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From global commitments to Indian farm fields: Accounting for nature in farming

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The values that enter policy, budgeting and monitoring are narrow by default, leaving out large portions of both costs and benefits — a problem that runs across sectors, not agriculture alone. This article examines what that omission means for food systems, drawing on TEEBAgriFood India Initiative assessments in Uttar Pradesh, Uttarakhand and Assam to test the question policymakers actually ask: does a shift to organic farming and agroforestry make economic sense? The evidence indicates it does. In the districts modelled, a supported transition results in yields 9.4–23% higher by 2050 than under the business-as-usual trajectory; soil organic carbon doubles on demonstration plots; and women's participation in crop decision-making is twice as high under organic systems. In the landscapes assessed, continuity carries the greater risk, not transition. The three shifts, viz. natural capital valuation in scheme design, stronger farmer collectives, and a wider evidence base across agro-climatic zones and the value chain, together serve India's climate and biodiversity commitments as one system rather than parallel tracks.

Keywords: Ecosystem services, Food systems transformation, Scenario modelling, TEEBAgriFood, True value accounting

EVERY year, India's agrifood systems carry an estimated hidden cost of $1.3 trillion, according to FAO's State of Food and Agriculture (SOFA) 2024 report, which applied True Cost Accounting (TCA) across 156 countries and grouped such costs into environmental, social and health categories i.e. greenhouse gas emissions, low incomes among agri-food workers, and diet-related disease, respectively. In India, dietary risks account for the largest share, more than 70%; while the environmental share, including nitrogen and greenhouse gas emissions, is where farm practices make the most direct difference. Costs of this order appear across every large food system, including those of China ($1.8 trillion) and the United States ($1.4 trillion), broadly reflecting the size of each food system rather than how well any one country manages its agriculture. These are present day estimates, not projections; and conventional national accounting was never designed to capture them, which is why they sit outside the frame within which subsidies, productivity targets and climate commitments are usually assessed.

These costs are part of a wider strain on the planet. The 2025 Planetary Health Check confirms that seven of the nine planetary boundaries have now been breached, with ocean acidification crossed for the first time. The 2025 EAT-Lancet Commission on Healthy, Sustainable, and Just Food Systems identifies food systems as the single largest contributor to the transgression of five planetary boundaries, accounting for roughly 30% of global greenhouse gas emissions, 70% of global freshwater use, and half of the world's habitable land. The Commission suggests that transforming food systems could cut these emissions by more than half, and that a shift to healthier diets could prevent up to 15 million premature deaths annually. Yet fewer than 1% of the world's population currently lives within its 'safe and just space', where nutritional needs are met within planetary limits.

For India, where agriculture and allied activities account for 18% of GDP, 57.2% of rural employment and 72.7% of rural female employment (Periodic Labour Force Survey Annual Report, MoSPI, 2025), these dependencies are immediate rather than distant. Where hidden costs are not reflected in the accounts, the full return on public investment in food security is understated as well.

Services provided by nature: What we count, we can protect

Understanding the environmental share of these costs begins with what nature provides to farming. Agriculture depends on ecosystem services such as pollination, soil fertility, water filtration and pest

regulation, which conventional cost-benefit analysis is only beginning to reflect. These are quantifiable values that, when accounted for, can bring greater attention to justice and equity in how nature and food systems are valued and accessed. The IPBES Assessment Report on Pollinators, Pollination and Food Production (2016) put the annual value of global crop production directly dependent on pollinators at USD 235–577 billion and found that over 40% of invertebrate pollinator species face extinction risk, with pesticide use and habitat loss among the principal drivers.

Pollinators are only one part of this picture. Soil, which holds more carbon than the atmosphere and all terrestrial vegetation combined, is under growing pressure from prevailing management practices. The FAO's State of the World's Land and Water Resources for Food and Agriculture (SOLAW, 2021) reports that human-induced degradation affects roughly 34% of global agricultural land (about 1.66 billion hectares), and that around 1.7 billion people live in areas where crop yields have fallen by at least 10% as a result.

The economic consequences of this pressure are already measurable. Globally, land degradation is estimated to cost more than 10% of annual global GDP in foregone ecosystem services (IPBES Land Degradation and Restoration Assessment, 2018). In India, ISRO's Desertification and Land Degradation Atlas records 97.85 million hectares (mha), 29.77% of the total geographical area, as undergoing degradation in 2018-19; under the UNCCD, against which India has pledged to restore 26 mha of degraded land by 2030. A study commissioned by the Ministry of Environment, Forest and Climate Change (MoEFCC) in 2018 put the annual cost of land degradation at roughly 2.5% of economic output, while the Economic Survey 2017-18 estimated that climate change could reduce annual farm incomes by 15–18% on average, and by 20-25% in unirrigated areas.

Water shows a comparable pattern, with agriculture accounting for 80–90% of the country's freshwater withdrawals — the resource base on which India's food self-sufficiency was built. In Uttar Pradesh, the rice–wheat system draws heavily on groundwater, with tube wells now irrigating 70% of the state's total irrigated area; as water tables fall, pumping costs rise and farm margins narrow, a household-level cost that current accounting does not register. In Assam, a shift toward simplified farming systems is narrowing the crop diversity that smallholders rely on as a buffer against shock. In Uttarakhand's fragile hill watersheds, land use pressures and increasingly intense rainfall events are increasing soil loss, with consequences for downstream water availability and agricultural stability. State and central programmes are already addressing these pressures; valuation evidence adds a clearer account of what that effort is worth, and where it repays fastest.

Evaluating the economic viability of India's transition

Recognising these costs raises a practical question for policy. A legitimate concern among policymakers is whether shifting from conventional to pro-nature agricultural practices means accepting lower yields and reduced farm incomes, a trade-off no country would want to make where food security is at stake. However, growing evidence suggests that agroecological and integrated farming approaches can maintain or improve yields over the medium term, while reducing input costs and generating environmental and social co-benefits.

True Value Accounting (TVA) makes the full costs and benefits of agricultural practices visible, giving policymakers a stronger economic basis for decisions on adoption and scaling. FAO's SOFA reports for 2024 and 2025 show that the benefits of nature-positive practices for ecosystem services and resilience often remain excluded from conventional economic assessments. The Economics of Ecosystems and Biodiversity (TEEB), a UNEP-led initiative, brings this approach to agriculture. In India, TEEB for Agriculture and Food (TEEBAgriFood) applies four-capitals accounting (natural, human, social and produced) to organic farming and agroforestry. Earlier assessments, such as those of zero-budget natural farming landscapes in Andhra Pradesh, also indicate that once ecosystem services are counted, the economic case for a sustainable transition is stronger than conventional accounting suggests. Transition does carry a short-term cost that falls disproportionately on farmers, so sustained capacity strengthening, continued support and appropriate incentives from policymakers are central to enabling it.

The state assessments under the TEEBAgriFood India Initiative were designed and carried out by its research partners ICAR-Indian Institute of Farming Systems Research (ICAR-IIFSR) for Uttar Pradesh, G.B. Pant University of Agriculture and Technology (GBPUAT), Pantnagar for Uttarakhand, and the ICAR-Central Agroforestry Research Institute (ICAR-CAFRI) for Assam. Working at watershed, district and state levels, the assessments compared conventional practice with organic farming and agroforestry under different policy and climate scenarios, covering yields, soil quality, carbon sequestration, water conservation, agrobiodiversity, livelihoods and gender inclusivity.

Their findings speak directly to the concerns most often raised by policymakers. On yields, where most of the caution about transition lies, the modelled evidence points the other way. In the districts modelled, the ICAR-IIFSR assessment finds that active support for organic farming and agroforestry results in 9.4–23.1% higher yields by 2050 than under a business-as-usual trajectory, along which yields fall by up to 14.5% by 2030 and up to 30% by 2050 as climate pressures build. Continuity is often assumed to be the lower-risk option; in these districts, the modelling suggests it is not.

The second concern is that soil takes a generation to rebuild. Demonstration plot studies by GBPUAT in Uttarakhand showed a two-fold increase in soil organic carbon and a five-fold increase in microbial populations after adopting organic practices on plots previously under continuous input-intensive management. Similarly, for water, ICAR-IIFSR modelling in Uttar Pradesh under an optimistic scenario showed that

water yield can improve by 6–28% by 2030 and up to 61% by 2050. In Uttarakhand, soil erosion in the Kosi and Kailash watersheds already costs a combined USD 9.15 million annually in erosion control services alone, a figure projected to rise under both moderate and high-emission scenarios.

Carbon is where the return is easiest to price. The Forest Survey of India (2021) identifies agroforestry as the second most cost-effective investment for carbon sequestration after restoring impaired forests. In Meerut district (Uttar Pradesh) alone, expanding agroforestry and organic farming could increase carbon sequestration potential by 7.5% by 2050, with a total economic value of USD 203.9 million. In Assam, scaling agroforestry from 0.70 to 0.80 mha by 2050 could raise soil carbon stock to 63 million tonnes; 14.5% above the BAU trajectory.

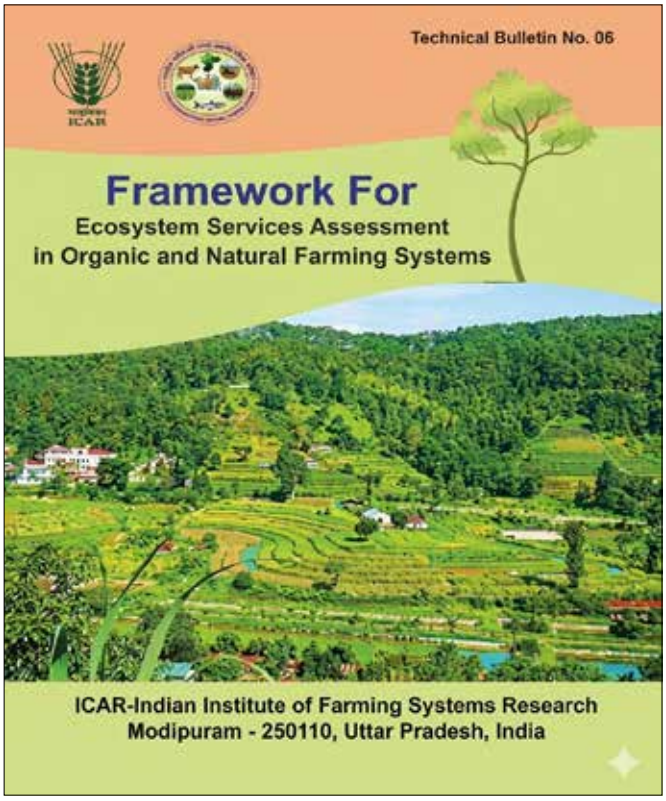
Sustainable Livelihood Security Index (SLSI) results from Uttar Pradesh showed that organic farming's contribution to ecological security significantly exceeds that of conventional farming, with the potential to double overall ecological security scores upon transition. Agro-diversity functions as insurance: organic plots in UP recorded a 13.5% higher Agro Diversity Index than conventional ones, giving farmers more crops to fall back on when a monsoon fails or a single crop's price collapses. Taken together, these findings show returns across ecological, economic and social dimensions, which is why they matter for India's national commitments.

Aligning agriculture's potential with India's climate ambition

Globally, the risks these findings address remain high on the agenda. The World Economic Forum's Global Risks Report 2026 ranks biodiversity loss and ecosystem collapse as the second most severe global risk over the next decade, behind only extreme weather events and up from third in 2024. The Kunming-Montreal Global Biodiversity Framework (KMGBF), to which India is a signatory, requires member states to value and integrate ecosystem services into national planning, decision-making, and accountability frameworks by 2030. Under the Paris Agreement, India's updated Nationally Determined Contributions (NDCs) commit to a 47% reduction in the emissions intensity, by 2035 and an additional carbon sink of 3.5–4 billion tonnes of CO_2 equivalent through forest and tree cover over 2005 levels, in line with India's long-term goal of net-zero by 2070. Agriculture, at approximately 18% of GDP, is central to these commitments.

Domestically, India has already built an architecture to act on these commitments. Of the eight National Missions under India's National Action Plan on Climate Change (NAPCC), three are of direct relevance to food systems transformation: the National Mission for Sustainable Agriculture, the Green India Mission, and the National Water Mission. State Action Plans on Climate Change (SAPCCs) translate this architecture to the ground, creating policy space within which TVA evidence can be meaningfully applied.

India's sustainable agriculture policies already work towards climate-resilient, resource-efficient farming. The Paramparagat Krishi Vikas Yojana (PKVY) supports the shift to organic farming clusters. The National Agroforestry Policy, and more recently the Voluntary Carbon Market Framework for the Agriculture Sector and the Green Credit Programme of MoEFCC, are building a foundation for a sustainable agriculture transition. The accounting itself is already taking institutional root. In November 2024, ICAR-IIFSR released a Framework for Ecosystem Services Assessment in Organic and Natural Farming Systems, and ICAR's All India Network Programme on Organic Farming has prescribed the TEEBAgriFood framework as its core methodology for this assessment, placing India among the first countries



to give this kind of valuation a place within its national agricultural research system. The capitals approach is also reflected in the revised guidelines for the Rainfed Area Development Programme, signalling its emerging relevance within agricultural policy and programme design.

The TEEBAgriFood evidence offers a way of expressing existing policy intent in measurable and accountable outcomes, connecting farm-level practice with GDP emissions intensity, carbon sinks, watershed health, and farmer livelihoods. India's NDC carbon sink commitment, for instance, is directly served by scaling agroforestry. The farm, the forest, the water table, and the emissions are all part of the same system, and agriculture is where the largest share of the solution lies. The next step is to translate this holistic picture into systematic implementation to ensure that scheme design, subsidy structures, and state-level action plans are informed by the full value of what sustainable agriculture delivers, alongside the per-hectare yields already measured.



Researchers interacting with women farmers associated with FPOs and SHGs

Using current framework for agricultural transition

Three shifts, among many possible, would help connect India's commitments more closely to what happens at the farm level, each building on architecture already in place.

Embed natural capital valuation into agricultural scheme design: The TEEBAgriFood framework provides a methodology to account for the full costs and benefits of agricultural practices across natural, social, produced and human capitals. Embedding it into scheme design, subsidy reviews, and state agricultural plans would give decision-makers a fuller picture of what current practices actually cost, and what sustainable alternatives deliver. ICAR's Research Advisory Committee has already recommended its application across additional agro-ecological zones, and TEEB principles have been incorporated into ICAR's new B.Sc. (Natural Farming) degree programme, signalling institutional readiness.

Empower farmer collectives to support transition: Global commitments under the KMGBF, the UNCCD and the NDCs are framed at the national level but must be delivered at the farm level. Farmer Producer Organisations (FPOs) and Self-Help Groups (SHGs), supported with technical capacity, market linkages, and transition finance, are the most viable mechanisms for shifting practices across India's 126 million small and marginal farmers. In the ICAR-IIFSR survey in Uttar Pradesh, women's participation in crop decision-making was twice as high in organic systems as in conventional ones (43% against 21%). Women-led FPOs linked with SHGs and the DAY-National Rural Livelihoods Mission represent both an equity imperative and a practical scaling pathway. Businesses facing rigourous sustainability standards in export markets have both the incentive and the influence to reinforce this shift.

Scale the evidence base to other agro-climatic zones and the full value chain: The partner assessments were designed to represent the distinct agro-climatic zones within each state, so that findings can be extended to comparable zones nationally, and the TEEBAgriFood Learning Landscape in Assam provides a replicable model for on-ground validation and demonstration of best practices. These studies should now be treated as the first layer of a national evidence base extended to other states, integrated into FPO level planning, and applied along the value chain from production to markets. The Voluntary Carbon Market Framework and the Green Credit Programme will also be more robust when calibrated against such ground-level, multi-capital evidence rather than modelled proxies alone.



Three shifts to connect India's commitments with action at the farm level

SUMMARY

To summarise, India comes to this with advantages few countries have i.e. a research system already generating the evidence, a policy architecture already committed to sustainable agriculture, and statistical capacity already building environmental accounts. What these assessments add is a way of showing what that investment is worth. The question is no longer whether the transition makes economic sense in the landscapes assessed; it is how quickly the accounts can be made to show it. The three shifts, together serve India's climate and biodiversity commitments as one system rather than parallel tracks.

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WORLD ANIMAL DAY

4th October

Celebrated to raise awareness and promote action for the welfare and protection of animals. In India, Animal Welfare Board of India (AWBI), a statutory body established under the Prevention of Cruelty to Animals Act, 1960 is responsible for the animal welfare.