



Proposed Problem Statements for NERVE CoE

A	Indicative problem statement provided by Industry Association <i>(Agriculture Focused)</i>
	<p>Problem Statement: AI-Driven Smart Agriculture & Climate Resilience</p> <p>Background Vidarbha, renowned for its orange cultivation, is also one of the regions most affected by agrarian distress due to high production volatility. Studies indicate that crop production risks can reach up to 40% for certain crops, primarily due to changing climatic conditions, erratic weather patterns, pest outbreaks, and limited access to timely advisory services. Despite various government initiatives, building resilience against these challenges remains a significant concern.</p> <p>The adoption of Artificial Intelligence (AI), Machine Learning (ML), Blockchain, IoT, Remote Sensing, and Geospatial Technologies presents a transformative opportunity to enhance agricultural productivity, improve decision-making, and strengthen risk management across the agricultural value chain.</p> <p>Problem Statements</p> <ul style="list-style-type: none"> • Develop AI-powered advisory systems for crop planning, weather-based recommendations, and disease forecasting. • Design intelligent crop stress diagnostics and predictive recommendation systems for farmers. • Develop AI-based crop classification and production forecasting at farms, village, Gram Panchayat, and district levels. • Create predictive models for crop yield estimation and production risk assessment. • Develop AI-enabled price forecasting models for high-value and volatile agricultural commodities. • Build digital platforms for ONDC-enabled market linkages and assured market access for farmers. • Develop intelligent systems for verification of farms to enable targeted distribution of subsidies, crop insurance, and financial assistance. • Design Agriculture Infrastructure Capacity Indices covering storage facilities, rural connectivity, logistics, and agricultural markets. • Develop AI-based logistics optimization solutions for efficient movement of agricultural produce from farms to markets. • Build decision-support systems for governments to optimize cropping patterns, infrastructure planning, and resource allocation. <p>Expected Impact:</p> <p>Benefits to Farmers</p> <ul style="list-style-type: none"> • Improved farm productivity and income. • Better crop planning and risk mitigation. • Enhanced market access and price realization. • Faster access to subsidies, insurance, and government benefits. • Reduced production losses due to climate and pest-related risks. <p>Benefits to Industry</p> <ul style="list-style-type: none"> • Improved supply chain visibility and demand forecasting. • Better price discovery and procurement planning. • Efficient logistics and reduced post-harvest losses. • Enhanced availability of quality agricultural produce. <p>Benefits to Government</p> <ul style="list-style-type: none"> • Improved agricultural planning and policy formulation. • Better alignment of production with market demand. • Efficient delivery of subsidies, insurance, and welfare schemes. • Enhanced crop disease surveillance and early warning systems. • Optimized utilization of agricultural infrastructure and public resources.

B	Indicative problem statement provided by CSIR-NEERI (<i>Environment Focused</i>)
	<p>1. Enhancing Environmental Monitoring and Enforcement in India:</p> <p>India’s environmental governance faces an enforcement crisis due to the inability of regulatory agencies to monitor vast, ecologically sensitive areas in real-time. Current methods rely on manual, in-person inspections that provide only partial coverage, allowing illegal activities like unregulated construction in the Aravallis, deforestation, and toxic dumping to go undetected. Furthermore, existing legal frameworks are "incapable" of handling algorithmic evidence, creating a "black box" where automated decisions lack the transparency and accountability required for judicial enforcement.</p> <p>Develop a transparent, real-time AI monitoring system that can detect environmental violations and provide 'explainable' evidence for legal enforcement.</p>
	<p>2. Mitigating the "Dual-Edge" Environmental Impact of AI:</p> <p>While Artificial Intelligence is a revolutionary tool for combatting climate change—offering solutions in disaster forecasting, wildlife conservation, and waste management - technology itself is becoming a significant environmental threat. The massive computational power required to train and operate large AI models leads to a surge in energy consumption and substantial carbon emissions. Furthermore, the infrastructure supporting AI, such as data centers, consumes vast quantities of water for cooling and generates hazardous electronic waste (e-waste) containing toxic substances like lead and mercury.</p> <p>In India, there is currently no specific codified law dedicated to regulating AI's environmental footprint. While existing frameworks like the IT Act (2000) and the DPDP Act (2023) address data privacy, they largely neglect the direct ecological damage caused by AI hardware disposal and resource intensification.</p> <p>Develop an AI-driven solution or 'Sustainable AI' framework that optimizes the performance of environmental monitoring while minimizing the model's own carbon, water, and e-waste footprint.</p>
	<p>3. Closing the Climate Resilience Gap in Vidarbha</p> <p>The Vidarbha region of Maharashtra is currently facing a climate resilience dichotomy. While some districts like Nagpur and Akola are successfully adapting through research institutions and precision farming, others like Yavatmal, Gadchiroli, and Chandrapur are trapped in an environmental and economic quagmire. Farmers in these "low-resilience" zones are battling a lethal combination of rising heat, pollution from mining, and a "deadly drought-cotton trap". Despite the existence of government schemes like PM Fasal Bima Yojana and the Kisan Credit Card, a lack of agri-extension services, mobile networks, and climate awareness means these benefits often fail to reach the most vulnerable, including tribal communities and women farmers.</p> <p>Develop an AI-driven localized support system that bridges the digital and informational divide to improve climate resilience for marginalized farmers in Vidarbha's worst-hit districts.</p>

C	Indicative problem statement provided by AIIMS Nagpur (<i>Healthcare Focused</i>)
	<p>1. Vector-Borne Diseases: AI-powered, scalable solution that can predict disease hotspots, optimize intervention targeting, and enable early diagnosis in low-connectivity settings.</p> <p>Despite decades of Mass Drug Administration (MDA), the Nagpur Division of Maharashtra, particularly high-burden districts such as Chandrapur and Gadchiroli continue to account for nearly 75% of the state’s active Lymphatic Filariasis cases, indicating persistent transmission in forested and tribal regions. Simultaneously, rural Vidarbha is experiencing rising cases of Scrub Typhus, often misdiagnosed as viral fever at Primary Health Centers due to limited diagnostic capacity.</p> <p>Design an AI-powered, scalable solution that can predict disease hotspots, optimize intervention targeting, and enable early diagnosis in low-connectivity settings.</p> <p><i>The solution should be deployable at PHC level and adaptable for state-wide scale-up.</i></p>
	<p>2. Genetic Blood Disorders: Sickle Cell Anemia; AI-enabled, end-to-end disease management solution</p> <p>Vidarbha is widely recognized as the Sickle Cell belt of Maharashtra, with a high prevalence of the Sickle Cell gene among vulnerable communities in districts such as Wardha and Nagpur. While screening programs have expanded, the healthcare system lacks a comprehensive “Cradle-to-Grave” management framework for Sickle Cell Disease (SCD).</p> <p>Critical gaps include limited premarital and genetic counseling, poor longitudinal patient tracking, inadequate early risk stratification, and suboptimal management of painful vaso-occlusive crises in adolescents and adults resulting in high morbidity and reduced life expectancy among the productive rural population.</p> <p>Design an AI-enabled, end-to-end disease management solution that supports predictive risk assessment, continuous monitoring, crisis prevention, and decision support at primary and district healthcare levels.</p> <p><i>The solution must be scalable, low-cost, and deployable in rural and low-connectivity settings.</i></p>
	<p>3. AI-powered, migration-aware nutritional intelligence system</p> <p>The tribal belt surrounding the Melghat Tiger Reserve in Amravati remains a persistent hotspot for malnutrition-related infant deaths despite multiple government nutrition schemes. Current interventions largely treat malnutrition as a standalone medical issue, while overlooking seasonal migration patterns.</p> <p>Each year, large numbers of tribal families migrate for sugarcane harvesting, leaving women and children without access to Anganwadi and primary health services for nearly six months. This disrupts nutritional supplementation, growth monitoring, immunization continuity, and maternal care — sustaining high Infant Mortality Rates (IMR).</p> <p>Design an AI-powered, migration-aware nutritional intelligence system that can predict at-risk children, track seasonal mobility, ensure service continuity, and enable targeted interventions beyond static service delivery models.</p>
	<p>4. AI-enabled, community-level mental health early warning and support system</p> <p>Vidarbha is widely recognized as the epicenter of India’s agrarian distress, with districts such as Yavatmal, Amravati, and Wardha frequently associated with farmer suicides. However, the mental health dimension remains under-addressed beyond economic narratives.</p> <p>There is a severe shortage of trained community-level mental health professionals, and the system largely depends on tertiary psychiatric facilities in urban centers. As a result, rural populations lack access to early counseling and screening for sub-clinical depression, anxiety, and stress disorders. This untreated distress escalates without timely intervention, contributing to preventable suicides.</p> <p>Design an AI-enabled, community-level mental health early warning and support system that enables proactive identification of psychological distress, provides low-cost counseling access, and bridges the treatment gap in rural agrarian regions.</p>

D	Indicative problem statement provided by MOIL Nagpur (<i>Mining Focused</i>)
	<p>1. AI-Vision for Mine Security & Safety The Challenge Current surveillance at MOIL relies heavily on manual patrolling and security guards at mine entries and sensitive locations. Existing CCTV systems require continuous human attention to catch unauthorized access or theft, with no automated alerts to flag dangerous activities. With large lease areas, maintaining 24/7 visibility through manpower alone is unsustainable and reactive.</p> <p>Develop an AI-integrated camera network and centralized dashboard that replaces manual vigilance with automated, real-time threat detection.</p> <ul style="list-style-type: none"> • Proactive Alerts: Automatically trigger alerts for unauthorized entry or unsafe activities. • Digital Management: Eliminate manpower dependency by maintaining digital surveillance records for better supervision.
	<p>2. Real-Time Intelligent Miner Tracking The Challenge Miners' movements underground is currently tracked using manual registers and verbal communication. Work allocations are handwritten, making real-time coordination during emergencies or rescue operations difficult. There is no automated way to monitor minor well-being, such as fatigue or distress, while they are at the underground working faces.</p> <p>Build a technology-supported tracking system to transition from verbal records to real-time safety and health monitoring.</p> <ul style="list-style-type: none"> • Safety Coordination: Proactively track locations to improve coordination during rescue operations. • Health Analytics: Monitor vital parameters like fatigue to provide early warnings of abnormal health conditions. • Interactive Safety: Create an AI-based digital character to interact with miners regarding safety and health best practices.
	<p>3. Predictive Maintenance & Pump Automation The Challenge Pumping systems are inconsistent across mines, with many still requiring manual "ON/OFF" switching by pumpmen based on observation. This manpower-dependent system is especially strained during the monsoon season. Pump health, including vibration, leakage, and noise—is checked manually, leading to delays in identifying failures and resulting in high maintenance costs.</p> <p>Transform mine dewatering into an intelligent, autonomous system that detects potential failures before they occur.</p> <ul style="list-style-type: none"> • Breakdown Prediction: Detect potential pump failures before breakdown to reduce repair costs. • Centralized Control: Implement a smart dashboard to monitor and ensure uniform pumping practices across all sections.
	<p>4. Real-Time Underground Strata Monitoring The Challenge Monitoring the stability of underground rock layers (strata) currently depends on manual readings from instruments like telltales and strain bars at fixed intervals. These observations only provide "post-deformation" data—information recorded <i>after</i> the movement has occurred. There is currently no real-time capability to identify abnormal movements or provide early warnings before a roof or strata failure.</p> <p>Revolutionize underground safety by moving from periodic manual checks to a connected, data-driven strata warning system.</p> <ul style="list-style-type: none"> • Autonomous Data Capture: Automatically capture and store data from extensometers and monitoring devices in a centralized location. • Early Warning Systems: Identify trends in abnormal movements to provide miners with real-time early warnings of potential strata instability.

E	Indicative Problem Statements for Agriculture (Agriculture Focused)
	<p>1. AI-powered Smart Soil & Crop Advisory Platform</p> <p>Across agrarian districts of Vidarbha such as Akola, Yavatmal, and Amravati, farmers largely follow traditional crop cycles and apply blanket fertilizer usage without aligning with real-time soil health parameters. This results in declining soil fertility, suboptimal crop yields, increased input costs, and long-term soil degradation. There is a need for a data-driven, app-based decision support system that integrates IoT-based soil sensing and AI analytics to enable precision agriculture at the farm level.</p> <p>Design an AI-powered Smart Soil & Crop Advisory Platform that can:</p> <ul style="list-style-type: none"> • Detect and monitor soil parameters (moisture, temperature, relative humidity, pH, CEC, NPK, nutrient levels, etc.) using IoT sensors • Analyze environmental and soil data to recommend optimal crop selection • Provide real-time, actionable remedies for soil deficiencies • Generate alerts for irrigation, fertilizer application, and nutrient correction <p>Bonus Objective: Develop an intelligent alert engine that provides customized, farm-level advisories (e.g., irrigation scheduling for low moisture, fertilizer dosage recommendations for NPK imbalance) through a mobile-first, low-connectivity compatible application.</p> <p>The solution must be scalable, cost-effective, and deployable in rural farming ecosystems</p>
	<p>2. AI-Powered Precision Cotton Health Monitoring & Advisory System for Vidarbha</p> <p>Vidarbha particularly districts such as Yavatmal, Akola, and Wardha is one of India’s major cotton-producing regions. However, many farmers continue to follow traditional farming practices, including indiscriminate use of fertilizers and pesticides without stage-specific crop assessment. This leads to reduced yields, increased input costs, pest resistance, and soil degradation.</p> <p>There is a need for a technology-driven, stage-wise cotton crop monitoring system that enables data-backed decision-making from sowing to harvest.</p> <p>Design an AI-enabled Cotton Crop Health Monitoring Application that integrates IoT sensors, UAV/satellite imagery, and machine learning models to:</p> <ul style="list-style-type: none"> • Monitor soil moisture, nutrient levels, and environmental conditions • Assess pest infection levels and crop stress • Track crop growth stages and estimate maturity/harvesting time • Provide timely alerts for irrigation, fertilizer dosage, and pesticide application • Generate stage-specific, actionable advisories for farmers <p>Bonus Objective: Develop an AI module that identifies the type and severity of pest infestation and recommends the appropriate pesticide and dosage, ensuring precision application and reduced chemical overuse.</p> <p>The solution must be scalable, cost-effective, mobile-first, and deployable in low-connectivity rural environments.</p>
	<p>3. AI-Enabled Smart Hydroponic Vertical Farming System for Water-Scarce Regions of Vidarbha</p> <p>Farmers in Vidarbha particularly in districts such as Amravati, Yavatmal, and Wardha face recurring challenges including water scarcity, small landholdings, climate variability, rainfed crop dependency, and labor shortages. These constraints often result in low profitability despite high input costs.</p> <p>Hydroponic-based Vertical Farming (VF) offers a potential alternative by enabling:</p> <ul style="list-style-type: none"> • 80–90% lower water usage • High yield in small spaces • Climate-independent, year-round production • Controlled nutrient management • Cultivation of high-value leafy vegetables and medicinal crops

However, the adoption barrier remains high due to cost, lack of standardization, and absence of affordable monitoring systems.

Design an **affordable IoT- and AI-powered Smart Hydroponic Vertical Farming System** capable of growing crops such as spinach, fenugreek, coriander, and lettuce using maximum natural light available in Vidarbha.

The system should:

- Monitor temperature, humidity, CO₂ concentration, and light intensity
- Track nutrient solution parameters such as pH and TDS
- Standardize nutrient uptake cycles for each crop
- Enable real-time monitoring and control via a mobile application
- Provide predictive alerts for nutrient imbalance or environmental stress

4. AI-Enabled Smart Crop Protection System Against Wild Animal Intrusion in Vidarbha

In agrarian districts of Vidarbha such as Akola, Buldhana, and Washim, major cash crops including pigeon pea, green gram, black gram, jowar, cotton, and soybean suffer significant damage due to wild animal intrusion. Species such as deer, nilgai (blue bull), wild pigs, and peacocks contribute to crop losses exceeding 35% in certain areas.

Beyond economic losses, this issue also escalates human–wildlife conflict, leading to landscape degradation and risk to both human and animal lives.

There is a need for a technology-driven, non-lethal, and affordable crop protection system that detects animal intrusion in real time and prevents damage proactively.

Design an **AI-powered Smart Crop Protection Solution** using IoT sensors, UAVs, GPS, and remote sensing technologies that can:

- Detect and identify wild animal presence near farm boundaries
- Provide real-time alerts to farmers via mobile application
- Assess crop damage using aerial or satellite imagery
- Enable automated deterrence mechanisms (sound/light-based systems)
- Map high-risk intrusion zones for preventive planning

5. AI-Based Cotton Pest Forecasting & Farm-Level Yield Prediction System for Vidarbha

Cotton is a primary cash crop across Vidarbha, particularly in districts such as Yavatmal, Akola, and Wardha. However, unpredictable pest, disease, and insect attacks combined with climate variability significantly reduce yields and farmer income.

Current advisories are largely generic and region-wide, lacking **farm-level predictive intelligence** based on local terrain, micro-climate, and historical farm data. Farmers often respond reactively after visible infestation, by which time economic damage has already occurred.

There is a need for an advanced forecasting system capable of predicting pest and disease risks at least 15 days in advance, along with accurate yield estimation at the individual farm level.

Design an AI-powered Cotton Forecasting & Yield Intelligence Platform that integrates satellite imagery, drone data, IoT field sensors, historical farm records, and weather data to:

- Predict potential pest/disease/insect outbreaks at least 15 days in advance
- Generate farm-specific risk scores
- Provide prescriptive, actionable advisories
- Estimate cotton yield at farm level
- Enable early intervention for improved productivity and income

The solution must provide hyperlocal, farm-level predictions rather than generic advisories, be mobile-first, scalable across Vidarbha, and enable data-driven decision-making that increases yield