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GREEN INSIGHTS

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Soil Matters: A Green Insight on Sustainability

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October - December 2024

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Foreword

The path to sustainable soil management demands a multifaceted and collaborative approach to address ongoing challenges and secure soil health for future generations. Priorities include strengthening soil testing infrastructure with advanced technologies like AI-based analysis and IoT-enabled sensors for real-time monitoring. Promoting organic farming and agroforestry practices can enhance soil fertility, reduce dependency on chemical inputs, and boost resilience against climate change.

Policy frameworks must evolve to support these advancements, ensuring equitable access to resources and education for farmers. Initiatives such as the Natural Farming Mission and Sub-Mission on Agroforestry should be scaled up to promote sustainable practices nationwide. Additionally, integrating traditional knowledge with modern science can offer culturally relevant and holistic solutions.

International cooperation and knowledge exchange are crucial in combating global challenges like climate change and food security. Empowering communities through education and incentivizing sustainable practices will further amplify efforts. By aligning technology, policy, and grassroots involvement, we can achieve a resilient and thriving soil ecosystem.

Caring for Soils: Measure, Monitor, Manage

Source: https://www.fao.org/world-soil-day/en

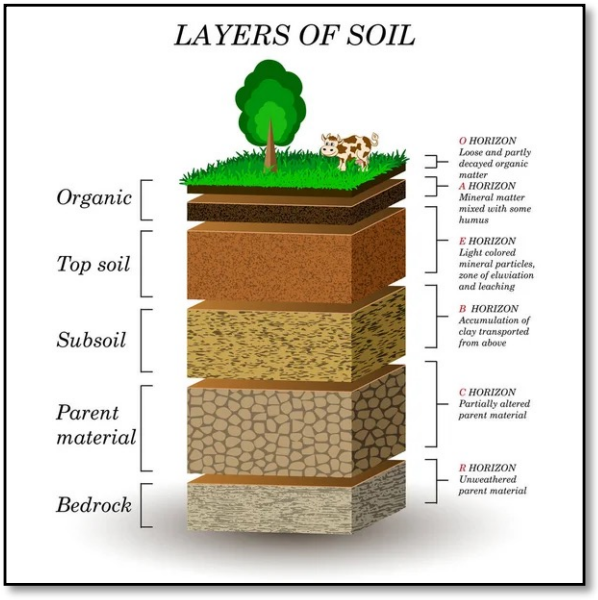
Soil Health in Modern Times

The celebration of World Soil Day on December 5th represents a pivotal moment in our global environmental calendar, drawing attention to one of Earth's most precious yet often overlooked resources. The 2024 theme, "Caring for Soils: Measure, Monitor, Manage" encapsulates the three fundamental pillars of sustainable soil management, presenting a holistic approach to soil conservation and restoration. This comprehensive analysis explores the intricate relationships between measurement methodologies, monitoring systems, and management strategies that collectively contribute to soil health and environmental sustainability.

The current state of global soil resources presents a concerning picture that demands immediate attention and action. According to recent assessments by the Food and Agriculture Organization (FAO, 2023), approximately one-third of the world's soil resources are in a state of degradation. This deterioration manifests through various processes, including erosion, salinization, compaction, acidification, and chemical pollution. The economic implications of this degradation are staggering, with annual losses estimated at hundreds of billions of dollars in ecosystem services and agricultural productivity. More alarmingly, the rate of soil degradation continues to accelerate, driven by intensive agriculture, urbanization, and climate change.

Modern soil measurement techniques have evolved significantly, incorporating advanced technologies and methodologies that provide unprecedented insights into soil health. Contemporary soil scientists employ a range of sophisticated tools, from portable spectrometers to satellite-based remote sensing systems, to assess physical, chemical, and biological soil properties. These measurements form the foundation of evidence-based soil management strategies. Particularly noteworthy is the development of real-time soil monitoring systems that utilize Internet of Things (IoT) sensors to provide continuous data streams on moisture levels, nutrient content, and microbial activity. This technological revolution in soil science has enabled more precise and timely interventions in soil management practices.

The economic dimensions of soil health present both challenges and opportunities. While the initial costs of implementing sustainable soil management practices may be substantial, the long-term benefits consistently outweigh these investments. Analysis of multiple case studies reveals that farms implementing comprehensive soil health programs typically see returns on investment within three to five years. These returns manifest not only in improved crop yields but also in reduced input costs, enhanced resilience to climate variability, and potential carbon credit revenues. The emerging market for soil carbon sequestration presents additional economic opportunities, with estimates suggesting a potential market value of several trillion dollars by 2030.



Source: https://as2.ftcdn.net/v2/jpg/01/71/48/65/1000_F_171486521_ZKsCMMexp5OuIMF51JbpgGQgnEiHC8bb.jpg

Advanced soil management strategies increasingly incorporate precision agriculture technologies and biological approaches. These innovations enable farmers to optimize resource use while maintaining or improving soil health. Precision agriculture technologies, including variable rate application systems and GPS-guided operations, have demonstrated significant reductions in input use while maintaining or improving yields. Similarly, biological approaches such as cover cropping, crop rotation, and the use of microbial inoculants have shown promising results in enhancing soil health while reducing dependency on chemical inputs.

Looking toward the future, several key areas require continued attention and investment. The development of more sophisticated monitoring technologies, including artificial intelligence-powered systems and quantum sensors, promises to further enhance our understanding and management of soil health. Policy frameworks need to evolve to support these technological advances while ensuring equitable access to resources and knowledge. International collaboration in soil research and conservation efforts will become increasingly important as we address global challenges such as climate change and food security.

Recommendations for advancing soil health initiatives include strengthening research funding for soil science, developing comprehensive soil protection legislation, creating financial incentives for sustainable soil management practices, and expanding environmental education programs. Additionally, the integration of traditional knowledge with modern scientific approaches offers opportunities for more holistic and culturally appropriate soil management strategies.

The journey toward sustainable soil management requires a coordinated effort from all stakeholders - farmers, scientists, policymakers, educators, and consumers. By measuring soil health parameters accurately, monitoring changes effectively, and managing resources sustainably, we can work toward preserving and enhancing this vital resource for future generations. The theme “Caring for Soils: Measure, Monitor, Manage” serves as a reminder that soil health is not just an agricultural issue but a fundamental component of environmental sustainability and human well-being.

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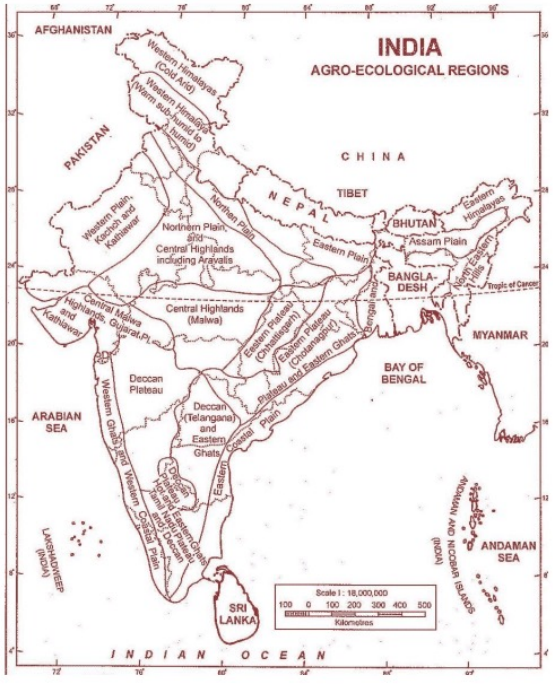
Status of National Soil Resources in India: Current Perspectives and Challenges

India's soil resources present a complex mosaic of diversity and challenges, reflecting the nation's varied agro-ecological zones and intensive agricultural practices. According to the National Bureau of Soil Survey and Land Use Planning (NBSS&LUP), India possesses 20 agro-ecological regions and 60 agro-ecological sub-regions, each characterized by distinct soil types and management requirements. Recent assessments indicate that approximately 120.72 million hectares of land in India are affected by various forms of degradation, representing about 36.7% of the total geographical area (ICAR, 2023).



Sources:

1)https://lotusarise.com/agro-ecological-regions-of-india-upsc/

2) https://myagrilife.com/empowering-farmers-soil-health-card-scheme/jenny/

The current status of Indian soils reveals concerning trends in nutrient depletion and organic matter content. The soil health card scheme data (2019-2024) indicates that about 59% of soils are deficient in nitrogen, 49% in phosphorus, and 36% in potassium. More alarmingly, nearly 65% of Indian soils have low organic carbon content (<0.5%), affecting soil fertility and microbial activity. The Indo-Gangetic plains, which contribute significantly to national food security, show declining soil health indicators, with organic carbon content decreasing by 0.3% annually over the past decade.

India has implemented several flagship programs to address these challenges. The Soil Health Card Scheme, launched in 2015, has issued over 229 million soil health cards to farmers across the country. This initiative has revolutionized soil testing accessibility, with 2,478 static and mobile soil testing laboratories operating nationwide. The scheme's impact assessment reveals a 8-10% reduction in chemical fertilizer use and a 5-6% increase in crop productivity where recommendations were followed (Ministry of Agriculture, 2024).

The National Mission for Sustainable Agriculture (NMSA) has made significant strides in promoting location-specific integrated farming systems. Through its various components, including Rainfed Area Development (RAD) and Soil Health Management (SHM), the mission has supported the development of model agricultural practices across different agro-climatic zones. The mission's interventions have resulted in the treatment of 25.75 million hectares of degraded land and the establishment of 9,573 soil and water conservation demonstration sites.

Traditional knowledge systems in India have historically emphasized soil conservation practices. The integration of these traditional approaches with modern scientific methods has shown promising results. For instance, the revival of traditional water harvesting systems in Rajasthan has improved soil moisture retention by 40% and reduced erosion by 35%. Similarly, the promotion of indigenous organic farming practices in the northeastern states has led to a 25% increase in soil organic carbon content over five years.

Urban soil management has emerged as a critical concern with rapid urbanization. Major metropolitan areas show elevated levels of heavy metals and reduced biological activity in soils. The Smart Cities Mission has incorporated urban soil health management into its framework, with 15 cities implementing pilot projects for urban soil restoration and management. These initiatives include the development of urban green spaces, soil remediation projects, and the promotion of urban agriculture.

The way forward for Indian soil resources management requires a multi-pronged approach. Priority areas include strengthening the soil testing infrastructure, promoting organic farming practices, enhancing farmer awareness, and developing region-specific soil management protocols. The integration of digital technologies, including AI-based soil analysis and blockchain-enabled traceability systems, offers promising solutions for better soil resource management.

Recent policy initiatives, such as the Natural Farming Mission and the Sub-Mission on Agroforestry, complement existing programs by promoting sustainable soil management practices. These initiatives aim to reduce chemical input dependency while improving soil biological activity and carbon sequestration potential. The Zero Budget Natural Farming movement, particularly successful in Andhra Pradesh and other states, demonstrates the feasibility of transitioning to more sustainable soil management practices at scale.

Climate change impacts on Indian soils require special attention. Projections indicate that soil organic carbon stocks could decline by 15-20% in vulnerable regions by 2050 under current climate scenarios. This necessitates the development of climate-resilient soil management strategies and the strengthening of soil carbon monitoring networks across different agro-ecological zones.

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Do's and Don'ts for Soil Conservation in INDIA

Do's

1.Adopt Agroforestry Practices
Incorporate trees and shrubs within farming systems to reduce soil erosion, enhance soil fertility, and maintain biodiversity (Nair, 1993).

3.Implement Contour Plowing and Terracing
Use plowing along natural contours and create terraces on slopes to minimize runoff and prevent soil erosion in hilly areas (Sharda et al., 2010).

5.Establish Vegetative Buffer Zones
Plant grass or vegetation along riverbanks and field edges to filter sediments and prevent runoff (Viglizzo et al., 2005).

7.Encourage Community Participation
Mobilize local communities for collective soil conservation efforts, including reforestation and management of grazing lands (Agarwal, 1998).

2.Practice Crop Rotation and Cover Cropping
Alternate crops with legumes and grasses to improve soil structure, prevent nutrient depletion, and reduce erosion (Lal, 2001).

4.Promote Organic Farming
Use organic composts and natural fertilizers to enhance soil organic matter and reduce chemical contamination (IFOAM, 2020).

6.Adopt Watershed Management
Integrate soil and water conservation measures within a watershed to address erosion and enhance soil moisture retention (Wani et al., 2003).

Don'ts

1.Avoid Overgrazing

Overgrazing leads to compaction, loss of vegetative cover, and increased susceptibility to erosion (Teague et al., 2011).

2.Limit Excessive Tillage

Repeated tillage breaks soil structure, accelerates erosion, and depletes organic matter (Lal, 1991).

3.Do Not Burn Crop Residues

Burning destroys soil organic matter, depletes nutrients, and contributes to air pollution (Singh et al., 2008).

4.Avoid Monocropping

Planting a single crop continuously depletes specific nutrients and reduces soil fertility over time (Tilman et al., 2002).

5.Prevent Deforestation

Cutting down trees exposes soil to erosion and reduces soil water retention capacity (FAO, 2015).

6.Refrain from Excessive Chemical Use

Overuse of synthetic fertilizers and pesticides leads to soil contamination and degradation (Jayaraj et al., 2016).

7.Avoid Constructing on Vulnerable Land

Building on fertile agricultural or erosion-prone land exacerbates soil loss and reduces arable land (NITI Aayog, 2018).

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Events (October – December 2024)

1. CERC EIACP conducted a millet awareness session at Sheth Amulakh Vidhyalay, Gota, to promote healthy and sustainable food practices. The session highlighted the nutritional benefits of millets like ragi, bajra, and jowar, as well as their importance in sustainable agriculture and food security. Following the session, students were inspired to form the CERC EIACP, aimed at spreading awareness about millets and supporting eco-friendly initiatives within the school community. This initiative encouraged students to adopt healthier, more sustainable food habits.

2. CERC celebrated World Standards Day in collaboration with BIS. Ms. Anindita Mehta (COO CERC, Coordinator CERC EIACP) talk as the Keynote speaker focused on the theme of the day" Shared vision for a Better World: Spotlight on SDG9 which focuses on building resilient infrastructure, promoting inclusive and sustainable industrialization and fostering innovation.

3. On 16th and 17th November 2024, a heartfelt tree plantation drive was carried out under the Ek Ped Maa Ke Naam initiative, in collaboration with Gayatri Parivar, Anand, Gujarat. A total of 31 native saplings, including Neem, Kadam, Kachnar, Peepal, Kesudo, and Banyan, were planted. Each tree symbolized hope for a greener tomorrow and a step towards healing the planet. The drive brought together individuals united by their love for the environment, turning this effort into a celebration of life, growth, and community spirit.

4. CERC EIACP PC RP conducted an engaging Reptile Education Program at the College of Technology, Silver Oak University, where 167 students explored the fascinating world of snakes found in their region. The session emphasized species identification, their ecological importance, and essential first aid for snake bites, empowering students with the knowledge to coexist safely with these remarkable creatures. Together, we're nurturing awareness, respect for wildlife.

5. CERC EIACP PC RP, Gujarat organised another plantation drive with the Kumkotar Youth Group at Kumkotar Village, Ta.Mahuva, Di.Navsari on December 3rd 2024. The drive involved 24 young participants who were made aware of the critical importance of trees in maintaining ecological balance. The event not only focused on tree planting but also discussed the broader impact of deforestation on our environment. Following the event, participants took a pledge to actively engage in environmental conservation efforts and promote sustainability in their communities.

6. CERC EIACP PC RP, Gujarat organized an awareness session at Shree Sukhanand Uttarbuniyadi Vidhyalay in Balethi Village, Ta.Mandavi, Di. Surat on December 4th 2024, attended by 316 Students . The session focused on Mission LiFE and the importance of adopting eco-friendly products in our daily lives. It encouraged students to make informed decisions regarding their environmental impact by choosing products that are sustainable and less harmful to the planet. students received awareness material, and a pledge was taken to integrate eco-friendly practices into their lifestyle.

Source: https://regenx.ag/blog/why-should-consumers-care-about-soil-health/

Environmental Information, Awareness, Capacity Building and Livelihood Programme acronymed as EIACP erstwhile Environmental Information System (ENVIS) was implemented by the Ministry of Environment, Forest & Climate Change by end of 6th Five Year Plan as a Plan Scheme for environmental information collection, collation, storage, retrieval and dissemination to policy planners, decision makers, scientists and environmentalists, researchers, academicians and other stakeholders. MoEF&CC has identified Consumer Education and Research Centre (CERC), Ahmedabad, as one of the Resource Partner to collect and disseminate information on "Environment Literacy - Eco-labelling and Eco-friendly Products". The main objective of EIACP Programme centre- Resource Partner is to disseminate information on Environment literacy, Eco-products, International and National Eco-labelling programmes.

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