

MEETING REPORT

Harnessing the nexus of soil, water and society for nature-based ecosystem conservation in the North Western Himalayas*

Soil is crucial, providing 95% of global food, but agricultural practices also lead to significant soil and environmental degradation, including greenhouse gas emissions and soil erosion. Almost 52% of soils globally are in poor condition, making land degradation a major challenge that must be addressed for sustainable soil management and agricultural productivity.

These challenges become more prominent and pressing in the Himalayan ecosystem, which is a unique and vital land feature of the Indian subcontinent, and provides an interesting canvas for examining interactions between nature and society. The Northwestern (NW) Himalayas, spanning 33 Mha, cover three Indian states Jammu and Kashmir, Himachal Pradesh and Uttarakhand. It is inhabited by 25 million humans and 19 million livestock. The entire hill economy is dependent on subsistence agriculture though only an area of 3.2 Mha is under cultivation^{1,2}. The hilly region on account of its topography, peculiar geographical features and special problems forms a distinct socio-economic region compared to plains. They have a vast wealth of natural resources, viz. natural vegetation, fertile soil, forests, pastures, lakes, and snow-clad mountain peaks which must be properly harnessed to foster the development of hills and adjoining plains. Though the NW Himalayas are capable of supporting the growth of a variety of crops, the extreme variations in growing conditions, scattered land holdings, location remoteness, and poverty are serious challenges towards sustenance of hill agriculture. These challenges heighten the need for efficient management of natural resources alongside the improvement in the livelihood of the hill population through strategic planning, participation and implementation at the ground level. Integrating the societal role in the conservation of soil

and water in harmony and tandem with the ecosystem and nature is greatly relevant in today's scenario, and this thought motivated the IASWC for organizing a three day conference and deliberations. The conference focused on four main themes and three special themes delving into various aspects of natural resource management (NRM).

Ritu Khanduri Bhushan (Honorable Speaker of the Uttarakhand Legislative Assembly) inaugurated the conference. Her Chief Guest address, emphasized the importance of translating research into practical applications that benefit farmers and stakeholders rather than limiting it to academic publications and accolades. She highlighted the proactive nature of the people and farmers of Uttarakhand and stressed the need for clear, scientifically-backed guidance to conserve resources and enhance livelihoods. In a message to the conference participants, Pushkar Singh Dhama (Honorable Chief Minister of Uttarakhand) stressed the importance of such deliberations and gathering for churning scientific findings and ensuring better percolation down the society.

The first technical session dealt with 'Trends in resource assessment and inventory', where key speakers focused on the advancement of techniques and tools employed for assessing natural resources. The era of artificial intelligence (AI) and machine learning (ML) has necessitated the use of AI/ML in combination with remote sensing and global information system (GIS) techniques for characterizing, classifying and database creation of various natural resources. Capacity building of manpower involved in NRM activities at the ground level should be considered a top priority. Projects involving the rehabilitation of degraded lands by combining local knowledge and scientific methodologies should be promoted and emphasized for funding to allow the participation of the direct stakeholders at the watershed level. The second technical session focused on the 'Sustainable management of soil and water' with special reference to the hill ecosystem. The springs are the lifeline of the Himalayan region, and an estimated 50% of the 3 million springs in the Himalayas is supposedly dried up³. The drying up of springs has

direct repercussions on the livelihood, economic and social security of the villagers and results in outmigration. Currently, 734 such villages dot the hill districts⁴. The Uttarakhand Government has implemented multiple spring-shed rejuvenation programmes using a watershed approach, with 'Spring and River Rejuvenation Authority' playing a pivotal role in identifying recharge areas. The need for integrated approaches for sustainable water management within agro-ecology to enhance resilience and productivity, including the promotion of citizen science, was the highlight of this session.

The third technical session focused on 'Ecosystem services and climate resilience' and the key point was the conservation of the biodiversity for ensuring climate resilience of various ecosystems. The concept of circular economy was stressed upon to reduce agricultural wastes and ensure the adaptation of improved agricultural practices like conservation agriculture to achieve carbon-neutral farming. The wetlands are often biodiversity hotspots capable of sequestering substantial amounts of carbon and also serve as a source of livelihood for local people⁵. The conservation of wetlands and their effective management for extreme weather conditions is required.

Technical session four was based on 'Society, policy and governance'. Given the high variability in natural resources, region-specific standard operating procedures are to be developed for targeted programmes and schemes. Ecosystem services of NRM interventions need to be quantified and monetized for promoting economic incentives to the suppliers (e.g. farmers and other stakeholders), and an institutional framework needs to be conceptualized for internalizing the evaluation of ecosystem services (EESs) in watershed planning. Provisions for compensating the farmers in events of yield losses during the initial stages of adoption of conservation efforts (e.g. natural farming). The establishment of natural-farming clusters in different agro-ecological zones involving grassroots institutions (non-governmental organizations and Krishi Vigyan Kendras), and nutritional gains of crops grown in natural farming needs to be assessed.

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Besides these four technical sessions, the three special sessions dealing with agro-ecological transitions, bamboo for resource conservation and land restoration and biodiversity protection all highlighted the importance of bringing society or citizen science into the arena of soil and water conservation and natural resource management. The three-day programme culminated in the formulation of the below recommendations for the Government of the NW Himalayan states.

- A national initiative is proposed to create a unified dataset for assessing natural resources, emphasizing the need for collaboration among key institutes like, Indian Council of Agricultural Research (ICAR), Indian Space Research Organisation (ISRO), Geological Survey of India (GSI), and Forest Survey of India (FSI). ICAR could host the platform, with ISRO managing data access. Strengthening existing platforms like Bhuvan and Bhunidhi for regular data and map updates is suggested, along with an inter-institutional policy to share high-resolution data generated by various centres.
- The watershed concept is gaining renewed global interest due to emerging challenges and heightened environmental awareness. A next-generation watershed programme should prioritize landscape rejuvenation, focusing on both surface and groundwater management. Key areas of emphasis in-

clude enhancing resilience to climate change, drought-proofing strategies and conserving biodiversity.

- Spring shed rejuvenation is critical in supporting the health of hill populations and downstream ecosystems, which are currently in decline. There is a pressing need for collaboration among hydrologists, geologists, environmental specialists, and social mobilizers to develop a comprehensive protocol for springshed delineation, management and rejuvenation.
- Capacity building, feedback mechanisms, and research support are increasingly relevant for sustaining watershed and soil and water conservation programmes, given the rising expectations and accountability. Strengthening the institute having mandate and a legacy of capacity building in watershed management and soil and water conservation is required. This can be achieved through additional resource allocation, forming Memorandum of Understandings with key stakeholders, or elevating the identified institute to centres of excellence.

The programme concluded with the Valedictory programme chaired by C. P. Reddy (Senior Additional Commissioner (WM), Department of Land Resources, Govt of India). In his valedictory remarks, he keenly urged the need to handover natural resources to our next generation in a condition that can sustain the ecosystem as we all

owe these natural resources to our future generations.

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