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AgriStack and Digital Agriculture: The Future of Farmer Welfare Schemes in India

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India is undergoing a major transformation in its agricultural governance system through the deployment of AgriStack, a federated digital infrastructure built on three core registries: Farmer Registry, Land Parcel Registry, and Crop Sown Registry. By linking these digital layers with existing welfare schemes such as PM-KISAN, PMFBY, KCC, eNAM, and Soil Health Cards, the Government of India aims to create a unified, transparent, and data-driven delivery system for farmer benefits. This article critically examines the architecture of AgriStack, its integration with major welfare schemes, the challenges of digital inclusion in rural areas, and the future potential of Artificial Intelligence (AI), satellite remote sensing, and blockchain in strengthening agricultural service delivery. The article concludes that while AgriStack holds transformative potential, its success depends on robust data governance, digital literacy among farmers, and equitable internet access in remote rural areas.

Keywords: AgriStack, PM-KISAN, farmer registry, eNAM, PMFBY, digital inclusion, AI in agriculture

Introduction

Agriculture is the backbone of the Indian economy, with agriculture and allied sectors contribute approximately 16–18% of India's GDP and provide livelihood support to nearly 45–46% of the workforce. Despite several welfare schemes launched over the decades, the delivery of benefits to farmers has historically been marred by leakages, duplication, delayed disbursements, and lack of real-time data. The shift toward a digital-first governance model under the Digital India initiative has opened new possibilities for transforming how farmer welfare is designed and delivered.

AgriStack, conceptualized by the Ministry of Agriculture and Farmers Welfare (MoAFW) in collaboration with the Ministry of Electronics and Information Technology (MeitY), is India's first comprehensive digital public infrastructure (DPI) for agriculture. It is designed as an open, interoperable, consent-based data ecosystem that connects farmers, land records, crop data, markets, credit institutions, and input suppliers through a unified digital platform.

The vision behind AgriStack is to create a 'Jan Dhan-Aadhaar-Mobile' (JAM) Trinity equivalent for the agriculture sector where every farmer has a verified digital identity (Unique Farmer ID or UFID), every land parcel is geo-referenced, and every crop sown is recorded through a combination of self-declaration and satellite verification. This article reviews the architecture, current status, scheme integration, challenges, and future roadmap of AgriStack in the context of India's digital agriculture transformation.

What is AgriStack? Architecture and Core Layers

AgriStack is a federated digital infrastructure comprising six interconnected layers that together form a comprehensive agricultural data ecosystem. The foundation is the Farmer Registry, which assigns a Unique Farmer ID (UFID) to every cultivator in the country, linked to Aadhaar, PM-KISAN records, and land ownership data. Above this sits the Land Parcel Registry, which maps every agricultural plot using GIS technology, satellite imagery, and state-level digitized land records (Bhu-Naksha, Bhulekh portals).

The Crop Sown Registry is the most dynamic layer, updated every season through a combination of farmer self-declaration via mobile apps and remote sensing verification using NDVI (Normalized Difference Vegetation Index) data from satellites such as Sentinel-2 and Resourcesat-2. This layer is critical for determining eligibility for crop insurance claims under PMFBY and for estimating production area for MSP procurement planning.

Additional layers include the Digital Credit Profile (linked to Kisan Credit Card data and loan repayment history), Advisory Services (weather forecasts, pest alerts, crop recommendations pushed via SMS/app), and Market Linkage (connecting farmers to eNAM and FPO portals). Together, these layers create an end-to-end digital journey for the farmer from seed to sale.

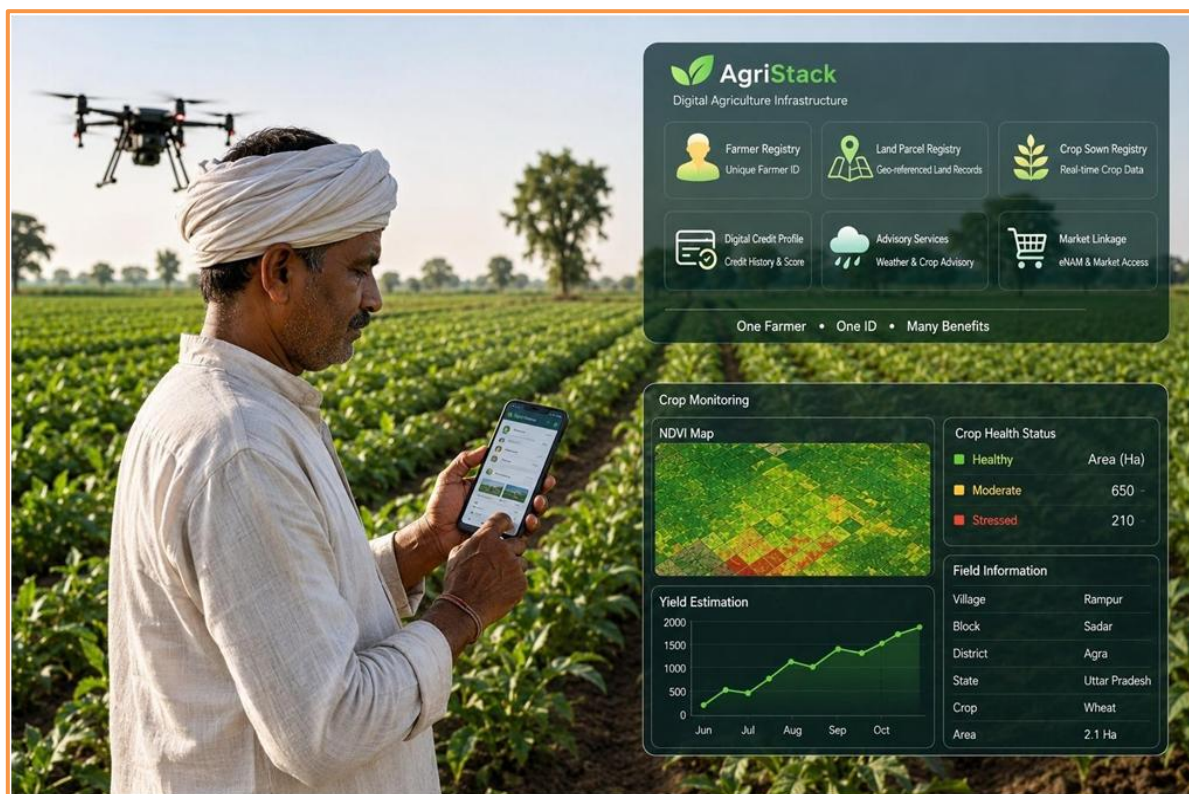


Figure 1. AgriStack-enabled Digital Agriculture Ecosystem for Farmer Welfare in India

Table 1: Architecture of AgriStack Layers, Technology, and Farmer Benefits

AgriStack Layer	Key Elements	Technology Used	Benefit to Farmers
Farmer Registry	Unique Farmer ID (UFID), land records, Aadhaar linkage	UIDAI, DigiLocker, PM-KISAN database	Single identity for all scheme benefits
Land Parcel Registry	Geo-referenced land parcels, soil health data	GIS, satellite imaging, Bhuvan portal	Accurate subsidy targeting, crop insurance
Crop Sown Registry	Self-declared + remotely sensed crop data	AI/ML, drone surveys, satellite NDVI	Timely MSP access, yield loss estimation

Digital Credit Profile	Repayment history, KCC linkage, input purchase records	Fintech APIs, banking data integration	Faster crop loans, collateral-free credit
Advisory Services	Weather alerts, pest advisories, market price push	SMS, AI chatbots, KVK network, apps	Informed decision-making at farm level
Market Linkage	eNAM, FPO portal, contract farming registry	Blockchain for traceability, e-Wallets	Better price discovery, reduced middlemen

Source: MoAFW (2023), NITI Aayog Digital Agriculture Mission (2021), AgriStack Policy Document

Integration of AgriStack with Major Farmer Welfare Schemes

The true potential of AgriStack lies in its ability to serve as the 'single source of truth' for all farmer-facing government programs. Currently, each welfare scheme operates on a separate database with different eligibility criteria, application portals, and verification mechanisms. AgriStack aims to unify these through the UFID, enabling seamless, automatic benefit delivery without repeated documentation.

PM-KISAN and Farmer Registry

The PM-KISAN scheme, which provides Rs. 6,000 per year in direct income support, was the first major scheme to be linked to a digitized farmer database. AgriStack's Farmer Registry builds upon the PM-KISAN database by adding UFID, Aadhaar e-KYC verification, and geo-tagged land parcel data. This linkage has helped eliminate 2.2 crore ineligible beneficiaries identified through data deduplication (MoAFW, 2023).

PMFBY and Crop Sown Registry

Under the Pradhan Mantri Fasal Bima Yojana (PMFBY), crop insurance claims have historically suffered from delayed settlement due to manual crop cutting experiments (CCE). Integration with the Crop Sown Registry, combined with AI-based yield estimation from satellite data, is now replacing CCE in pilot districts across Maharashtra, Madhya Pradesh, and Andhra Pradesh. This is expected to reduce claim settlement time from 60–90 days to under 15 days.

Kisan Credit Card (KCC) and Digital Credit Profile

The KCC scheme provides short-term agricultural credit at concessional interest rates. AgriStack's Digital Credit Profile layer integrates KCC repayment history with crop and land data, allowing banks to offer pre-approved, collateral-free digital loans. Under the Kisan Rin Portal launched in 2023, over 1.5 crore new KCC accounts were targeted for digital onboarding.

eNAM and Market Linkage

The electronic National Agriculture Market (eNAM) platform connects 1,522 mandis across 23 states and 4 union territories. AgriStack's market linkage layer adds FPO (Farmer Producer Organisation) registration, trade invoice management, and blockchain-based quality certification to eNAM, enabling farmers to sell directly to buyers across the country with transparent price discovery.

Table 2: Government Welfare Schemes and Their Digital Integration through AgriStack

Government Scheme	Digital Tool/Platform	AgriStack Integration	Current Coverage (Approx.)
PM-KISAN	PM-KISAN Portal, eKYC via Aadhaar	Farmer Registry UFID linkage	11.4 crore farmers (2023)

Pradhan Mantri Fasal Bima Yojana (PMFBY)	National Crop Insurance Portal (NCIP)	Crop Sown Registry yield loss AI model	5.5 crore farmers enrolled
Kisan Credit Card (KCC)	Bank API + NABARD platform	Digital Credit Profile layer	7.35 crore active KCC accounts
eNAM	National Agriculture Market portal	Market Linkage layer + FPO registry	1,522 mandis across 23 states and UTs
Soil Health Card (SHC)	SHC portal + mobile app	Land Parcel Registry soil data layer	22 crore cards issued
PM Kisan Sampada Yojana	Cold chain + logistics digital map	Market Linkage + Crop Registry	6,000+ agriprocessing units
RKVY-RAFTAAR	Startup portal + grant management	Advisory & Innovation layer	700+ agri-startups supported

Source: MoAFW Annual Report (2022-23), NABARD Digital Agriculture Report (2022), PM-KISAN Dashboard (2023)

Figure 2. Uttar Pradesh AgriStack Farmer Registry Portal for Digital Farmer Identification and Registration

Role of AI, Remote Sensing, and Big Data in Digital Agriculture

Artificial Intelligence and Machine Learning are fast becoming the backbone of AgriStack's analytical capabilities. AI models trained on historical crop yield data, weather patterns, soil maps, and pest outbreak records can now generate season-specific advisory for individual farmers at the village level. The Indian Council of Agricultural Research (ICAR) and the National Remote Sensing Centre (NRSC) have jointly developed platforms such as Fasal

Salah and CRIDA Agro-Met Advisory that push location-specific, weekly crop advisories to over 35 million farmers via SMS.

Satellite remote sensing, particularly using NDVI, EVI (Enhanced Vegetation Index), and Land Surface Temperature (LST), enables near-real-time monitoring of crop health, drought stress, and flood damage at the plot level. When integrated with the Crop Sown Registry in AgriStack, this data can automate insurance claim triggers, identify areas needing emergency input support, and map pest hotspots before outbreaks escalate.

Big data analytics applied to AgriStack's multi-layer database can also generate predictive insights for policy planning such as estimating district-level food production, identifying areas with declining soil organic carbon, or projecting farmer income under different monsoon scenarios. Blockchain technology, being piloted in states like Telangana and Andhra Pradesh, adds tamper-proof traceability to the supply chain from farm to retail, helping both farmers and consumers.

Challenges and Concerns in AgriStack Implementation

Despite its enormous potential, AgriStack faces several implementation challenges that must be addressed for the platform to deliver on its promise of farmer welfare.

1. **Digital divide:** As per TRAI (2023), internet penetration in rural India stands at approximately 38%, with significant gaps in hilly, tribal, and remote areas. Farmers without smartphones or reliable connectivity cannot access digital services, risking exclusion from benefit schemes.
2. **Data privacy and consent:** AgriStack involves collection of highly sensitive personal and financial data. Absence of a comprehensive data protection law (the Digital Personal Data Protection Act 2023 is yet to be fully operationalized) raises concerns about unauthorized use of farmer data by private entities.
3. **Land record digitization gaps:** Over 30% of land records in states like Bihar, Jharkhand, and Assam remain undigitized or contain disputed entries, making land parcel registry creation unreliable in these regions.
4. **Interoperability across states:** Agriculture is a State subject under the Indian Constitution, and each state has its own revenue department systems, crop codes, and data formats. Achieving seamless interoperability between AGRISNET, Bhu-Naksha, and state agricultural databases remains a major technical challenge.
5. **Farmer awareness and trust:** A survey by CSISA (2022) found that less than 20% of smallholder farmers in eastern India were aware of AgriStack or UFID. Low digital literacy and distrust of data-sharing systems are significant adoption barriers.

Table 3 (Pie Chart Data): Factors Driving AgriStack Adoption Among Indian Farmers (% Weight)

Factor Driving AgriStack Adoption	Estimated Weight (%)
Aadhaar-enabled direct benefit transfers	28%
Smartphone penetration in rural India	22%
eNAM / digital market access	18%
Crop insurance & yield monitoring (PMFBY + AI)	14%
Digital credit and KCC integration	10%
Soil Health Cards and advisory platforms	08%

Source: Expert synthesis based on MoAFW (2023), TRAI (2023), ICAR Reports, CSISA (2022)

Digital Inclusion and the Role of Agricultural Extension

Agricultural extension services delivered through Krishi Vigyan Kendras (KVKs), ATMA (Agricultural Technology Management Agency) groups, and Common Service Centres (CSCs) play a critical bridging role in making AgriStack accessible to digitally excluded farmers. KVKs can serve as assisted digital onboarding centres where extension workers help farmers register on AgriStack, obtain UFID, verify land records, and access scheme benefits.

The MY Bharat platform and similar youth engagement initiatives under the National Service Scheme (NSS) and NCC can mobilize educated rural youth as Digital Agri-Mitra volunteers who assist elderly and illiterate farmers in navigating the digital ecosystem. This is especially important for women farmers and tribal communities who are disproportionately excluded from formal digital systems.

State governments such as Karnataka (through Raitha Mitra app), Maharashtra (MAHADBT portal), and Odisha (KALIA scheme app) have demonstrated that well-designed, regional-language mobile interfaces can significantly improve farmer engagement with digital benefit delivery platforms. These state models provide important lessons for the national AgriStack rollout.

Future Roadmap and Policy Recommendations

The Digital Agriculture Mission (DAM) 2021-2025, approved by the Government of India with a budget outlay of Rs. 2,817 crore, provides the strategic framework for completing AgriStack's rollout. Key milestones include completion of farmer and land parcel registries in all states by 2024-25, nationwide KCC digital integration, and AI-powered crop advisory deployment across 650 districts.

For AgriStack to truly transform farmer welfare, the following policy measures are essential: First, enactment of a robust Farmer Data Protection Framework with explicit consent mechanisms before any private-sector access to AgriStack data. Second, expansion of BharatNet broadband to all gram panchayats with last-mile connectivity guarantee by 2025. Third, integration of AgriStack with the National Livestock Mission registry and fisheries data to create a comprehensive rural livelihoods digital platform. Fourth, mandatory use of UFID as the single identifier across all central and state agri-welfare schemes to end duplication.

In the long run, AgriStack combined with Open Credit Enablement Network (OCEN), Account Aggregator frameworks, and the India Data Empowerment and Protection Architecture (DEPA) can position Indian farmers at the center of a data-sovereign, AI-assisted agricultural system where every rupee of government subsidy reaches the right farmer at the right time.

Conclusion

AgriStack represents a paradigm shift in how India approaches farmer welfare, moving from scheme-specific, paper-based delivery to a unified, data-driven digital ecosystem. By creating interoperable registries for farmers, land, and crops, and linking them to credit, insurance, market, and advisory services, AgriStack has the potential to eliminate leakages, reduce transaction costs, and empower farmers with real-time, location-specific information. However, realizing this potential requires urgent attention to digital inclusion, data privacy, land record accuracy, and state-level interoperability. Agricultural extension systems, youth volunteers, and community-based institutions must serve as the human bridge between rural farmers and the digital infrastructure. With the right policy support, investment in rural connectivity, and farmer-centric design, AgriStack can indeed become the foundation of a future-ready, transparent, and equitable farmer welfare system in India.

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