Tackling Soil Degradation in India

This editorial is based on "Nourishing our soil" which was published in The Financial Express on 09/12/2024. The article brings into focus the critical challenge of India's agricultural sustainability, highlighting deteriorating soil health with less than 5% of soils having adequate nitrogen and only 20% containing sufficient organic carbon. The current fertilizer subsidy system, focused on urea, causes nutrient imbalances, reducing productivity and contributing to environmental degradation, necessitating urgent reforms.

For Prelims:Soil health deterioration,India's Agricultural Sustainability, Chemical Fertilizers, Unregulated grazing,2023 Himachal Pradesh floods, Char Dham Highway, Invasive plant species,Soil Health Card Scheme,Paramparagat Krishi Vikas Yojana,MNREGA,Land degradation neutrality,Happy Seeder.

For Mains: Key Issues Leading to Soil Degradation in India, Measures for Effective Soil Health Management in India

India's agricultural sustainability faces a critical challenge with soil health deterioration. Recent assessments reveal that less than **5% of Indian soils have high nitrogen levels, while only 20% contain sufficient organic carbon.** The current fertilizer subsidy system, predominantly focused on **urea**, has led to **imbalanced nutrient usage**, with excessive nitrogen and insufficient phosphorus and potassium application. This nutrient imbalance not only reduces agricultural productivity but also contributes to environmental degradation. **Urgent systemic reforms** are needed to address these challenges and ensure long-term soil health and agricultural sustainability.

What is the Current Status of Soil Degradation in India?

- **Current Status**:The **Desertification and Land Degradation Atlas of India (SAC 2021)** indicates the current extent of land degradation to be **97.85 million hectares** covering **29.77% of the geographical area** of the country during 2018-19.
- **Geographic Spread and Severity**: Semi-arid and dry sub-humid regions are the most impacted, with states like **Rajasthan, Maharashtra, Gujarat, and Telangana** showing significant degradation.
    - Rajasthan alone has over **21 million hectares classified as degraded**, primarily due to wind erosion in its arid zones.
    - **Desertification processes have increased**, with **83.69 million hectares** now classified as drylands undergoing desertification, a net rise of over 1 million hectares since 2003-05.

What are the Key Issues Leading to Soil Degradation in India?

- **Unsustainable Agricultural Practices:** India's reliance on intensive farming techniques,

including **overuse of chemical fertilizers, pesticides, and monocropping**, has resulted in nutrient depletion and soil acidification.
    - For example, Punjab and Haryana face declining organic carbon levels due to the Green Revolution's legacy of high-yield cropping.
    - In India **organochlorine insecticides such as DDT and HCH** constitute more than **70% of the pesticides used at present.**
- **Deforestation and Urbanization:** Rapid deforestation for agriculture, infrastructure, and urban expansion accelerates soil erosion and reduces water retention.
    - Recent data showed that **95% of the tree cover loss in India from 2013 to 2023 occurred within natural forests.**
        - For instance,the Western Ghats, which is among 36 global biodiversity hotspots, saw a loss of **5% evergreen forest cover,** impacting local soil fertility.
- **Overgrazing and Unsustainable Livestock Management: Unregulated grazing** leads to vegetation loss, **exposing topsoil to erosion**, particularly in arid and semi-arid regions like Rajasthan and Gujarat.
    - India has over **535 million livestock** exceeding sustainable carrying capacity. Increase in livestock numbers, has led to **increased pressure on grazing lands** with consequent overgrazing and denuding of plant cover.
- **Water Mismanagement and Irrigation Practices:** Excessive groundwater extraction and poor irrigation techniques, **such as flood irrigation,** result in soil salinization and waterlogging.
    - Over-irrigation has led to severe salinity. Around **6.74 million ha area in the country is salt-affected**.
        - In Punjab, **around 50% of land is degraded due to salinization** caused by over-irrigation, leading to waterlogging and salt accumulation on the surface.
    - Estimates suggest that every year nearly **10% additional area is getting salinized,** and by 2050, around **50% of the arable land would be salt-affected.**
- **Industrial Pollution and Mining Activities:** Industries discharge **heavy metals, chemicals, and pollutants** into nearby soil ecosystems, particularly in mining-intensive states like Odisha and Jharkhand.
    - Toxic contamination from **coal mining and fly ash dumps** has rendered large swathes of land unproductive.
    - For instance, the **Sterlite Copper plant in Tamil Nadu has caused severe soil and water contamination** due to the discharge of toxic chemicals into the air and nearby water bodies.
- **Climate Change and Extreme Weather Events:** Climate change-induced phenomena, such as **erratic rainfall, droughts, and floods**, exacerbate soil erosion and nutrient depletion.
    - For example, the **2023 Himachal Pradesh floods caused severe topsoil loss in agricultural zones**.
    - Areas susceptible to high or very high soil erosion rates are likely to increase from **35.3% to 40.3%** toward the end of the century, due to climate change.
- **Shifting Cultivation and Slash-and-Burn Practices:** In northeastern states like **Nagaland and Manipur,** shifting cultivation continues to degrade soil fertility due to slash-and-burn cycles that destroy organic matter.
    - A total of 4925 km² in North East India has been identified as **jhuming hotspots,** of which over **62% falls in Arunachal Pradesh, Assam, and Mizoram,** which leads to extensive soil erosion and biodiversity loss.
- **Unregulated Construction and Infrastructure Projects:** Large-scale construction for **roads, dams, and urban settlements** strips topsoil and disrupts natural drainage patterns.
    - For example, the construction of the **Char Dham Highway in Uttarakhand** has led to soil instability and landslides, with over **300 instances recorded along one section of the highway.**
- **Invasive Species:** Proliferation of **invasive plant species** like ***Lantana camara*** reduces soil fertility by depleting nutrients and disturbing native biodiversity.
    - Recent studies show high concern invasive plants were recorded in **22% natural areas** and predicted to potentially threaten **66% of natural areas.**

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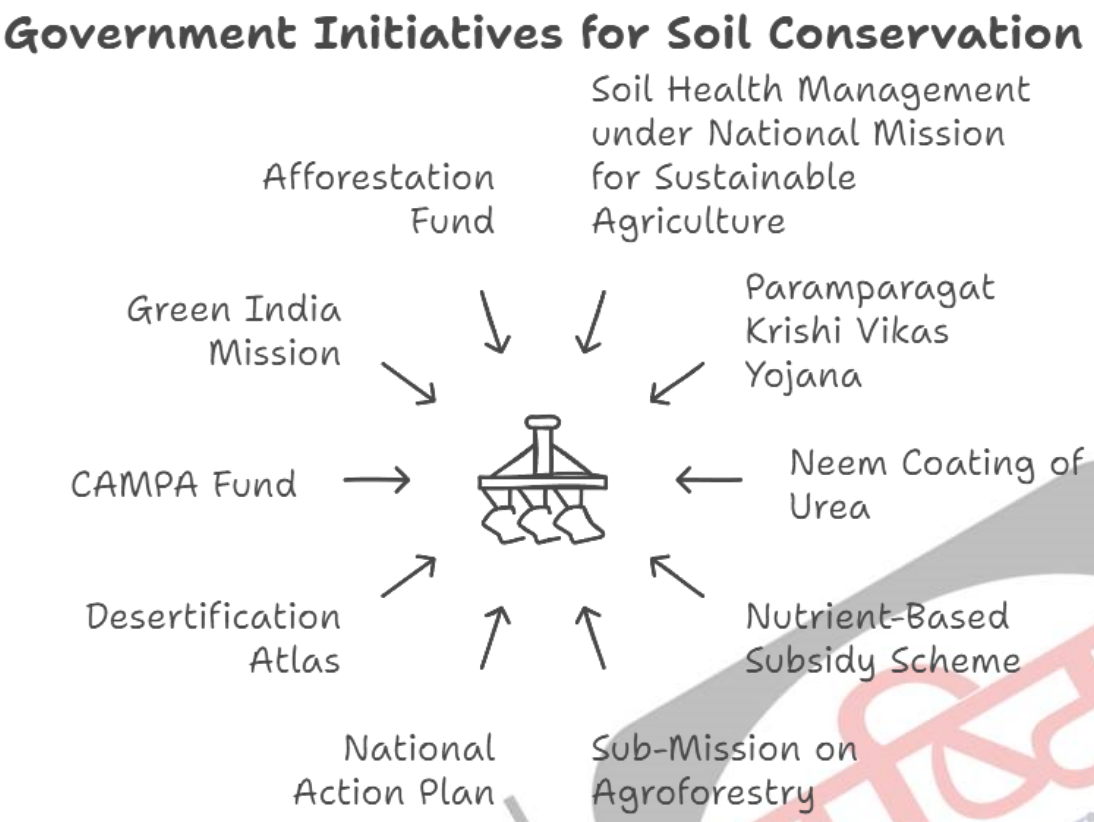

Why Indian Government Initiatives Related to Soil Conservation Remain Partially Effective?

- **Fragmented Policy Framework**: India's soil management policies are **scattered across multiple ministries and schemes**, leading to a lack of coordination and focus.
  - For instance, the **Soil Health Card Scheme** operates independently of programs like **Pradhan Mantri Krishi Sinchayee Yojana (irrigation) and MNREGA (land restoration).**
  - This siloed approach **prevents holistic soil management.**
- **Inadequate Implementation and Monitoring:** While schemes like the **Soil Health Card and Paramparagat Krishi Vikas Yojana (PKVY)** aim to improve soil health, their on-ground implementation faces significant hurdles.
  - A 2022 data states that **only 33% of farmers use soil health recommendations**. A lack of accountability and real-time feedback further dilutes the impact.
- **Neglect of Regional Specificity:** Most soil health initiatives are generic and fail to address region-specific challenges like **desertification in Rajasthan or salinity in Gujarat.**
  - This one-size-fits-all approach undermines the effectiveness of soil management programs.
- **Weak Linkages Between Research and Implementation:** India's soil research outputs from institutions like ICAR and IITs are not effectively translated into field-level solutions.
  - For example**, innovations like biochar and microbial fertilizers remain** underutilized due to lack of government support for commercialization. This disconnect reduces the impact of R&D on soil health improvement.

What Measures can be Adopted for Effective Soil Health Management in India?

- **Promoting Sustainable Farming Practices:** Encouraging **organic farming, crop rotation, and agroforestry** can restore soil health by increasing organic matter and microbial activity.
    - The **Paramparagat Krishi Vikas Yojana** supports organic farming, but its reach needs expansion with greater farmer training.
    - **Linking PKVY with the Soil Health Card Scheme for real-time soil monitoring** can ensure region-specific recommendations.
- **Promoting Wadi System**: A traditional tree-based farming approach in India, the Wadi system integrates **agriculture, horticulture, and forestry**.
    - It promotes agroforestry as a sustainable practice**, enhancing soil health by preventing erosion,** conserving water, and enriching biodiversity.
    - This approach also supports socio-economic empowerment and sustainable agriculture, making it a valuable measure for effective soil health management.
- **Improving Water Management Techniques:** Adopting micro-irrigation methods like drip and sprinkler systems **reduces waterlogging and salinization while conserving water.**
    - For instance, PM Krishi Sinchayee Yojana (PMKSY) aims to expand irrigation but **can be integrated with precision agriculture to optimize water-soil balance.**
        - Currently there is only **19% micro-irrigation coverage, indicating a vast scope for scaling up.**
- **Enforcing Regulations Against Sand Mining:** Strict monitoring and sustainable sand mining policies can prevent excessive riverbank erosion and protect soil ecosystems.
    - Using technologies like **drones and AI to monitor riverbeds**, as seen in the **Andhra Pradesh sand mining regulation model,** can ensure compliance.
- **Rehabilitating Degraded Lands:** Land reclamation through **afforestation, grassland restoration (like Banni Grassland Restoration), and wetland revival** can significantly reduce soil erosion, in line with India's commitment to achieve **land degradation neutrality by 2030** under the **United Nations Convention to Combat Desertification (UNCCD).**
    - Programs like the **National Afforestation Programme(NAP)** should integrate community-led initiatives for better outreach.
    - Integrating **NAP with MGNREGA** to provide employment opportunities in land restoration could serve **dual objectives of ecological recovery and rural development.**
- **Promoting Conservation Agriculture:** Conservation agriculture practices like **zero tillage, mulching, and cover cropping** enhance soil structure and organic carbon.
    - For example, the **Borlaug Institute for South Asia (BISA),** based in Ludhiana, Punjab, actively promotes **zero-tillage farming practices, particularly through the use of a "Happy Seeder" technology,**
    - Expanding these methods to other high-yield zones under PMKSY would ensure broader impact.
- **Adopting Bioremediation for Contaminated Soils:** Bioremediation using **microbes and plants can clean up soils polluted** by heavy metals and industrial effluents.
    - This technique has been successfully piloted in **Gujarat's Ankleshwar industrial region to restore farmland**.
    - An example of adopting bioremediation for contaminated soils is the **use of fish oil added to spent mushroom compost,** which was mixed with **creosote-contaminated soil.**
        - This combination resulted in the most effective **degradation of polycyclic aromatic hydrocarbons (PAHs).**
- **Expanding Soil Health Card Utility:** The Soil Health Card (SHC) Scheme should move beyond distribution and **focus on farmer education for implementing its recommendations.**
    - Linking SHC data with digital platforms lik**e Kisan Suvidha app** can provide **real-time advisory services.**
    - Integrating this with **local Krishi Vigyan Kendras (KVKs)** could ensure grassroots-level support for farmers.
- **Creating Coastal Soil Management Plans:** Comprehensive soil management plans for coastal regions can mitigate salinity intrusion through mangrove afforestation and saline-resistant crops.
    - Projects like the **National Coastal Mission under the National Action Plan on Climate Change (NAPCC**) should focus more on soil health along with habitat protection.
    - **Tamil Nadu's mangrove restoration model** can be replicated for broader impacts.
- **Investing in Research and Development:** Encouraging R&D for developing soil-friendly

technologies such as **bio-fertilizers and efficient soil testing** kits can revolutionize soil management.
    - Institutes like ICAR should **collaborate with startups to innovate affordable solutions.** For example, **integrating biochar production with agricultural waste management** could reduce waste while enriching soil.
- **Promoting Urban Composting and Circular Economy:** Encouraging municipal composting facilities can convert **urban organic waste into high-quality manure**, reducing dependency on chemical fertilizers.
    - **Karnataka Compost Development Corporation, which processes 250 tons of wet waste daily,** is a replicable model.
    - Incentivizing such projects through GST rebates on compost sales could further boost adoption.
- **Strengthening Natural Farming Initiatives:** Natural farming techniques like the **Subhash Palekar Natural Farming (SPNF) model** reduce dependency on external inputs while enhancing soil biodiversity.
    - Linking SPNF with local **Krishi Vigyan Kendras (KVKs)** can ensure farmer adoption and better outreach.
- **Promoting Integrated Nutrient Management:** Balanced use of chemical fertilizers along with **organic and bio-fertilizers can address nutrient imbalances.**
    - Revising the **Nutrient Based Subsidy (NBS)** to **include bio-fertilizers** and promoting fortified fertilizers can ensure better soil health.
    - Linking NBS reforms with soil health card data can ensure farmer-specific recommendations.
- **Developing Digital Soil Health Mapping:** A n**ational digital database for soil health mapping** can help monitor degradation trends and recommend location-specific measures.
    - Leveraging **ISRO's Earth Observation Satellites f**or periodic soil mapping would provide actionable insights.
    - Integrating such data into agricultural policies can enable precision soil management practices.
- **Tackling Microplastic Contamination:** Strict **bans on single-use plastics must extend to better management of agricultural plastics.**
    - Promoting biodegradable alternatives and recycling systems can reduce microplastic soil contamination.
    - **Incentives for industries developing biodegradable agri-plastics** could support this shift.
- **Strengthening Community Participation:** Empowering **local self-help groups and Panchayati Raj institutions** in soil conservation ensures better outreach and implementation.
    - For instance, **Gujarat's participatory watershed program can be a model**.
    - Expanding such community-led models nationwide could enhance ownership and success rates.
- **Integrating Climate Adaptation with Soil Conservation:** Combining climate adaptation strategies like **afforestation with soil health programs** can build resilience against climate-induced degradation.
    - For example, integrating **National Adaptation Fund for Climate Change (NAFCC)** projects with **watershed development schemes can create synergies.**
        - States like Rajasthan could benefit from such dual-purpose initiatives.

Conclusion:

Addressing **soil degradation through integrated, sustainable farming practices, effective water management, and targeted conservation** efforts is crucial for India's agricultural future. Soil health is vital for India's agricultural economy (e.g., dependency on agriculture for 57% of livelihoods and in achieving **SDG 15 (Life on Land)**, ensuring long-term agricultural productivity, food security, and environmental sustainability.

Drishti Mains Question:

Examine the major causes of soil degradation in India and assess the effectiveness of current government measures to combat it. Suggest additional strategies to restore soil health and ensure

sustainable agriculture.

UPSC Civil Services Examination Previous Year Question (PYQ)

Prelims:

Q. Consider the following statements: (2017)

The nation-wide 'Soil Health Card Scheme' aims at

1. expanding the cultivable area under irrigation.
2. enabling the banks to assess the quantum of loans to be granted to farmers on the basis of soil quality.
3. checking the overuse of fertilisers in farmlands.

Which of the above statements is/are correct?

(a) 1 and 2 only

(b) 3 only

(c) 2 and 3 only

(d) 1, 2 and 3

Ans: (b)

Mains:

Q. How far is the Integrated Farming System (IFS) helpful in sustaining agricultural production? (2019)
