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#SaveOurSnow

HKH snow update 2025

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Preface

The Hindu Kush Himalaya (HKH) Snow Update is an annual report that monitors seasonal snow anomalies in the HKH region. These reports provide year-wise analysis of seasonal (November-March) snow persistence - the fraction of time snow remains on the ground after snowfall. With snowmelt contributing about a fourth of the total annual runoff of twelve major river basins in the region, on average, anomalies in seasonal snow persistence affect water security of nearly two billion people across these river basins.

While below-normal snow persistence has occurred before in this region – between 2003 and 2025 the region experienced thirteen below-normal snow years –the increasing frequency and intensity of such occurrences in recent times is a growing concern. For instance, 2025 has not only been the third consecutive year of below-normal snow persistence, but it also hit a twenty-three-year record low of 23.6% below normal.

The steadily declining persistence of seasonal snow is a warning bell for an emerging water crisis. Continuous deficit of meltwater from snow would mean lesser river runoff in dry months and early melt season, highlighting the urgent need for adaptive water resource management strategies in mitigating forthcoming impacts of water shortage, especially for downstream communities facing intensifying summer extremes.

Introduction

The Hindu Kush Himalaya (HKH) region heavily depends on the cryosphere – frozen water on the earth's surface - as a critical source of freshwater for over two billion people living in these mountains and downstream. The contribution of meltwater from snow to the total river runoff in the HKH region is around 23%, on average, with the share of snowmelt increasing from the river basins in the east to west (ICIMOD 2023). Seasonal snowmelt is crucial for regional and local water availability, especially in the early melt season. It nourishes rivers for agriculture, hydropower, and several ecosystem services.

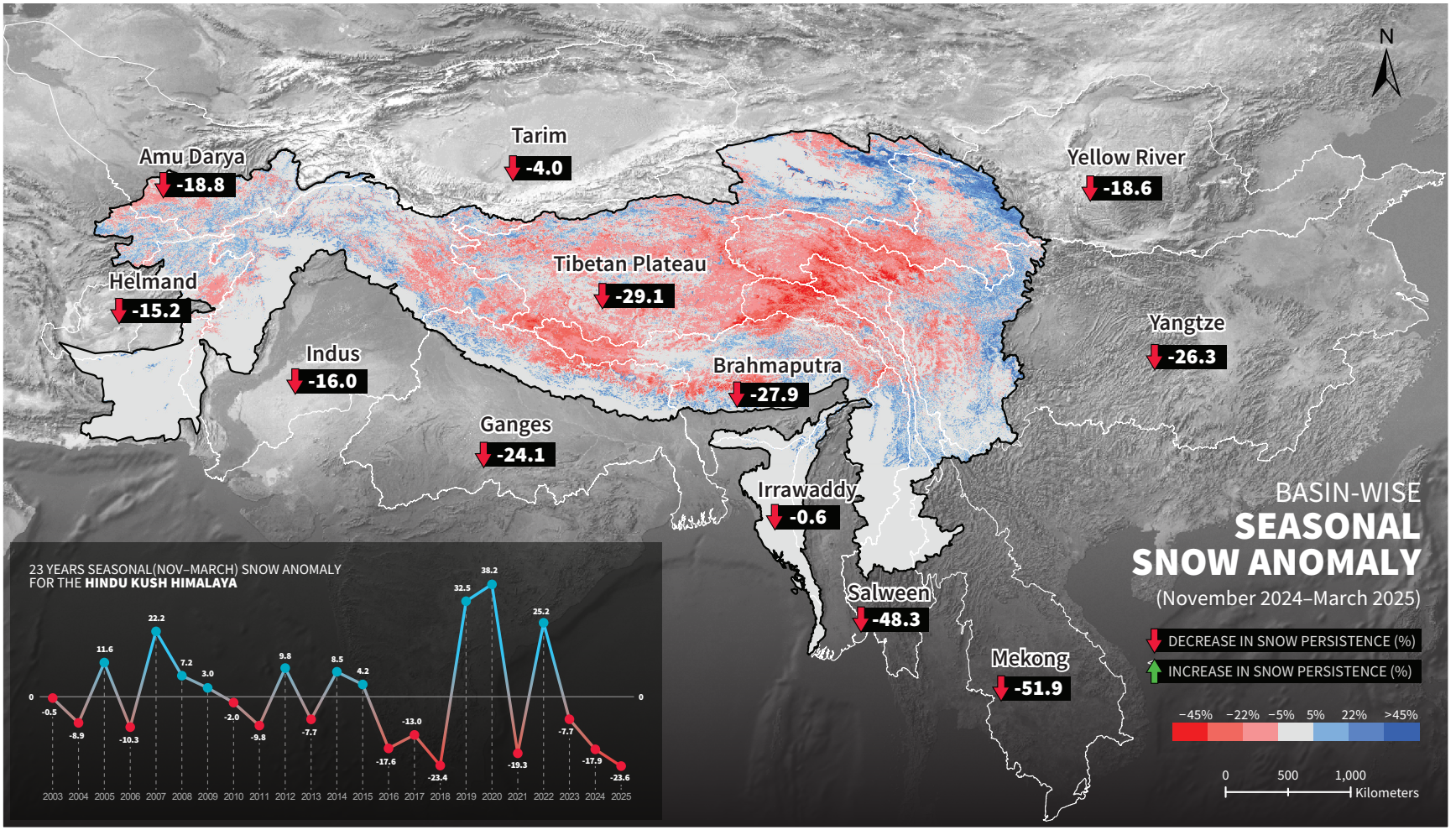
While our 2024 Snow Update examined snow conditions from November (2023) to April (2024), the current Update focuses on snow conditions between November (2024) and March (2025), for timelier decision support. However, methodologically, both issues are based on the improved cloud-free snow data from the Terra and Aqua (Muhammad and Thapa 2019, 2020). By comparing the persistence of seasonal snow in the current year with historical records, this report examines the anomaly of seasonal snow persistence.

Four of the past five winters between 2020- 21 and 2024-25 saw below-normal snow persistence in this region. The 2024 HKH Snow Update reported a decrease in snow persistence by 18.5% compared to the mean snow persistence in the preceding two decades from 2003 to 2023. But the 2024–2025 winter evidenced a historically low snow persistence at -23.6%, the lowest ever recorded in the past twenty-three years (Fig 1). Snow persistence has been below normal across all twelve major river basins, with the most alarming decline observed in the Mekong (-51.9%) and Salween (-48.3%) basins, followed by the Tibetan Plateau (-29.1%), Brahmaputra (-27.9%), Yangtze (-26.3%), and Ganges (-24.1%). Even snow-dominant basins such as the Amu Darya (-18.8%) and Indus (-16.0%) also continued experiencing reduction in snow persistence (Fig.2). In the context of such steadily declining persistence of seasonal snow, below-normal precipitation in spring may lead to reduced runoffs, further cascading into increased groundwater extraction, and risks of droughts across the region.

This below-normal snow persistence is alarming for early summer water availability downstream. It is recommended that relevant authorities prepare adaptive water management strategies and enhance drought preparedness. Early warnings for possible water shortages, optimised water allocation plans, and joint efforts among relevant agencies will be instrumental in mitigating the impact of possible water scarcity downstream. In addition, drought response mechanisms need to be established for effective and timely relief and for sustaining water supply for snow-dependent regions in South Asia.

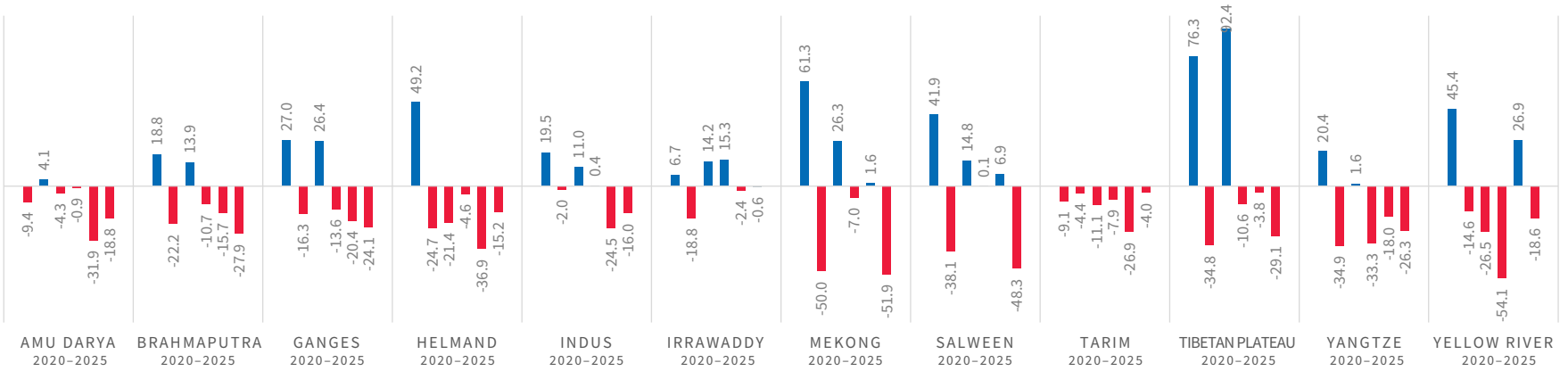
Figure 1 shows the spatial distribution of snow persistence anomaly, and the overlaid graph is the HKH-WIDE average seasonal snow anomaly (November-March) for the last twenty-three years. Figure 2 shows the Basin-wise anomaly between 2020 and 2025.

FIGURE 1: **SNOW COVER PERSISTENCE ANOMALY DURING NOVEMBER 2024–MARCH 2025 (COMPARED TO HISTORIC OBSERVATIONS DURING THE REFERENCE PERIOD 2003–2024)**



Note: Map shows the spatial distribution of snow persistence anomaly, and the overlaid graph is the HKH-WIDE average seasonal (November-March) anomaly for the last twenty-three years.

FIGURE 2: **SNOW PERSISTENCE (%) ANOMALY BETWEEN 2020 AND 2025 IN MAJOR RIVER BASINS OF THE HKH.**



Note: Years are in ascending order from left to right for each basin. Bar graphs represent yearly snow persistence anomaly.

Basin-scale seasonal snow assessment

AMU DARYA BASIN: Snow persistence reached its highest level, peaking at 40.4% above normal in 2008. In 2024 the basin experienced the lowest ever snow persistence (-31.9%) in two decades. While the anomaly in 2025 (-18.8%) is lower in comparison to the previous year, it is still the fourth lowest figure recorded in the past twenty-three years. Such consistent deficit in seasonal snow will threaten downstream water availability.

BRAHMAPUTRA BASIN: Snow persistence was at the highest level of 27.7% above normal in 2019. In contrast, it fell to the lowest of 27.9% below normal in 2025. Continued decline in snow persistence is likely to have adverse impact on hydropower generation and agriculture, especially in early summer, and underscores the need for integrated drought risk planning.

GANGES BASIN: The snow persistence in this basin this year has been 24.1% below normal, the lowest in the past twenty-three years, vis-à-vis the highest of 30.2% above normal in 2015. The current snowmelt deficit may lead to reduced flows in early summer.

HELMAND BASIN: The basin experienced the peak of snow persistence at 49.2% above normal in 2020 vis-à-vis a trough of 45.0% below normal in 2018. While the anomaly of -15.2% in 2025 is moderate in comparison to 2018, yet it is concerning for early summer season. Continued deficits will further worsen Afghanistan's water stress.

INDUS BASIN: From a highest of 19.5% in 2020, the basin experienced a steep drop in snow persistence to 24.5% below normal level in 2024, also the lowest it faced in the past twenty-three years. While the anomaly of -16% recorded in 2025 is less than 2024. The decline creates a water scarcity in early summer – threat for nearly 300 million people - and calls for urgent water management strategies.

IRRAWADDY BASIN: In 2017 snow persistence fell to a vicennial lowest of 21.1% below normal. This year's snow persistence shows no significant change, underscoring minimum impact on river runoff.

MEKONG BASIN: Snow persistence has been the 51.9% below normal in 2025, the lowest recorded in the twenty-three-year span. When compared to the highest persistence of 80.3% above normal in 2019, this indicates drastic fluctuations in seasonal snow, which can severely undermine hydropower generation and agriculture in the upcoming months.

SALWEEN BASIN: This basin also witnesses drastic fluctuations in season snow ranging from the highest persistence of 41.9% above normal in 2020 to the lowest of 48.3% below normal in 2025. However, this basin in not predominantly dependent on seasonal snowmelt.

TARIM BASIN: The vicennial highest snow persistence for this basin was recorded in 2006 at 28.7% above normal, while the lowest of 26.9% below normal occurred in 2024. In 2025, snow persistence has been around 4% below the normal level. The basin experienced below normal snow persistence continuously in the last six years.

TIBETAN PLATEAU: In the twenty-three years' time from 2003, the Tibetan Plateau has experienced a drastic drop in snow persistence from the highest level of 92.4% above normal in 2022 to a lowest of 29.1% below normal in 2025.. Snow persistence significantly fluctuates in Tibetan Plateau.

YANGTZE BASIN: Seasonal snow persistence has been volatile in this basin since 2015. Persistence of seasonal snow in 2025 has been 26.3% below normal, the sixth lowest in the past twenty-three years. While the highest persistence recorded in 2008 was 70.4% above normal. Steadily declining snowpack jeopardizes hydropower efficiency of the Three Gorges dam.

YELLOW RIVER BASIN;The basin experienced the vicennial lowest snow persistence of 54.1% below normal in 2023 via-a-vis the highest of 98.2% above normal occurring in 2008. Snow persistence in 2025 has been 18.6% below normal. Although this is better than 2023, yet it is critical given that the basin experiences continued snowmelt deficits that stress agriculture, hydropower generation and water availability.

Way forward

With consistently declining seasonal snow persistence and increasing snowmelt anomaly across the river basins in HKH, there is pressing need for immediate basin-level targeted actions. Investing in adaptive infrastructure like seasonal storage systems and enhancing efficient use of meltwater, developing national preparedness and response plans for negative snow anomaly and drought conditions, integrating snow anomaly information into national water strategies for hydropower, agriculture, and allied sectors, and disseminating snow anomaly statistics to strengthen evidence-based decision making and sectoral coordination, are some of our recommended action points. At the same time the HKH countries need to embrace a paradigmatic shift toward science-based, forward-looking policies and renewed regional cooperation to tackle the regional snow crisis and the challenges it creates for long-term food, water and energy resilience.

Citation

Muhammad, S. (2025). *HKH snow update 2025*. ICIMOD. https://doi.org/10.53055/ICIMOD.1087

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