



Popular Article

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Circular Agriculture: Turning Waste into Wealth for a Sustainable Future

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Indian agriculture stands at a crucial crossroads. Declining soil fertility, shrinking water resources, rising input costs, and increasing environmental pollution are putting immense pressure on farmers and natural ecosystems. For decades, farming has largely followed a *linear model* extract, use, and discard. Crop residues are burnt, nutrients are lost, and dependency on chemical inputs continues to grow.

But what if waste could become wealth?

This is where **circular agriculture** offers hope. Inspired by nature's self-sustaining cycles, circular agriculture promotes recycling, regeneration, and resource efficiency. It transforms crop residues, livestock waste, and organic by-products into valuable inputs such as compost, biofertilizers, bioenergy, and soil conditioners.

Interestingly, this is not entirely new to India. Traditional practices like mixed cropping, integrated farming, composting, and livestock integration have long reflected circular principles. Today, by combining this indigenous wisdom with modern technology and supportive government policies, circular agriculture can become a powerful pathway toward sustainable growth, climate resilience, and improved farmer incomes.

Did You Know?

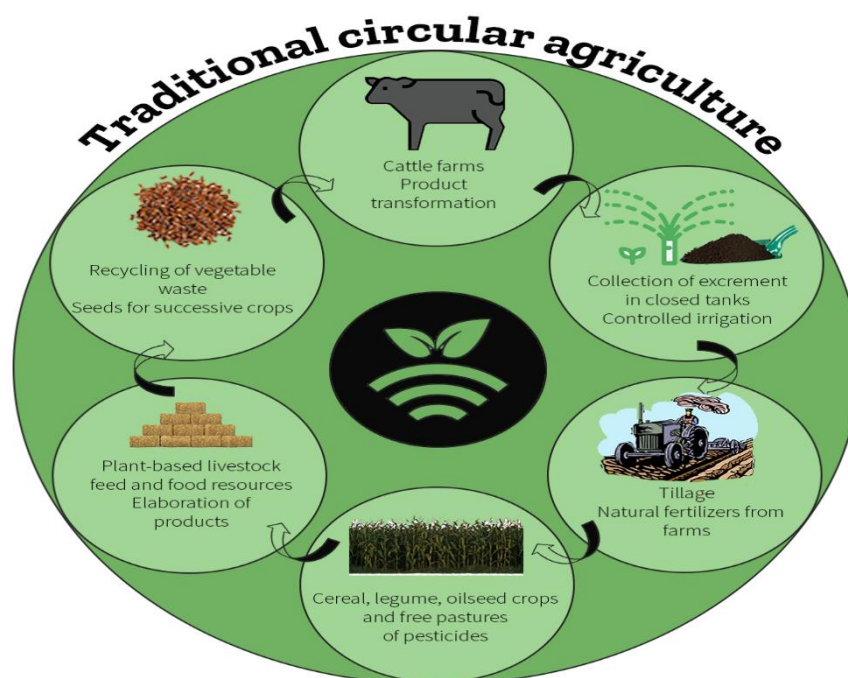
- India generates 500+ million tonnes of crop residues annually, yet a large portion is burnt instead of recycled.
- Composting residues can return 25-30% of key nutrients back to the soil, improving fertility naturally.
- Raising soil organic carbon by just 0.4% per year can significantly enhance soil health and water retention.

- Biogas plants convert cattle dung into clean energy while producing nutrient-rich bio-slurry for crops.
- Integrating crops and livestock can cut external fertilizer use by 30-50% in smallholder systems.
- According to the Food and Agriculture Organization (FAO), circular food systems reduce waste and improve farmer profitability.

What is Circular Agriculture:

Circular agriculture transforms traditional farming by creating closed-loop systems that minimize waste, recycle resources, and regenerate ecosystems, mimicking nature's cycles. This approach addresses food security challenges amid growing populations and environmental pressures. It promotes sustainability through practices like nutrient recycling and integrated crop-livestock systems.

At its core, circular agriculture is about **closing resource loops**. For example, instead of cultivating crops with imported synthetic fertilizers and discarding crop residues, circular systems strive to recycle nutrients through composting, green manures, and on-farm nutrient cycles. This transition requires a blend of ancient farming wisdom and modern innovation.



Principles of Circular Agriculture:

Closing Nutrient Cycles: In circular systems, nutrients like nitrogen and phosphorus are kept within the farm ecosystem for as long as possible. Crop residues, animal manures, and organic waste are composted and reapplied to enrich soils. This restores soil fertility while reducing dependency on chemical fertilizers. Nutrient reuse not only cuts input costs but also limits nutrient runoff that causes water pollution.

Soil Health as a Foundation: - Healthy soils are living systems packed with microbes, fungi, and organic matter that regulate water, nutrients, and plant productivity. Techniques like reduced tillage, cover cropping, and organic amendments increase soil carbon stocks and enhance structure. In circular agriculture, soil is not treated as an inert growing medium but as a dynamic natural resource that must be protected and nurtured.

Water Efficiency and Recycling: - Water scarcity affects many regions worldwide, making efficient water use vital. Circular systems invest in rainwater harvesting, soil moisture retention, and wastewater reuse for irrigation. By capturing and storing water when it's abundant, farmers can ensure steady supply during dry spells, reducing the stress on freshwater ecosystems.

Crop Diversity and Rotation: - Monocultures deplete specific nutrients and create vulnerability to pests and diseases. Circular agriculture advocates for crop rotations, intercropping, and polycultures that diversify resource use and disrupt pest cycles. This not only improves soil nutrients but also stabilizes yields and supports biodiversity.

Integration of Livestock: - Instead of segregating crop and livestock production, circular agriculture harmonizes them. Livestock consume crop residues while providing manure that replenishes soil fertility. Managed grazing can also stimulate pasture growth, sequester carbon, and reduce the need for external feeds.

Key Benefits:

Environmental Protection: Circular systems lower greenhouse gas emissions by increasing soil carbon and reducing fertilizer manufacturing footprints.

Economic Resilience: Farmers become less dependent on volatile global markets for inputs like fertilizers and fuels and gain stability through diversified production.

Social Well-Being: Local recycling of resources can strengthen rural economies, create jobs, and connect communities to sustainable food systems.

Climate Adaptation: With improved soil structure and water management, circular farms are more resilient to droughts and floods key in an era of climate uncertainty.

Major Challenges:

Despite its promise, circular agriculture is not without challenges. Transitioning from conventional methods can require new knowledge, initial investment in infrastructure (e.g., composting facilities), and access to markets that value sustainably produced food. Incentives from governments, access to extension services, and investment in research are crucial to scale these systems. However, the increasing recognition of soil degradation, biodiversity loss, and climate change impacts underscores the urgency for change. As more farmers adopt circular practices, and as policies incentivize sustainable resource cycles, agriculture can move toward

a future that nourishes people **without destroying ecosystems.**

Major Govt Schemes Supporting Circular Agriculture

S.NO	Scheme/Initiative	Ministry/Agency	Key Focus Areas	Contribution to circular Agriculture
1	GOBAR-Dhan (Galvanizing Organic Bio-Agro Resources)	Ministry of Jal Shakti (under Swachh Bharat Mission–Grameen)	Conversion of cattle dung, crop residues, and organic waste into biogas, bio-CNG, and bio-slurry	Promotes waste-to-energy conversion, nutrient recycling, reduction of methane emissions, improved soil fertility, and rural entrepreneurship
2	Swachh Bharat Mission (Grameen) Agriculture Waste Component	Ministry of Jal Shakti	Management of organic and agricultural waste through composting and biogas plants	Enables village-level circular waste loops, reduces open dumping, and supports sustainable manure and energy generation
3	PM-KUSUM (Pradhan Mantri Kisan Urja Suraksha evam Utthaan Mahabhiyan)	Ministry of New and Renewable Energy (MNRE)	Installation of solar pumps and decentralized solar power for agriculture	Encourages renewable energy use in farming, reduces fossil fuel dependence, and strengthens energy sustainability in rural areas
4	Operation Greens	Ministry of Food Processing Industries (MoFPI)	Value chain development, storage, processing, and logistics for TOP crops (Tomato, Onion, Potato)	Reduces post-harvest losses, prevents food waste, and keeps agricultural produce and nutrients within productive cycles
5	Sub-Mission on Agricultural Mechanization (SMAM)	Ministry of Agriculture & Farmers Welfare	Subsidy on farm machinery such as mulchers and residue management equipment	Prevents stubble burning, promotes residue recycling, improves soil organic carbon, and reduces air pollution
6	Support for Organic and Regenerative Practices (Soil Health Card,	Ministry of Agriculture & Farmers Welfare	Soil testing, organic input promotion, vermicompost and biofertilizer use	Encourages balanced nutrient use, reduces chemical fertilizer dependency, and

	Organic Farming, Vermicompost)			enhances on-farm nutrient recycling
7	Innovation and Bioeconomy Initiatives (e.g., Circular Bioeconomy Innovation Hub)	Research institutions & international agencies (e.g., CGIAR)	Biogas, biochar, waste-to-resource technologies, capacity building	Strengthens grassroots adoption of circular practices and supports sustainable rural bio-enterprises

Conclusion: From Linear to Regenerative

Circular agriculture is more than a concept it is a necessary transformation. By shifting from a linear “take-make-waste” model to a regenerative “reduce-reuse-recycle” approach, Indian agriculture can nourish both people and the planet.

The future of farming lies not in extracting more from the land, but in restoring and regenerating it.

Circular agriculture shows us that sustainability and profitability can go hand in hand, when waste becomes wealth, and farming becomes truly circular.

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