3. Net Zero Agriculture - Economy

NITI Aayog's roadmap integrates India's agricultural growth with Net Zero 2070 goals, transitioning the sector from high-emission practices to climate-resilient, tech-driven sustainable farming. It prioritizes an "Adaptation-First" approach that safeguards farmer livelihoods and food security while achieving carbon mitigation through crop diversification and renewable energy adoption.

Report Overview

Release Authority - NITI Aayog released reports outlining pathways for a developed India (*Viksit Bharat*) by 2047 and achieving Net Zero emissions by 2070.

Sectoral Focus - The agriculture study highlights the sector's dual role as a significant contributor to emissions and the most climate-vulnerable sector, necessitating a human-centric transition.

Preparation & Scope

Timeline & Collaboration - Prepared over 18 months by 10 inter-ministerial working groups.

Significance - It is India's first government-led, multi-sectoral assessment of long-term climate transition pathways.

Methodology -Utilizes analytical modelling to test historical trends, existing policies, and additional measures.

incorporates rapid electrification and circular economy practices.

Goal - To reconcile economic growth with environmental sustainability.

Outcome -Emphasizes a "Development-First" approach.

Advocates for a just and calibrated transition.

Concludes that Viksit Bharat 2047 is achievable across various climate scenarios.

Fiscal & Governance Framework (FY 2025-26)

Financial Allocations

Ministry of Rural Development (MoRD) - Allocated Rs. 1,90,405.53 Crores. Ministry of Agriculture & Farmers Welfare (MoA&FW) - Allocated Rs. 1,37,756.55 Crores.

Budget Share - The MoA&FW allocation represents 2.71% of the Total National Budget.

Center-State Synergy - Agriculture remains a State Subject. The Central Government supplements efforts through dynamic Priority Areas reviewed periodically to address emerging sectoral challenges.

Modernization Pillars

Risk Mitigation - Implementation of Crop Insurance.

Digital Agriculture - Leveraging technology for farm management.

Knowledge Empowerment - Utilizing Extension Services to improve market access and lower cultivation costs.

Key Strategic Highlights of the Report

Core Strategic Approach

Adaptation-First Framework - Prioritizes improving farmer livelihoods, food/nutritional security, and resilience. Climate mitigation is treated as a significant co-benefit rather than the primary driver.

Transition Beyond Green Revolution - Advocates shifting away from the cereal-centric Green Revolution model toward a system balancing productivity with sustainable resource use and climate resilience.

Modelling Scenarios

Scenario	Description
Current Policy Scenario (CPS)	Assumes effective implementation of existing government agricultural policies at current intended ambition levels.
Net Zero Scenario (NZS)	Represents a transformative path with Accelerated Adoption of existing and new policies to drive resource efficiency, farm productivity, and climate resilience.

Key Mitigation and Energy Interventions

Strategic scaling of core interventions in the Net Zero Scenario (NZS) could unlock approximately 26% in mitigation co-benefits (non-energy) by 2070 compared to the CPS.

Crop and Farming Interventions

Crop Diversification - Encourages shifting area (up to 20% by 2070) from water-intensive crops (rice, wheat, sugarcane) to Pulses, Oilseeds, and Millets.

Natural/Chemical-Free Farming - Targets bringing 25% of the Net Sown Area (NSA) under agroecological practices by 2070, replacing synthetic chemicals with bio-based alternatives.

Sustainable Rice Cultivation (SRC) -Scaling practices like Direct Seeded Rice (DSR) and System of Rice Intensification (SRI).

Impact - Potential to reduce methane emissions from rice fields by up to 59%.

Fertilizer Uptake Efficiency (FUE) - Improving nutrient uptake to 50% by 2070 using technologies like neem-coated urea and AI-driven precision agriculture.

Livestock and Energy Interventions

Livestock Productivity -Target - Enhance In-Milk Bovine Productivity to 15 kg/head/day.

Increase the share of the in-milk population to 55% via better animal health and nutrition.

Efficiency-First Strategy - Prioritizing Micro-Irrigation (MI) and precision scheduling to curb energy demand.

Clean Energy Adoption -Target - 60% Solar Pump share in the NZS by 2070.

Transition land preparation toward nearly 99% Electric mechanization.

Strategic Recommendations

Agri-Food Systems Approach - Integrating Demand-Side Shifts (e.g., millets in PDS) to stimulate market demand.

Policy Integration - Coordinated action across Land, Energy, and Water Systems.

Circular Bioeconomy - Reducing Agricultural Waste Burning (AWB) by 60% by 2070 through ex-situ management and diversified income streams.

The Governance Nexus - Solarization vs. Groundwater

The report recommends transitioning from "unrestricted resource access" to Regulated Resource Stewardship.

The KUSUM Paradox (Energy vs. Water) - The PM-KUSUM scheme aids decarbonization but lowers the marginal cost of pumping water to near zero.

Risk - Without strict governance, "free" solar power could lead to over-extraction of aquifers (Hydro-Geological Exhaustion).

Proposed Strategic Safeguards

Mandatory Smart Metering - Transition to AI-enabled Smart Meters for real-time monitoring.

Energy Accounting - Grid buy-back of surplus power allowed only if water extraction is within sustainable limits.

Feeder Separation - Implementing Feeder Level Solarization for centralized control over power availability aligned with crop water requirements.

Incentivizing Water Savings - Treating Saved Water as a financial asset; higher "Feed-in-Tariffs" for farmers who use less than their water quota.

Understanding Net Zero

Definition - A state of Climate Neutrality where greenhouse gases (GHGs) produced are balanced by those removed from the atmosphere. It is a "Net-Neutral" state, not zero pollution.

Global Target - To limit warming to 1.5°C, the world must reach this balance by 2050.

Implication for Agriculture - Reducing emissions from rice, livestock, fertilizers, and energy while enhancing soil and biomass carbon sinks.

The 6 Pillars of Net Zero

Renewable Energy Transition - Shifting to Zero-Carbon Sources (Solar, Wind, Nuclear).
Electrification of Infrastructure - Adopting EVs and Heat Pumps.
Industrial Innovation - Using Green Hydrogen for sectors like steel and cement.
Carbon Removal Technologies - Direct Air Capture (DAC) and Carbon Capture and Storage (CCS).
Nature-Based Sequestration - Reforestation, biodiversity protection, and wetland restoration.
Operational Efficiency & Reduction - Circular Economy practices and Energy Efficiency upgrades.

The Current Agricultural Landscape (2025-26)

Economic Contribution

Supports ~66% of the population directly or indirectly. Contributes nearly one-fifth of National Income. Employs 46.1% of the workforce.
Growth - Average annual growth rate of 4.4% over the last five years (highest decadal growth).
Horticulture - Contributing one-third of agricultural GVA; India is the 2nd largest producer of fruits and vegetables.
Evolution - Structural shift from subsistence farming to Commercial Agriculture (Tea, Coffee, Coconut).

Technological Integration

Digital Public Infrastructure (DPI) - Launch of Agri Stack and Bharat-VISTAAR AI.
Advisory Mechanization - Reached 47%; focus shifting to drones (Namo Drone Didi).
Organic Leadership - Sikkim recognized as the first 100% organic state; Uttarakhand following suit.

Emissions Profile and Climate Impact

GHG Contribution - Agriculture contributes 13–15% of India's total GHG emissions.

Primary Sources

Methane - From livestock (enteric fermentation) and rice cultivation.
Nitrous Oxide (N2O) - From fertilizer use.
The "Two-Way" Paradox - Agriculture causes emissions but is also uniquely vulnerable. 40% of districts are classified as "high climate risk."
Livestock Challenge - As the world's largest milk producer, managing enteric fermentation is a major hurdle.

Key Government Initiatives

E-NAM (National Agriculture Market) - Pan-India electronic trading portal networking APMC mandis.
NMSA (National Mission for Sustainable Agriculture) - Focuses on productivity in rainfed areas and integrated farming.
PMKSY (Pradhan Mantri Krishi Sinchayee Yojana) - Vision of 'Har Khet ko pani' and 'More crop per drop' (water use efficiency).
PKVY (Paramparagat Krishi Vikas Yojana) - Launched in 2015 to promote organic farming and soil health.
PMFBY (Pradhan Mantri Fasal Bima Yojana) - Crop insurance scheme integrating multiple stakeholders.
Micro Irrigation Fund (MIF) - Rs 5,000 crore fund under NABARD.
Digital Agriculture - Developing DPI under the National e-Governance Plan in Agriculture (NeGPA).
New Agriculture Export Policy - Aims to diversify the export basket and boost high-value exports.

Major Challenges & Systemic Barriers

Atomized Structural Issues - Cumulative effect of small, individual problems.
Water Stress & Virtual Exports - 65% of farmland is rain-dependent. Exporting 20 million tonnes of water-intensive rice equates to exporting billions of litters of groundwater.
Land Fragmentation - Arable land shrinking (180 mha to 176 mha). Average landholding shrunk to 0.6–1.08 hectares, preventing economies of scale.

Yield Gap - 66% yield gap vs. global benchmarks. 12 million hectares of Rice-Fallow Land remain underutilized. Significant gaps in Oilseeds (18–40%) and Pulses (31–37%).
R&D Underinvestment - Spending is 0.5% of Agri-GDP (₹11,600 crore) vs. global standard of 1.5–3%.
Post-Harvest Losses - Annual loss of over ₹92,000 crore due to inadequate logistics.

Global Actions & Strategic Initiatives

G20 Agriculture Working Group (AWG) - Focus on "One Earth, One Family, One Future" and reducing Food Loss/Waste by 50% by 2030.COP30 & Belém Declaration **-** Placing agriculture at the center of the climate agenda.
Quad's AI-ENGAGE - Partnership (India, Australia, Japan, U.S.) using AI for crop disease detection.
CGIAR Partnership - Collaboration for Biofortified and Climate-Resilient Seeds (e.g., 109 varieties launched in 2024).
AIM for Scale - Sharing Agri-Stack and DPI models with Africa and Asia.
OCOP (FAO) - Promoting unique products like Millets and Moringa globally.
Global Alliance Against Hunger and Poverty - India contributing via the Lakhpati Didi model.
World Bank's Climate-Smart Agriculture (CSA) - Mainstreaming practices to reduce GHGs in rice/livestock.

Way Forward - The Transition Path

Paradigm Shift - Move from "Production-Centric" to "Sustainable Income-Centric" ecosystem.
Aatmanirbharta via Re-alignment - Shift from rice-wheat to Pulses, Oilseeds, and Millets.
Mission-mode programs like NMEO-Oilseeds.
Water Neutrality - Scale PMKSY and Sustainable Rice Cultivation (SRC).
Target - Decouple production from groundwater depletion.
The SKY Model - Expand KUSUM to treat solar energy as a "secondary crop" using Feed-in-Tariff**s** to prevent over-extraction.
Innovation & R&D - Triple R&D investment to 1.5% of Agri-GDP. Leverage Agri-Stack and AI for real-time advisory.
Soil as a Sink - Expand Natural Farming to generate revenue via Carbon Credits.
Institutional Reform - Revitalize Krishi Vigyan Kendras (KVKs) (High ROI - ₹1 investment = ₹7 return). Scale FPOs to make farmers "Price Makers."
Investment Reality - Achieving Food Security and Carbon Neutrality requires a cumulative investment of $22.7 trillion by 2070.
Source - https -//www.pib.gov.in/PressReleasePage.aspx?PRID=2226683&reg=3&lang=1