



MULTISTAKEHOLDER CITIZEN SCIENCE PROGRAM ON EVALUATING TOURISM CARRYING CAPACITY IN KODAIKANAL, TAMIL NADU

The **Multistakeholder Citizen Science Programme on Evaluating Tourism Carrying Capacity** was held on *5 December 2025* at the *Mango Hill Hotel, Kodaikanal*. Organized jointly by the *Centre for Atmospheric and Climate Studies (CACS)*, *IIT Madras*, and the *Progyan Foundation for Research and Innovation (PFRI)*, the programme marked an important step towards strengthening sustainable tourism planning in the hill station, with a specific focus on post-monsoonal conditions.

The programme brought together representatives from the Forest and Tourism Departments, Highways Department, Public Works Department (PWD), Pollution Control Board, Kodaikanal Municipality, Panchayat leaders, Self-Help Groups (SHGs), non-governmental organizations, local guides, and community members. This diverse participation enabled meaningful dialogue on managing tourism pressures following the monsoon season, when ecological sensitivity and tourist inflows both remain high.

OBJECTIVES

Assess post-monsoonal ecological conditions and tourism pressures, with emphasis on impacts on biodiversity, water, waste, and infrastructure.

Foster collaboration between government agencies and local communities to address seasonal tourism challenges.

Identify season-specific, sustainable management strategies through multistakeholder discussions.

KEY DISCUSSIONS

Discussions highlighted post-monsoonal challenges such as traffic congestion, road safety concerns, and parking limitations during tourist surges. Stakeholders emphasized ecologically sensitive road planning and alternative routes to reduce congestion and wildlife-vehicle interactions.

Persistent solid and liquid waste management issues, including inadequate segregation and recycling, were noted to worsen after the monsoon. Despite recent rainfall, water scarcity due to uneven recharge and rising demand remained a concern. Participants also discussed pressure on healthcare facilities and increasing biodiversity stress. The **IIT Madras** and **PFRI** team presented post-monsoon-focused measures to safeguard ecological integrity while supporting sustainable livelihoods.

WAY FORWARD

Participants agreed to jointly develop a seasonally informed Carrying Capacity Action Plan, integrating scientific expertise, governance, and community participation to promote sustainable tourism while safeguarding Kodaikanal's ecological and cultural heritage.





PLACE-BASED AGROFORESTRY; *Boosting Carbon Sequestration and Yields Across Indian Landscapes*

Agroforestry integrates trees into farming systems, boosting biodiversity, soil health, and farmer incomes while combating climate change. Unlike monoculture, it mimics natural ecosystems by combining woody perennials with crops and livestock. Scientifically, this practice enhances carbon sequestration - trees absorb CO₂ at rates up to 10 tons per hectare annually, per IPCC reports - and improves soil fertility through nitrogen-fixing species like *Gliricidia* or *Leucaena*. It also reduces erosion by 50-70% in sloped terrains, according to studies from the Indian Council of Agricultural Research (ICAR).

Agroforestry practices in India are customized to distinct agroclimatic zones, enhancing productivity, soil health, and climate resilience through scientifically validated models. In the semi-arid Deccan Plateau of Maharashtra, water-conserving systems like wadi farming integrate drought-resistant trees such as neem (*Azadirachta indica*) and tamarind (*Tamarindus indica*) with millets and pulses, reducing soil evaporation by 20-30% and boosting groundwater recharge in regions receiving <600 mm annual rainfall, as demonstrated by ICAR-CAFRI field trials.

Bihar's flood-prone alluvial plains employ horti-silviculture models, combining mango (*Mangifera indica*) and guava (*Psidium guajava*) with bamboo or short-duration cereals like pigeon pea (*Cajanus cajan*), which stabilize soils against erosion (reducing losses by 40-50%) and improve water infiltration during monsoons, per studies from the Bihar Agricultural University. In West Bengal's coastal Sundarbans, mangrove-based agroforestry with *Avicennia marina* and *Rhizophora* species interplanted with rice or aquaculture sequesters 5-15 Mg C/ha/year while mitigating salinity (up to 35 ppt) and cyclone surges, supported by long-term ICFRE monitoring. Odisha's eastern plateau and coastal zones favor agri-horti-silvipasture systems featuring *Casuarina* windbreaks alongside cashew and fodder grasses, restoring degraded lands and sequestering over 800,000 tons of CO₂ across projects, aligning with national agroforestry policy outcomes.

In India, where 60% of farmland is rainfed and vulnerable to extremes, agroforestry offers tailored solutions. Droughts parch Maharashtra's fields, floods ravage Bihar's plains, and salinity plagues West Bengal's Sundarbans. PFRI leads innovative, place-based models across agroclimatic zones. In drought-prone Maharashtra, they deploy 'Pouch Planting' - require just 20-30% less water than traditional methods, enabling survival rates above 80% even in low-rainfall areas (<500 mm/year). This model of pouch planting combined with rainwater harvesting offers a sustainable, climate-resilient, and resource-efficient approach to land management. This model integrates tree planting, crop cultivation, and water conservation in a way that maximizes the benefits of each component. This technique, rooted in minimal-resource hydrology, pairs hardy trees like Acacia or Neem with millets.

Bihar's floodplains demand resilience against annual inundation. Here, Progyan promotes 'Float Framing,' elevated ridges combining fruit trees (mango, guava) with cereals, pulses, or tubers suited to the soil - pigeon pea or yam in alluvial zones. This agroforestry variant stabilizes floodwaters, cuts soil loss by 40%, and diversifies yields, as evidenced by ICAR field trials showing 25-30% income hikes for smallholders.

In West Bengal's Sundarbans, PFRI builds on years of mangrove agroforestry. Salt-tolerant species like *Avicennia* and *Rhizophora* interplanted with rice or betel leaf restore degraded coasts, buffering cyclones (e.g., Amphan 2020) and sequestering 5-10 tons CO₂/ha/year. These models, need-based and region-specific, align with India's National Agroforestry Policy (2014), fostering community-led adaptation.



BENEFITS EXTEND BEYOND ECOLOGY

Agroforestry boosts yield by 20-50% via microclimates and pest control, per World Agroforestry Centre data, while providing fodder, fuelwood, and off-season income. Agroforestry systems store 30-50% more soil organic carbon (SOC) than croplands alone, with trees contributing 4-12 Mg C/ha/year via biomass accumulation and deep roots reducing decomposition losses (IPCC, 2019). This mitigates climate change while qualifying farmers for carbon credits under schemes like India's Carbon Credit Trading Scheme. Economically, diversified outputs (fuelwood, fodder, fruits) yield 25-40% higher net returns, per World Agroforestry Centre meta-analyses, with internal rates of return exceeding 20% over 5 years. Pest suppression via biodiversity cuts pesticide use by 30-50%, enhancing resilience. As India eyes net-zero by 2070, embracing these systems could transform 25 million hectares.



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