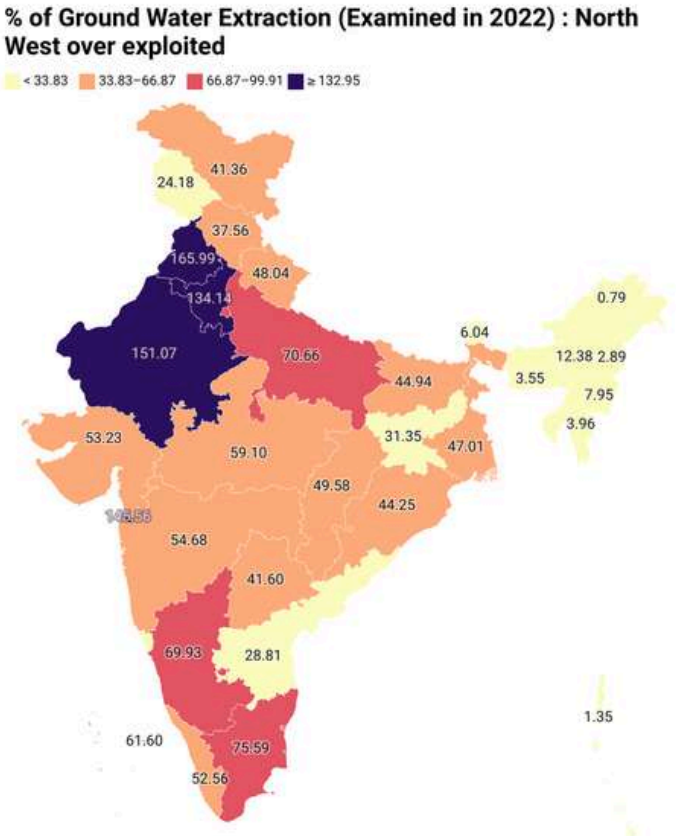
The implications of water table degradation are profound. As groundwater levels plummet, the energy required to pump water increases, inflating farmers' electricity bills and carbon emissions. Simultaneously, the falling water table leads to the drying up of wells and hand pumps, especially in rural households dependent on shallow aquifers for drinking water. This contributes to water scarcity, particularly in lean seasons, affecting hygiene, health, and daily life.

In terms of agricultural sustainability, degraded groundwater resources directly threaten food security. Reduced water availability can constrain crop productivity and limit options for crop diversification. Farmers may find it increasingly difficult to sustain the current intensity of cultivation, thereby reducing incomes and potentially pushing many into debt or out of farming altogether.

Efforts to address the crisis have been initiated, but much more needs to be done. Government schemes promoting micro-irrigation systems like drip and sprinkler methods have shown promise, but their adoption remains limited in these regions. Similarly, awareness campaigns and programs promoting crop diversification such as switching from paddy to millets, pulses, or oilseeds face socio-economic and policy-related barriers. Minimum Support Prices (MSPs) still heavily favor rice and wheat, discouraging shifts to less water-intensive crops. On a positive note, some districts have started implementing groundwater recharge strategies, including check dams, recharge wells, and restoration of traditional ponds. However, these initiatives need scaling up with strong institutional support, inter-state coordination, and community involvement. Policymakers must also reconsider subsidy structures and incentivize efficient water use and sustainable cropping practices.

Additionally, accurate groundwater mapping using remote sensing, real-time monitoring, and farmer-centric advisories through digital platforms can significantly improve management outcomes. Educational outreach and capacity building at the village level can help promote behavioral change among farming communities.

The challenge of groundwater depletion in Punjab, Haryana, and Western Uttar Pradesh is not just an environmental issue it is a socio-economic and existential one. If not addressed urgently, it threatens to undermine decades of agricultural progress and endanger the livelihoods of millions. A paradigm shift in water management, cropping patterns, and agricultural policy is essential to reverse the tide and ensure water security for future generations.



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