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FARMTECH INDIA CONFERENCE 2026

A Report on New Developments & Space Based Farming Techniques in India

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Table of Contents

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Executive Summary

The FarmTech India 2026 Conference addressed new developments in space-based farming techniques amid challenges like unpredictable weather, soil degradation, water scarcity, pest infestations, and inefficient supply chains facing Indian farmers. Space technology offers transformative solutions for productivity, resilience, and profitability, aligning with goals like doubling farmers' income through multi-stakeholder collaboration and global best practices. Key recommendations include adopting SAR-AI models for real-time monitoring, parametric insurance, satellite-first systems, and farmer-centric training to bridge technology gaps.

1. BACKGROUND AND CONTEXT

1.1 Agriculture in India: Current Challenges

Indian agriculture grapples with monsoon dependency, market volatility, soil degradation, floods affecting 40 million hectares annually, chemical overuse creating "cancer belts," labor shortages, and high machinery costs. Marginal farmers (80% of total) face disproportionate climate risks, digital divides, and last-mile delivery issues for tech insights. Traditional monitoring fails during monsoons due to cloud cover, manual inspections, and reactive approaches.

1.2 The Role of Space Technology in Agriculture

Space tech provides imagery, PNT (positioning, navigation, timing), and communication for Earth observation, enabling NDVI monitoring, disease alerts, flood depth measurement, and yield estimation. Initiatives like Bhuvan, FASAL, and AI-DISC integrate satellite data with ground realities for precision tasks. Budget allocation of over ₹30,700 crore in 2026-27 prioritizes applications like drought assessment and hyperspectral analytics from startups like SatSure.

1.3 Policy Context

NITI Aayog's farmer income doubling goal extends to sustainable growth via Gati Shakti for market logistics and PM FasalBima Yojana using objective satellite data to curb corruption. Digital agriculture stacks map land holdings, while state centers like HARSAC support stubble monitoring and water management. Global partnerships and open data access signal space as a national development pillar.

2. TECHNOLOGY TRANSFORMING INDIAN AGRICULTURE

2.1 Earth Observation for Crop Monitoring
EO data from Sentinel-2 enables tree counting, biomass calculation, phenology tracking, and spectral signatures for yield gap analysis. High-resolution imagery (10m+) monitors NDVI, pests, and soil moisture, calibrated with ground-truthing.

2.2 Disaster Management and Climate Resilience
SAR penetrates clouds for flood depth (cm accuracy), stubble burning detection, and post-disaster infrastructure assessment. Parametric insurance triggers payouts based on thresholds, with historical data for resilient planning.

2.3 Precision Agriculture and Smart Farming
Satellite heat maps guide nutrient/irrigation timing, GPS driverless tractors, and AI agents for dialect-based advisories. Drones and hyperspectral data automate monitoring, reducing labor dependency.

2.4 Digital Agriculture Platforms and Data Integration
Bharat Vistar unifies Fasal, Chaman, PM-KISAN data; Bhuvan offers open access; state portals provide field scorecards. LoRaWAN and WhatsApp alerts deliver invisible tech for smallholders.

2.5 Emerging AgriTech Innovations
ICEYE SAR, AI-DISC for disease ID, autonomous electric tractors, and carbon credit mechanisms for DSR. Private sector complements ISRO with analytics.

3. FARMERS' PERSPECTIVES AND GROUND REALITIES

3.1 Operational Challenges Farmers report blocked irrigation, late disease detection, yield variability within acres, and labor shortages in Punjab/Western Ghats. Manual monitoring fails on large farms; rats/power issues disrupt connectivity.

3.2 Economic Constraints High tractor costs (₹7 lakh), chemical dependency, and no premium for organics deter adoption; subsidies needed for IoT/machinery. Marginal farmers can't afford high-res data or equipment individually.

3.3 Trust and Adoption Issues Skepticism toward satellite over ground observation; language barriers (need Punjabi/Hindi); fear of yield loss in organics; one error erodes confidence. Tech must be simple, immediate-benefit showing.

4. BRIDGING THE TECHNOLOGY–ADOPTION GAP

Equity-focused design for smallholders via FPOs, community hubs, feedback loops, and video training in local languages addresses last-mile issues. Ground-truth protocols, offline apps, and skill development for panchayats ensure tech reaches grassroots. Intermediaries, aggregator platforms, and direct subsidies verified by satellites build trust.

5. POLICY RECOMMENDATIONS

Category	Key Recommendations	Responsible Entities	Timeline
Monitoring & Alerts	SAR-AI for soil/crop insights; automated alerts via WhatsApp; NDVI/stubble tracking [1]	ISRO, HARSAC, AgriTech firms	Short-term (1-2 yrs)
Insurance & Finance	Parametric triggers; field health scores for loans; dynamic premiums [1]	NDMA, Banks, Insurers	Medium-term (2-3 yrs)
Infrastructure & Hardware	LoRaWAN networks; jungle-proofing; mobile GIS units [1]	Govt, Private sector	Short-term
Capacity Building	Digital literacy workshops; video training; bilateral farmer-scientist dialogue [1]	ICAR, Universities, NGOs	Ongoing
Incentives & Markets	Organic premiums; carbon credits; FPO subsidies; crop diversification packages [1]	NITI Aayog, FPOs, Markets	Medium-term
Platforms & Integration	National spectral library; state data portals; AI block-level systems [1]	Space Dept, States	Long-term (3+ yrs)

6. CONCLUSION

The conference underscores integrating space tech with farmer realities for resilient agri-economies, fortifying food security via precision and inclusivity. Collaborative action—uniting sun, soil, seed in digital ecosystems—empowers marginal farmers.

PREFACE

Agriculture stands at a pivotal crossroads, where time-honored practices must integrate with advanced technologies to tackle sustainability, food security, and national resilience. We need to recognize farming's evolution beyond soil-centric methods, embracing space-based technologies, artificial intelligence, and geospatial analytics. The aim is to transform agriculture into a data-driven sector, fostering transparency, efficiency, and equitable growth.The mission is to establish a robust framework uniting farming's core elements i.e. sun, soil, and seed, within a digital ecosystem. It replaces subjective manual assessments with objective satelliteenabled oversight, redefining agriculture through precision and accountability. Beyond crop insurance and irrigation, it optimizes resources, builds climate resilience, and boosts sustainable productivity for eliminating inefficiencies, reducing corruption, and delivering real-time insights to empower farmers' livelihoods.

Central to this vision is the Digital Agriculture Stack: an expansive intelligence network mapping billions of land parcels for granular resource management. Bolstered by hyperspectral drones and Earth observation satellites, it delivers precise monitoring of soil health, water availability, and crop conditions. The backbone i.e. imagery, positioning, navigation, timing, and communication, renders technology a practical tool for daily operations.Technology along with capacity building is essential. By training farmers, administrators, and rural institutions to interpret and apply these insights, the initiative ensures innovation benefits the most marginalized. This inclusivity bridges orbital data with grassroots realities.

Ultimately, the end state is to delivera precision agriculture to the system's "last person." For targeting marginal farmers' challenges such as soil moisture, weather forecasting, yield optimization, etc., the space assets are to be converted into empowerment tools. This transition fortifies food systems, national sovereignty, and the dignity of those who cultivate the land.

TECHNICAL SESSIONS

Dr. Sanjeev Chopra , Chairman, FEED

The speaker emphasized that the "fundamental duty of a sovereign" is to provide food security; without it, a nation cannot sustain itself. Further, agriculture depends on two major variables: Monsoon and Markets. There are Space Tech Solutions:
(i) For Markets: Using the **Gati Shakti** platform to understand logistics and advise farmers on what to grow based on market demand.
(ii) For Monsoons: While we can't control rain, better forecasting (10-15 days out) helps mitigate risk.

It also emerged how technology has reduced corruption in crop insurance claims (Pradhan Mantri FasalBima Yojana) by providing objective data on crop damage rather than relying on manual inspections. The key takeaway was to link the "Sun, Soil, and Seed" through a digital ecosystem (Soil Health Cards + Satellite Imagery + Market Linkage) to ensure the prosperity of the marginal farmer.

Shri Anil Prakash , Director General, SIA

The speaker presented the vision for industry-led national development in the field of agriculture There is already a "New Pathway" created by the convergence of Space Technology, Artificial Intelligence (AI), and Geospatial Analytics:

(i) **Technological Game-Changers**

- **Digital Agriculture Stack**: A move toward building a massive agriculture intelligence ecosystem where billions of land holdings are digitally mapped.
- **Resource Optimization**: Transitioning from general discussion to precise implementation in irrigation, groundwater monitoring, and land-use planning.
- **Next-Gen Tools**: The integration of drones (Agritech) and hyperspectral data to provide actionable intelligence for farmers and insurers.

(ii) Budgetary and Policy Support (2026–27)

- Funding:The Department of Space has been allocated over ₹30,700 crore in the 2026-27 budget.
- Prioritization: A significant portion is dedicated specifically to technology applications, signaling that space infrastructure is now a core pillar of national development rather than a peripheral activity.
- Open Access: Initiatives like "Bhuvan" provide open access to remote sensing data for drought assessment and crop forecasting.

(iii) The Private Sector & Global Leadership

- Startup Ecosystem: Private Indian companies (e.g., SatSure, KaleidEO, Skyroot) are increasingly complementing national capabilities by delivering hyperspectral data and advanced analytics.

Lt Gen PJS Pannu, Advisor, SIA and Chief Mentor, Dept of Space Studies (DSS-MERI)

The utility of space through a three-pronged framework was highlighted.

(i) Imagery: Visual data of Earth.

(ii) PNT (Positioning, Navigation, and Timing): Essential for determining precise locations and calculating distances (e.g., whether a spot is 5 km or 500 km away).

(iii) Communication: The critical link that allows imagery and PNT data to be downloaded and utilized; without it, data remains inaccessible.

- Technological Gap: While the first Green Revolution relied on agricultural universities and high-yield seeds, the "Second" or "Ever-Green" Revolution must rely on space-based Earth Observation and remote sensing.

Skill Development: Technology alone is not enough; the speaker emphasizes the need for training and skill development for farmers and Block Development Officers to ensure high-tech insights reach the rural "Panchayat" level.

Presentation 1: Kiran Gange (Farmer & Entrepreneur)
From Orbit to Orchard – The Farmer's Reality

A former Silicon Valley tech entrepreneur who returned to India to farm in the Western Ghats (growing areca nut, mango, and jackfruit). He emphasized that technology must be "invisible" and easy for farmers. They shouldn't have to learn complex ERP systems or coding.

Key Takeaways

(a) Disease & Irrigation: He faced issues where trees were dying due to blocked drip irrigation or diseases that weren't detected early because he couldn't physically monitor every inch of his 50-acre farm daily.
(**b) Need for Satellite/Remote Sensing:** He specifically asks for alerts like "Plot 43 is drying up" or "Disease detected in the northern sector" sent directly to his phone so he can take action immediately.
(**c) Connectivity:** Highlighted basic infrastructure issues like rats biting internet cables and lack of stable electricity, which foreign tech often overlooks.

Category	Specific Pain Points	Impact
Operational	Blocked drip irrigation emitters	Undetected dehydration leading to tree death
Pathological	Late - Stage disease detection	Spread of infection across sectors before visible to the eye
Infrastructure	Physical cable damage by rats and Power instability	Total system blackout; loss of real-time monitoring

Challenges

(a) Operational: Blocked drip irrigation emitters cause undetected dehydration, leading to tree death.

(a) Operational: Blocked drip irrigation emitters cause undetected dehydration, leading to tree death.
(b) Pathological: Diseases are detected too late, spreading across sectors before visible symptoms appear.
(c) Infrastructure: Rats damaging cables and unstable electricity grids result in monitoring blackouts.
(d) Usability: Complex ERP systems and apps are impractical; farmers need simple, "invisible" technology.
(e) Scale: Monitoring large farms (50 acres) manually is impossible, delaying responses to irrigation or disease issues.

The "Orbit to Orchard" philosophy dictates that technology should serve as the farmer's "eyes in the sky" and "ears on the ground" without requiring them to leave the tractor. By solving for connectivity resilience and focusing on predictive alerts rather than raw data, AgTech can finally move from a Silicon Valley novelty to a rural necessity.

Presentation 2: Shih Shen Wong (ICEYE) Synthetic Aperture Radar (SAR) Technology in Transforming Farming

Mr. Wong, Global Lead for SAR Applications at ICEYE, serves as the technical authority in advancing Synthetic Aperture Radar (SAR) technology. His presentation emphasized the transformative role of SAR in overcoming the limitations of optical satellite imaging, particularly in regions prone to cloud cover and extreme weather. By positioning SAR as "all-weather, all-day eyes," he highlighted its critical relevance for agriculture and disaster resilience in India.

Key Takeaways

(a) All-Weather Vision – SAR penetrates clouds, smoke, and darkness, ensuring uninterrupted monitoring during the monsoon season.
(**b) High Revisit Rates –** ICEYE's constellation enables multiple daily observations of the same field.
(**c) Flood Depth Accuracy –** SAR provides centimeter-level precision in measuring water depth, vital for damage assessment.
(d) Insurance Gap Reduction – SAR accelerates insurance payouts from months to days.
(e) Parametric Triggering – Automated claim settlements can be based on satellite data thresholds.
(f) Infrastructure Monitoring – SAR supports post-disaster evaluation of dams, canals, and rural roads.
(g) Soil Moisture –Mapping-Enables optimized irrigation planning beyond flood scenarios.
(h) Global Data Standards – ICEYE delivers standardized datasets trusted by insurers and governments.

(i) Disaster Versatility – Applications extend to floods, wildfires, landslides, and volcanic activity.
(j) Cost-Efficiency at Scale–The data-as-a-service model makes advanced monitoring affordable for nations.

Challenges

(a) High Cost of Deployment: Individual SAR satellites are expensive, requiring significant investment before scaling becomes affordable.
(b) Data Integration: Governments, insurers, and farmers must adapt systems to process and act on SAR data, which can be complex.
(c) Technical Expertise: Effective use of SAR requires specialized knowledge, making adoption difficult for non-technical stakeholders.
(d) Infrastructure Readiness: Rural regions may lack the digital infrastructure to fully leverage SAR insights in real time.
(e) Policy & Coordination: Integrating SAR into national disaster response and insurance frameworks demands strong institutional alignment.
(f) Trust & Adoption: Farmers and local agencies may be hesitant to rely on satellite-driven "digital truth" without visible, ground-level validation.

Mr. Wong's address underscored SAR's potential to revolutionize agricultural monitoring and disaster management in India. By bridging the gap between technology and financial resilience, SAR empowers farmers, insurers, and policymakers with reliable, real-time insights. The integration of SAR into national disaster response, insurance frameworks, and agricultural planning represents a strategic step toward building climate resilience and ensuring food security.

Presentation 3:Dr. Anshu Bharadwaj(Principal Scientist –ICAR) Bridging The Gap BetweenThe Space Based Earth Observation (EO) Data and Ground Level Agronomy

Dr. Anshu Bhardwaj, principal scientist at ICAR, represents the scientific backbone of Indian agriculture. Her presentation focused on bridging the gap between space-based Earth observation (EO) data and ground-level agronomy. She emphasized that while satellites provide the "big picture," their true value lies in calibration with the biological realities of Indian crop cycles.

Key Takeaways

(a) Macro-to-Micro Scaling – The challenge of downscaling global satellite data to the level of small Indian farms.
(**b) Crop Phenology Tracking –** Monitoring growth stages of wheat and paddy to optimize fertilizer timing.

(c) Spectral Signatures - Mapping unique crop fingerprints to improve classification accuracy.
(d) Yield Gap Analysis - Identifying reasons for productivity differences between adjacent plots.
(e) Pest & Disease Early Warning - Detecting spectral stress before visible damage occurs.
(f) Ground-Truthing Necessity - Satellite insights must be validated with field-level data.
(g) Resource Mapping - GIS-based mapping of underground water tables and depletion rates.
(h) Agro-Climatic Zonation - Redefining zones based on current climate shifts rather than historical averages.
(i) Interoperability - Need for integration across optical, SAR, and thermal sensors.
(j) Institutional Knowledge - Leveraging ICAR's decades of research to train AI models for predictive accuracy.

Challenges

(a) Data Downscaling: Translating global EO datasets into actionable insights for smallholder farms.
(b) Ground-Truth Dependency: Satellite data requires extensive field validation, which is resource-intensive.
(c) Interoperability Gaps: Different sensors and platforms often operate in silos, limiting holistic analysis.
(d) Climate Variability: Rapid shifts in agroclimatic zones demand continuous recalibration of models.
(e) Adoption Barriers: Farmers may lack digital literacy to engage with EO-driven tools effectively.
(f) Infrastructure Limitations: Reliable connectivity and data-sharing frameworks are still evolving in rural India.

Dr. Bhardwaj's address highlighted the critical role of earth observation in shaping the future of Indian agriculture. By integrating satellite insights with agronomic realities, India can move toward precision farming, climate resilience, and sustainable resource management. The path forward requires not only technological innovation but also institutional collaboration, farmer engagement, and infrastructure strengthening. EO, when grounded in local realities, can become a cornerstone of India's agricultural transformation.

Presentation 4: Vikas Mishra (Business Director,EIP) Importance of Equity in Agricultural Technology Adoption

Vikas Mishra, Lead at Evergreen Innovation Platform (EIP), emphasized the importance of equity in agricultural technology adoption. His discourse centered on marginal farmersthose with the least resources and highest vulnerability to climate shocks. He advocated for "Technology with a Human Face," ensuring that space and digital innovations empower smallholders rather than widen the gap between rich and poor farmers

Key Takeaways

(a) Equity in Tech – Technology often favors large landholders unless specifically designed for smallholders.
(b) Marginality Trap – With 80% of Indian farmers being marginal, solutions must be affordable and accessible via simple apps.
(c) Social Engineering – Building trust within village communities is essential before introducing new technologies.
(d) Value Chain Integration – Technology should enhance both production and market access.
(e) Climate Justice – Marginal farmers suffer most from climate change despite contributing the least.
(f) Data as an Asset – Farmers must own and understand their land data to avoid exploitation.
(g) Institutional Credit – Digital farm records can help marginal farmers qualify for formal loans.
(h) Collaborative Ecosystems – NGOs, SHGs, and tech firms must work together in consortium models.
(i) Drudgery Factor – Technologies that reduce physical labor, especially for women, should be prioritized.
(j) Sustainable Adoption – Farmers adopt technology only if it visibly increases monthly income.

Challenges

(a) Accessibility: High-tech solutions often remain out of reach for smallholders due to cost and complexity.
(b) Digital Divide: Marginal farmers may lack smartphones, connectivity, or digital literacy.
(c) Trust Deficit: Without community-level engagement, farmers may resist new technologies.
(d) Market Inequities: Even with better production, smallholders struggle to negotiate fair prices.

(e) Climate Vulnerability: Marginal farmers face disproportionate risks from floods, droughts, and heatwaves
(f) Adoption Barriers: Technologies that don't show immediate financial benefits fail to sustain farmer interest

Vikas Mishra's address highlighted the urgent need to align agricultural technology with equity and inclusivity. By focusing on smallholder-first design, community trust-building, and direct financial empowerment, technology can become a tool of climate justice and economic resilience. His vision underscores that innovation must not only be advanced but also accessible, ensuring that marginal farmers—who form the backbone of Indian agriculture—are active beneficiaries of the digital revolution

Presentation 5: Maninder Rao,Chief Data Scientist, EarthNow [Alumnus- Haryana Space Application Centre (HARSAC)] Regional Perspective on Agricultural Monitoring

He presented a regional perspective on agricultural monitoring in India's "Breadbasket." His focus was on how state-level space agencies can provide hyper-local insights to governments, particularly in managing the wheat-paddy cycle and addressing environmental challenges such as stubble burning. His data-driven approach highlighted the role of space technology in resource management, disaster response, and sustainable land use

Key Takeaways

(a) State-Level Monitoring – Hyper-local insights that complement national-level datasets.
(b) Stubble Burning Detection – Real-time identification of fire points using thermal sensors.
(c) Canal Water Management – Satellite tracking ensures equitable water distribution to tail-end farmers.
(d) Crop Acreage Estimation – Accurate hectares-under-plow data supports market planning.
(e) Urban-Agri Encroachment – Monitoring agricultural land loss to urbanization and industry.
(f) Soil Salinity Mapping – Tracking underground water salinity trends across Haryana.
(g) Disaster Impact Assessment – Instant damage maps for hailstorms and other disasters.
(h) Digital Land Records – Integration of satellite imagery with traditional land records for governance.
(i) Horticulture Expansion – Identifying wastelands suitable for orchards through GIS.
Inter-Agency Coordination – Acting as a data bridge between agriculture, irrigation, and environment departments

Challenges

(a) Data Utilization: Translating satellite insights into actionable policies at the village level.
(b) Technology Adoption: Farmers and local officials may lack training to interpret GIS outputs.
(c) Infrastructure Gaps: Limited digital infrastructure in rural areas hinders real-time data use.
(d) Coordination Complexity: Multiple departments must align on shared datasets and protocols.
(e) Urban Pressure: Rapid urbanization continues to erode fertile agricultural land despite monitoring.
(f) Resource Constraints: Continuous monitoring requires sustained funding and technical capacity

Maninder Rao's presentation underscored the importance of regional space applications in bridging the gap between national datasets and local realities. By focusing on stubble burning, water management, and land governance, HARSAC demonstrates how state-level agencies can serve as "Eyes in the Sky" for governments. The integration of satellite data into insurance, disaster response, and farmer services represents a pathway toward sustainable agricultural management in Haryana and beyond.

ROUND-TABLE DISCUSSION

The Punjab farmer segment brought a pragmatic voice to the conference, representing the end-users of agricultural technology. Their perspective was rooted in survival, profitability, and the growing burden of shifting climate patterns in India's grain belt.

SATWANT SINGH, FARMER FROM PUNJAB (WHEAT & PADDY GROWER)

He highlighted the challenges of balancing productivity with sustainability while navigating economic and environmental pressures

Key Takeaways

a) The Productivity Trap – Farmers pursue high yields but face consequences of excessive chemical usage
b) Labor Crisis – Scarcity and rising costs of labor are the most pressing current issue.
c) Chemical Overload – Recognition of the "Cancer Belt" legacy of the Green Revolution and desire for cleaner practices.

(d) Direct Seeded Rice (DSR) – Interest in technologies that save water and reduce labor
(e) The Organic Dilemma – Fear of yield loss when transitioning to organic farming.
(f) Yield vs. Market – Farmers will adopt sustainable methods only if markets pay a premium for clean produce.
(g) Irrigation Inefficiency – Overwatering due to lack of real-time soil moisture data.
(h) Reliability of Data – Trust in satellite forecasts is fragile; one error can undermine confidence.
(i) Machinery Costs – High-tech equipment remains unaffordable for individual farmers.
(j) Last Mile Disconnect – Government data often fails to reach farmers at the community level in time.

Challenges

(a) Economic Pressure: High input costs and expensive machinery limit adoption of modern practices.
(b) Labor Shortage: Rising wages and scarcity of farm labor intensify operational difficulties.
(c) Health & Sustainability: Chemical dependency has long-term health and environmental consequences.
(d) Market Limitations: Lack of assured premium pricing discourages organic or sustainable transitions.
(e) Trust Deficit in Technology: Farmers lose confidence quickly if forecasts or data prove inaccurate.
(f) Information Gap: Government and institutional data often fail to reach farmers effectively at the grassroots level.

The Punjab farmer's perspective underscored the urgent need for technology that is affordable, reliable, and directly beneficial to income and survival. While farmers are open to innovations like DSR and soil monitoring, adoption hinges on trust, market incentives, and practical usability. Bridging the last-mile disconnect and aligning technology with farmer realities is essential for sustainable agricultural transformation in Punjab and India's broader grain belt.

TAJINDER SINGH (FARMER FROM PUNJAB)

He shared the ground-level realities of farming under climate stress. His perspective highlighted the unique challenges faced by vegetable growers compared to wheat-paddy cultivators. He emphasized the importance of practical, trustworthy, and accessible technology that directly addresses farmer needs, market linkages, and sustainability concerns.

Key Takeaways

(a) Climate Vulnerability – Real-time data is critical as climate change is causing massive crop losses (e.g., 1 lakh acres of vegetables).
(b) Vegetable Mapping – Seasonal vegetable growers face distinct challenges compared to staple crops.
(c) Trust in Traditional Methods – Farmers rely more on "feet on the ground" than "eyes in the sky."
(d) Market Linkage Frustration – Growing produce is not enough; accessing high-value markets remains uncertain.
(e) Communication Barriers – Technology developers often fail to communicate in Punjabi/Hindi, limiting adoption.
(f) Carbon Farming Potential – Interest in Direct Seeded Rice (DSR) as a pathway to carbon credit markets.
(g) Crop Diversification – Space-tech could guide farmers toward alternative crops suited to their soil.
(h) Verification of Work – Satellites can confirm whether contractors have completed assigned tasks.
(i) Disease Outbreaks – Sudden pest attacks devastate crops before local departments can respond.
(j) Sustainability Interest – Farmers are willing to adopt new methods if they reduce input costs like diesel and fertilizer.

Challenges

a) Climate Risk: Increasing vulnerability of vegetable crops to unpredictable weather events.
b) Market Access: Lack of reliable linkages to premium buyers undermines profitability.
c) Trust Deficit: Farmers hesitate to rely on satellite data over traditional observation.
d) Language Gap: Limited communication in local languages reduces farmer engagement with technology.
e) Pest Management: Rapid disease outbreaks overwhelm existing response systems.
f) Economic Constraints: Adoption depends on visible cost savings and income improvements.

Tajinder Singh's testimony highlighted the urgent need for farmer-centric technology that addresses climate vulnerability, market access, and communication barriers. His perspective reinforced that adoption hinges on trust, simplicity, and tangible economic benefits. By combining real-time data, localized training, and equitable market mechanisms, space-tech can evolve from a distant innovation into a practical ally for Punjab's farmers.

SUMMARY OF RECOMMENDATIONS

Category	Key Recommendations	Responsible Entities	Timeline
Satellite Monitoring	SAR+AI real-time soil/crop insights; Hybrid SAR-optical systems; NDVI monitoring; National Spectral Library; Automated alerts; Drought indexing	ISRO, NRSC, SAC	1-2 years
Disaster Response	Parametric insurance triggers; SAR-first NDMA response; Monsoon resilience planning; Fire alerts via Panchayat WhatsApp; Supply chain monitoring	NDMA, IRDAI, State Disaster Cells	1-3 years
Precision Agriculture	Jungle-proof LoRaWAN networks; Action-only WhatsApp alerts; Precision nutrient mapping; Ground-truth protocols; Labor-saving GPS autonomous tractors	Agri Ministry, ICAR, AgriTech Firms	2-3 years
Digital Infrastructure	Smallholder-first offline apps; Village data hubs; Mobile GIS units; State GIS portals; Block-level 24×7 AI systems with drone integration	Digital India, State Space Agencies, FPOs	2-4 years
Financial Inclusion	SAR-derived Field Health Scores for bank loans; Satellite-verified direct subsidies; Dynamic insurance premiums; IoT/soil probe subsidies	RBI, NABARD, PM-KISAN, Banks	1-2 years
Capacity Building	Digital literacy workshops; Farmer-engineer feedback loops; Local-language video training; University space tech centers	ICAR, Universities, KVKs, NGOs	Ongoing
Market & Sustainability	FPO aggregator platforms; Organic yield packages; Satellite-certified premium markets; Crop diversification tracking; Carbon credits; Good practice incentives	NITI Aayog, APEDA, FPOs, Cooperatives	2-5 years
Policy & Planning	Flood-resilient infrastructure; National food security SAR integration; Climate vulnerability mapping; Groundwater planning; University satellite surveys	Space Dept, MoA, State Agri Depts, NITI Aayog	3-5 years

ANNEXURE I

ABOUT MERI GROUP OF INSTITUTIONS

MERI Group of Institutions transforms students from foundational learners (Pre) to industry-ready professionals (Pro) through its cutting-edge curriculum, expert mentorship, and holistic development approach. Established in 1987, MERI has been at the leading edge of nurturing young minds, fostering innovation, and developing future leaders across various disciplines. MERI bridges the gap between theory and practice, offering experiential learning, global collaborations, and advanced skill-building programs. The institute's state-of-the-art infrastructure, industry exposure, and robust placement support ensure students are equipped to excel in the modern professional landscape. At MERI, every learner is empowered to lead, innovate, and succeed.

MERI Group of Institutions is a premier academic institution providing quality education in India for the past 37 years in the States of New Delhi and Haryana. MERI-Group is an ISO 9001:2015 certified & NAAC accredited institution. It has established itself as a Centre of Excellence in education, with focus on providing quality education in the fields of Engineering. Management, Law, Journalism, Information Technology, Teacher's Training and School Education. Presently, five academic institutions are being operated by the Group in New Delhi and NCR

Presently, MERI-Group has 30+ Global partnerships with reputed Universities and Educational Institutions from Thailand, China, South Korea, France, Germany, Bulgaria and Canada for students & faculty exchange, research, and related academic activities. MERI Group of Institutions is striving to help youth to develop their skills and values by not just letting them go through life but grow through life.

ABOUT MERI DEPARTMENT OF SPACE STUDIES

The Department of Space Studies (DSS) at the Management Education & Research Institute (MERI), New Delhi, is an autonomous centre of excellence dedicated to advancing research in cosmology and promoting scientific awareness at the grassroots level. Launched with strong academic enthusiasm, the department reflects MERI's commitment to futuristic and interdisciplinary education, integrating space science with technology, management, policy, and innovation. DSS focuses on cutting-edge research in cosmological topics, while also popularizing science to nurture a scientific temper among the wider population. Its faculty maintain active collaborations with national and international research networks, ensuring global exposure and academic rigor.

ABOUT SIA – INDIA

The Space Industry Association (SIA-India) is a not-for-profit organization representing the interests of India's space and satellite communication industry. It serves as a platform for thought leadership on policy, regulatory, and spectrum-related matters, working closely with government agencies, regulatory bodies, and international stakeholders to foster a conducive business and regulatory environment. Its membership spans satellite operators, manufacturers, suppliers, startups, academic institutions, and law firms, reflecting the diverse ecosystem of the space sector. SIA-India is dedicated to advancing industry growth, catalyzing innovation, and strengthening India's position in the global space economy. Recently, in collaboration with CERT-In under the Ministry of Electronics and Information Technology, SIA-India released comprehensive guidelines on space cyber security, underscoring its commitment to safeguarding satellite communication systems that are vital for national security, disaster response, navigation, broadcasting, and economic resilience.

ABOUT FORUM OF ENTERPRISES FOR EQUITABLE DEVELOPMENT (FEED)

The Forum of Enterprises for Equitable Development (FEED), headquartered in New Delhi, is a pioneering initiative dedicated to improving the livelihoods of marginal farmers through innovative, sustainable, and inclusive solutions. Established with the vision of enhancing farmer incomes, FEED works at the intersection of advocacy, research, and public–private partnerships to strengthen agricultural value chains and empower vulnerable farming communities. Its programs span the entire farming cycle—from production to market access—ensuring that productivity, profitability, and sustainability are optimized at every stage. Key initiatives include the Marginal Farmer Think Tank, the Responsible Farming Lab, and the FEED Academy, which provide knowledge, skills, and strategic support to farmers while fostering collaboration between enterprises, policymakers, and civil society. FEED also publishes the Annual Survey on the State of Marginal Farmers of India, offering critical insights into challenges and opportunities in the sector. By combining grassroots engagement with systemic interventions, FEED has successfully delivered measurable outcomes such as yield improvements, cooperative strengthening, and enhanced market access, positioning itself as a catalyst for equitable agricultural development in India.

ANNEXURE II

LIST OF PARTICIPANTS

1	Prof. Lalit Aggarwal, Vice President, MERI Group of Institutions
2	Lt Gen PJS Pannu, Advisor, SIA & Chief Mentor, Dept of Space Studies (DSS-MERI)
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