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POPULAR ARTICLE

Balanced use of fertilizer in the north eastern hills of India- the why and how?

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Intricacies of the subject

The North Eastern Hill (NEH) Region of India encompasses states like Arunachal Pradesh, Meghalaya, Mizoram, Nagaland, Sikkim, and the hilly tracts of Assam, Manipur, and Tripura. Agriculture in this terrain faces unique challenges, including severe soil acidity, steep slopes, high rainfall, and traditional Jhum (shifting) cultivation. Historically, the region has had a very low average fertilizer consumption rate (often under 35 kg/ ha). Implementing a strategy for balanced fertilizer application is vital to transitioning this region from low-productivity subsistence farming to sustainable, high-yield agriculture.

Introduction

The primary objective is to replace insufficient nutrient application with a scientifically calibrated approach that respects the delicate mountain ecosystem.

Ameliorating soil acidity: Over 80% of soils in the NEH region are highly acidic (pH < 5.5). This creates Aluminium (Al) and Iron (Fe) toxicities while locking up Phosphorus (P) availability. A balanced application aims to neutralize this acidity to unlock bound nutrients.

Correcting micro nutrient deficiencies: Hill soils are severely deficient in critical secondary and micro nutrients, particularly Boron (B), Zinc (Zn), and Sulphur (S).

Optimizing nutrient use efficiency (NUE): Due to heavy downpours and steep slopes, up to 70% of surface- applied nitrogen is generally washed away. The goal is to minimize leaching and run off losses.

Transitioning from shifting cultivation: Aiding farmers move away from the ecologically degrading Jhum cycle toward settled, terrace- based farming by maintaining permanent soil fertility.

Sustaining crop productivity: Boosting the yields of regional staples (rice, maize) and high-value cash crops (ginger, turmeric, king chilli and citrus) without degrading the environment.

Achieving balanced fertilization in a hilly landscape requires integrating targeted chemical inputs with organic and bio- logical resources through Integrated Nutrient Management (INM) approach.

Soil testing and diagnostic tools

Soil health card (SHC) scheme: Registering and assessing farm holdings across 12 critical parameters (including macro, secondary, micro-nutrients and pH). This provides

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customized, crop-specific fertilizer recommendations directly to hill farmers.

GPS-based soil fertility mapping: Developing block-level and watershed- level fertility maps to identify localized Boron or Phosphorus stress pockets.

Soil amendment and acid management

Liming intervention: Applying agricultural lime or paper mill sludge at recommended rates (typically 2- 4 quintals/ ha in furrows) to alter pH. This process mitigates Aluminum toxicity and allows crops to absorb phosphorus efficiently.

Rock phosphate utilization: Using low- cost, indigenously available rock phosphate as a primary P source, which dissolves effectively and gradually in acidic hill soils.

Integrated nutrient management (INM)

Blending chemical and organic sources: Combining 50- 75% of the recommended inorganic NPK dose with locally abundant organic manures. These include Farmyard Manure (FYM), pig/ poultry manure and vermicompost.

***In- situ* bio-mulching and green manuring**: Growing and incorporating leguminous green manure crops (like Sesbania or rice- bean) during fallow periods to lock atmospheric nitrogen into the soil.

Bio-fertilizers: Inoculating seeds or soils with acid- tolerant strains of Azotobacter, Rhizobium, and Phosphorus Solubilizing Bacteria (PSB) to maximize nutrient uptake organically.

Advanced fertilizer forms and application techniques

Customized and fortified fertilizers: Utilizing specialized fertilizer grades pre-blended with Zinc and Boron tailored precisely to NEH soil profiles.

Nano-fertilizers: Deploying liquid Nano Urea and Nano DAP via targeted foliar spraying. This drastically decreases the physical volume of fertilizer needed up steep, unpaved terrain while reducing ground runoff.

Deep placement and splitting: Shifting away from surface broadcasting. Splitting Nitrogen applications into 3 installments and deep-placing urea briquettes near the root zone, prevents rain- induced washing.

4R Nutrient stewardship

Right rate: Apply based on soil testing and crop yield targets

Right time: Time application for maximum crop uptake; avoid fall N on high-leaching soil

Right place: Band application near roots; reduce runoff on slopes

Right source: Use urease/ nitrification inhibitors; choose acid- tolerant formulations.

Creating awareness on health and pollution hazards

Large- scale awareness programs, led by institutions like the ICAR Research Complex for NEH Region (Umiam) with initiatives like Mera Gaon Mera Gaurav (MGMG), Central & State Agricultural Universities, State Agricultural Departments and Krishi Vigyan Kendra's have proven highly effective.

The thrust needed…

- **Large-scale production of bio-inputs:** Scaling up the regional production of bio-fertilizers and bio-pesticides to ensure a reliable, steady supply for farming communities.
- **Validating and honoring indigenous technical knowledge (ITK):** Systematically testing, validating and

popularizing traditional local wisdom and folk remedies used by farmers for generations to manage soil fertility.

- **Championing low- input crops like millets:** Encouraging low- input requirement crops like millets to naturally demand fewer chemical and water resources to thrive.
- **Smart cropping and residue management**: Emphasizing double or multiple cropping systems, paired with careful crop residue management to keep soils continuously covered and nourished.
- **Village- level skill development on bio-inputs**: Empowering rural communities through hands- on training, teaching local farmers how to easily brew and utilize low-cost, homemade bio- inputs right in their own villages.
- **Diversifying with crop rotation and pulses**: Actively introducing crop rotations and legume/ pulse cultivation into the rotation cycle to naturally fix nitrogen in the soil.
- **Expanding integrated farming systems (IFS):** Advocating for holistic, multi-layered Integrated Farming Systems where crops, livestock, horticulture, and sometimes aquaculture support and feed into one another.
- **Crop residue management:** Encouraging the integration of the Black Soldier Fly (BSF) into modern agriculture to act as a catalyst for "circular farming."