



Nature-based Solutions in Agriculture

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ABSTRACT

Nature-based solutions in agriculture offer a holistic approach that balances agricultural production with environmental preservation, fostering systems that are both productive and ecologically sustainable. These are sustainable practices that work with nature to enhance productivity, improve resilience and restore ecosystems. Nature-based solutions in agriculture aim to address climate change, biodiversity loss and food security while maintaining economic viability for farmers. In India, national programmes like NMSA, NMNF, PMKSY, IWMP, National Agroforestry Policy and Green India Mission are working on Nature-based solutions in agriculture, thus contributing in enhancing productivity and sustainability. By implementing Nature-based solutions in agriculture, we can foster a climate-resilient agricultural sector and safeguard food security for the future.

INTRODUCTION

Nature-based solutions (NbS) are increasingly being considered to neutralize the negative consequences of climate change. India has committed to achieving net zero emission targets by 2070 to

offset greenhouse gas emissions – the main driver of climate change (Kumar BM, 2023). Nature-based solutions (NbS) are preferred over conventional agricultural practices because they are more sustainable,

environmentally friendly and resilient to climate change. They promote long-term ecosystem health, reduce pollution and improve carbon sequestration. Unlike conventional methods that rely heavily on synthetic inputs like fertilizers and pesticides, NbS work with natural processes to enhance soil fertility, water retention and biodiversity. NbS also help farmers adapt to extreme weather events, ensure food security and lower production costs, providing a more sustainable and cost-effective alternative for future farming.

In response, Nature-based solutions (NbS) in agriculture have emerged as a key strategy to mitigate the impacts of climate change on agriculture to ensure food security and sustainability. In the face of increasing extreme climatic events—acute and frequent droughts, floods, desert locust attacks—examples of resilience are emerging from the ground, highlighting sustainable agriculture's potential.

NbS in agriculture integrates agricultural production, conservation (biodiversity, land, water), climate change and socioeconomic considerations in agricultural landscapes. In India, government-led initiatives like National Innovations in Climate Resilient Agriculture (NICRA) and National Action Plan on Climate Change (NAPCC), in collaboration with ICAR, actively promote and implement climate-resilient agricultural technologies to support farmers and enhance agricultural sustainability.

Nature-based solutions in agriculture

1. Agroforestry: Agroforestry is a land-use management system that combines the best of both worlds by promoting agricultural productivity while simultaneously providing ecological and environmental benefits. Agroforestry works with nature to enhance farm resilience to climate change,

improve soil health, conserve water, enhance carbon sequestration, foster biodiversity, enhance economic diversification and increase crop yields.

2. Cover cropping: Cover cropping is a key nature-based solution (NbS) in agriculture, where crops are planted not for harvest, but to provide environmental and agronomic benefits to the soil and the broader ecosystem. Cover crops aid in soil erosion control, improved soil fertility, weed suppression, water management, enhanced biodiversity, pest and disease management, carbon sequestration, climate resilience, economic benefits and reduced dependence on external inputs.

3. Integrated weed management: The widespread use of agro-chemicals has allegedly led to issue with the environment and human health therefore currently there is resurgence of interest in organic weed management. It is crucial to realize that weeds can never truly be eradicated under an organic system, they can only be managed. The main objective of a weed management strategy in organic system is to lower weed competition and reproduction to a level that farmers can tolerate. The use of non-chemical weed control technique is encouraged for the protection of human wealth and environment.

4. Agroecology: By focusing on ecological balance and using nature-based solutions, agroecology helps improve productivity, biodiversity and resilience, making it a key strategy in the fight against climate change and unsustainable agricultural practices. The mechanisms to improve agroecosystem immunity are to increase of plant species and genetic diversity in time and space, enhancement of functional biodiversity, enhancement of soil organic matter and biological activity, to increase soil cover

and crop competitive ability and elimination of toxic inputs and residues. An agroecological transformation increases the productivity, sustainability and resilience of agricultural production while reducing undesirable socio-economic and environmental impacts due to climate change (Altieri et al., 2015).

5. Integrated pest management: IPM is a holistic, nature-based approach that works with the natural environment to manage pests in a sustainable and ecologically sound manner. IPM supports biodiversity, reduces environmental impact, and helps ensure food security while minimizing the ecological footprint of agriculture. IPM as a nature-based solution aids in biological control, physical and mechanical control, pest monitoring and threshold, habitat enhancement, reduced chemical dependence and promotes soil health as well as ecosystem services.

6. Water management through natural infrastructure: Water management through natural infrastructure is a powerful nature-based solution in agriculture that leverages ecosystems and natural processes to enhance water efficiency, reduce the risk of flooding, improve water quality and ensure long-term water availability for crops. Water management through natural infrastructure offers an innovative, sustainable approach to managing water resources in agriculture. By working with nature, farmers can improve water availability, reduce environmental impacts and build resilience to climate change. Water can be managed through agroforestry, wetland restoration, rainwater harvesting, soil health management, mulching, cover cropping, contouring and terracing, developing riparian buffers, vegetated buffers, wet and dry ponds or check dams. In India, RWH increased

farmers' incomes in different climatic zones (Singh et al., 2019).

7. Integrated livestock and crop systems (ILCS): Integrated livestock and crop systems (ILCS) represent a holistic, nature-based solution in agriculture that combines the benefits of both livestock and crop production within the same farming system. By fostering symbiotic relationships between crops and animals, these systems promote sustainability, biodiversity, soil health and water management while reducing the reliance on synthetic inputs.

8. Soil health improvement: Soil health improvement as a nature-based solution is a promising way to create more sustainable agricultural systems that help combat climate change and support biodiversity. When implemented effectively, these solutions can create a win-win scenario for farmers, the environment and society at large. Soil health can be enhanced by cover cropping, agroforestry, composting, crop rotation, grazing management and reduced tillage or no-till farming.

9. Pollinator habitat protection: By adopting NbS practices to safeguard pollinators, we can improve food security, enhance biodiversity, and create more resilient agricultural systems. Pollinator habitat protection leads to biodiversity conservation, climate change mitigation, enhanced pollination services, reduced input cost and increased sustainability.

10. Conservation tillage: Conservation tillage is a nature-based solution in agriculture that involves minimizing soil disturbance by reducing or eliminating tillage practices typically used in conventional farming. It plays a significant role in enhancing soil health, conserving water, increasing carbon sequestration and improving overall farm sustainability.

11. National programmes for nature-based solutions in agriculture:

India has key initiatives addressing agricultural challenges and moving towards sustainability. The National Mission for Sustainable Agriculture (NMSA) promotes sustainable practices, Pradhan Mantri Krishi Sinchayee Yojana (PMKSY) focuses on water management, National Mission on Agroforestry (NMAF) protect forests and promote agroforestry, National Mission on Natural Farming (NMNF) focuses on natural farming and agriculture-animal husbandry and Green India Mission aims to restore degraded lands and enhance biodiversity. These efforts support India's sustainability and productivity goals.

CONCLUSION

In essence, Nature-based solutions in agriculture aim to design farming systems that harness nature's services to meet the needs of food production and environmental conservation in a balanced and integrated

manner. They leverage resources like soil, water, plants and biodiversity to tackle challenges while supporting climate change mitigation, soil health, biodiversity and water management.

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