

SATSURE

In collaboration with ISpA

India's Sovereign AgriStack: Powering the Future of Agriculture, from Farmers to the Cloud

Building sovereign, inclusive, and innovation-friendly digital public infrastructure for India's farmers



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Abbreviations



- **AgriStack** – Agriculture Digital Public Infrastructure (sovereign digital stack for agriculture)
- **DA&FW** – Department of Agriculture and Farmers' Welfare
- **DAM** – Digital Agriculture Mission
- **IDEA** – India Digital Ecosystem of Agriculture
- **UFSI** – Unified Farmer Service Interface
- **DCS** – Digital Crop Survey
- **K-DSS** – Krishi Decision Support System
- **NeGP-A** – National e-Governance Plan in Agriculture
- **RKVY-RAFTAAR** – Rashtriya Krishi Vikas Yojana – Remunerative Approaches for Agriculture and Allied Sector Rejuvenation
- **R-ABI** – RKVY Agri-Business Incubator
- **PMFBY** – Pradhan Mantri Fasal Bima Yojana
- **CSC** – Common Service Centre
- **FPO** – Farmer Producer Organisation
- **UPI** – Unified Payments Interface
- **NPCI** – National Payments Corporation of India
- **ONDC** – Open Network for Digital Commerce
- **AA** – Account Aggregator
- **DEPA** – Data Empowerment and Protection Architecture
- **MeitY** – Ministry of Electronics and Information Technology
- **DPI** – Digital Public Infrastructure
- **NAAS** – National Academy of Agricultural Sciences
- **MANAGE** – National Institute of Agricultural Extension Management
- **IARI** – Indian Agricultural Research Institute
- **SAMETI** – State Agricultural Management and Extension Training Institute
- **AIM** – Atal Innovation Mission
- **CEA** – Centre of Excellence for AgriStack & Digital Agriculture
- **BIS** – Bureau of Indian Standards
- **IRDAI** – Insurance Regulatory and Development Authority of India
- **IMD** – India Meteorological Department
- **NDHM** – National Digital Health Mission
- **DBT** – Direct Benefit Transfer
- **AI** – Artificial Intelligence
- **IoT** – Internet of Things
- **NDVI** – Normalized Difference Vegetation Index
- **UAV** – Unmanned Aerial Vehicle
- **SDG** – Sustainable Development Goal

FOREWORD



India's population is projected to cross 1.6 billion, by 2050. Feeding this population sustainably requires agricultural self-reliance. We will need to produce more with less, less water, less land, and emitting less carbon. Indian agriculture has sustained not just livelihoods but culture, community, and national identity. Yet, even as it continues to feed 1.4 billion citizens and contributes 16% to the national GDP, the sector faces an inflection point. Fragmented landholdings, climate unpredictability, declining productivity, and widening rural-urban divides threaten its sustainability. The adverse impact of such vulnerabilities is severe on India, where the majority 86 per cent of farmers are small and marginal.

Today, as India stands on the threshold of becoming a global digital powerhouse, a parallel transformation is underway in its fields. In 2010, the National e-Governance Plan in Agriculture (NeGP-A) marked the first attempt to digitize the agriculture ecosystem. Later, initiatives like Soil Health Cards, PM-KISAN, and Pradhan Mantri Fasal Bima Yojana (PMFBY) generated valuable data but remained siloed. Farmers still navigate multiple portals, departments, and direct benefit transfer (DBT) systems with little interoperability. It is argued that comprehensive digital interventions are required to enhance resilience and innovation for better agricultural productivity.

The urgency of this digital transition cannot be overstated. Agriculture remains the livelihood base for 46% of India's population, yet productivity has plateaued. The average farm size has fallen to 1.08 hectares, input costs are rising, and weather volatility has intensified. Traditional risk management tools have failed to keep pace with the complexity of climate change, market fluctuations, and global supply chain disruptions.

In September 2024, the government announced the Digital Agriculture Mission 2024. Its key components include the AgriStack (Farmer Registry, Geo-referenced maps, Crop Sown Registry), the Krishi Decision Support System (Krishi-DSS), and a national Soil Fertility & Profile Map. The mission seeks to use technology to provide farmers with timely and reliable information, support data-driven decision-making for the government, and foster innovative farmer-centric solutions. The AgriStack, conceived under the India Digital Ecosystem for Agriculture (IDEA) framework, creates federated digital registries - Farmer, Land Parcel, and Crop Sown - laying interoperable rails upon which both public services and private innovation.

In this context, SatSure's AgriStack initiative, a sovereign digital public infrastructure that fuses spatial data, farmer identity, and crop intelligence, represents a landmark step toward building a smarter, more equitable, and future-ready agricultural economy.

The Agristack archetype recognises the diversity of Indian agriculture - varied agro-climatic conditions, wide range of seeds & crops, livestock, and multiple farming styles, from traditional subsistence to modern commercial and mixed farming methods. SatSure collaborated with the Government of Uttar Pradesh to co-create the Crop Sown Registry using geospatial technology. By mapping millions of land parcels through satellite imagery calibrated with vegetation indices (NDVI) and agro-climatic models, SatSure has transformed the once manual, error-prone survey data into dynamic, real-time intelligence.

Moreover, SatSure's Agristack platform allows farmers to authorize who can access their information providing a critical safeguard in a data-rich future and protecting small farmers against exploitation.

Data is the new seed empowering both farmers and policymakers. With geo-referenced data, weather analytics, and satellite insights, SatSure enables informed decisions for climate adaptation, resource optimization, and market linkages, turning farmers active participants rather than passive beneficiaries. AgriStack converts fragmented data into actionable intelligence improving government programs like PMFBY by enhancing risk evaluation and reducing reliance on manual assessments.

Geospatial insights from Agristack also drive precision agriculture and sustainability. Monitoring soil moisture, optimizing irrigation, and predicting pest outbreaks, providing climate resilient advisories reduce input waste and environmental stress while improving yield quality and storage efficiency. Strengthening supply chain will facilitate transfer and procurement of surplus from one region to fill in the deficit in another, minimizing waste, stabilizing prices, and enhancing food security.

In Uttar Pradesh, crop classification powered by SatSure's geospatial models has already enabled district administrators to pre-empt drought impacts while in Karnataka, integration of digital land records with crop advisories has improved input planning and reduced fertilizer misuse. These are blueprints for systemic modernization rather than isolated pilots.

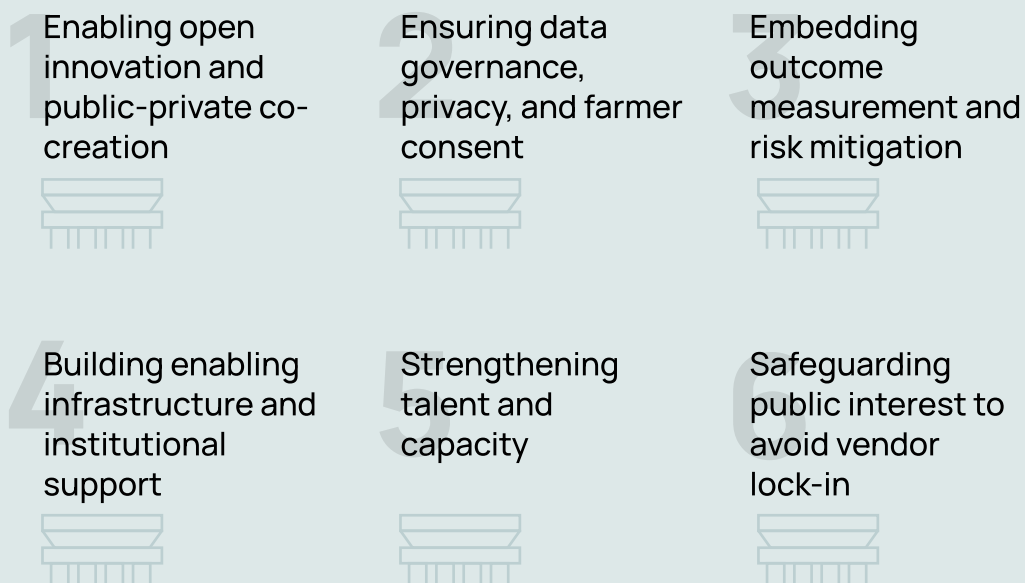
AgriStack aims to unify India's agriculture ecosystem through a shared, consent-based data network, making every land plot, farmer, and crop a verifiable digital node. This enables targeted interventions, predictive policies, and equitable access to opportunities. Powered by satellite data, cloud computing, and inclusive applications, AgriStack drives the Digital Agriculture Revolution, supporting India's goals of food security and farmer empowerment through advanced technologies.

India's agricultural story will be written not just in the soil, but also in the code that empowers it. The fields of tomorrow will be guided by satellites, sustained by data, and strengthened by trust. SatSure's AgriStack is the architecture of that future, a digital public good that empowers farmers and allied stakeholders to cultivate a prosperous future together.

Lt Gen A K Bhatt
PVSM UYSM AVSM SM VSM (Retd)
Director General,
Indian Space Association (ISpA)
Chairperson, Board of Governors,
IIIT Kota & IIIT Ranchi
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Executive Summary

India's AgriStack stands out as a sovereign, state-led digital infrastructure that integrates farmer identity, land records, financial services, and advisories at a scale unmatched by any other initiative. Unlike siloed, proprietary models elsewhere, AgriStack combines public infrastructure, private innovation, and grassroots participation to build a unified, inclusive agri-data ecosystem tailored to India's diverse agricultural landscape and adaptable for broader use. To unlock its transformative potential, critical institutional, technological, and governance challenges must be addressed



These pillars offer a clear roadmap for AgriStack to evolve into a resilient, inclusive, and innovation-friendly digital public infrastructure that empowers India's farming communities and sets a benchmark for agricultural transformation.

“AgriStack redefines the interface between farmer and state.”

Introduction

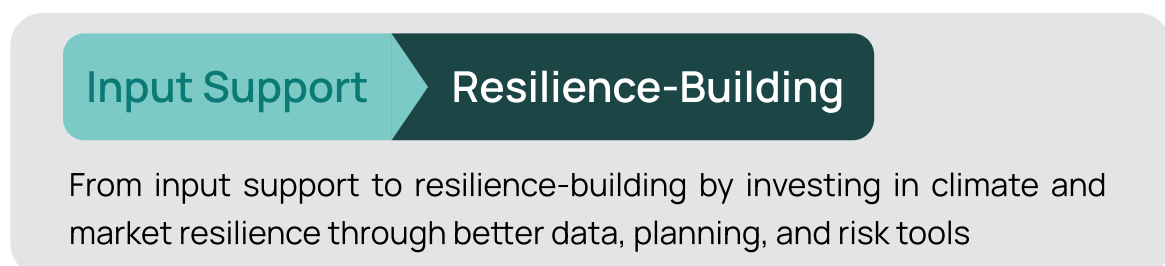
↘ The Reimagining of Indian Agriculture

Agriculture remains a foundational pillar of the Indian economy. The Economic Survey 2024–25 reports that the sector contributes around 16% to GDP at current prices and supports livelihoods for 46.1% of the population. Yet, three persistent challenges limit its potential: fragmented landholdings, outdated production techniques, and volatile and inefficient market linkages, compounded by limited access to formal credit and insurance. These issues have endured despite significant public investments.



Breaking this cycle requires a new approach.

Three key shifts are needed to move from fragmented support to integrated, digital-first delivery:



Top-Down

Ecosystem-Driven Solutions

From top-down to ecosystem-driven solutions by enabling farmers, governments, innovators, and financial institutions to collaborate within a digitally enabled ecosystem

This is where AgriStack plays a foundational role. The Government of India's initiative serves as a digital public infrastructure that builds federated, consent-based datasets on farmers, landholdings, cropping patterns, and agricultural activity. Rather than deliver services directly, AgriStack provides a shared foundation that enables private sector innovation to scale.

AgriTech startups are essential to this transformation. They address four critical service gaps that public systems have long struggled to fill including timely credit, precision inputs, climate-smart advisories, and transparent market access.

Their agility, data-centric models, and local responsiveness allow them to build scalable, region-specific solutions. However, their impact is limited by three major barriers:



Fragmented data ecosystems



High customer acquisition costs



Limited interoperability with government systems

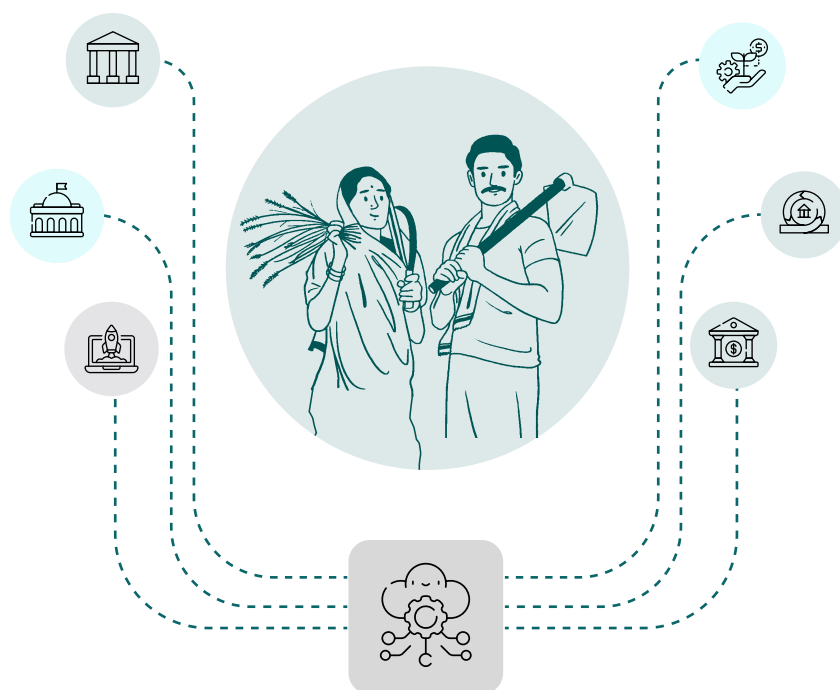
AgriStack can change that equation by enabling verified access to public registries, reducing duplication, and allowing startups to focus on building value-driven services rather than basic infrastructure.

This paper outlines how AgriStack, supported by forward-looking policies, can help startups, financial institutions, and other value chain actors build scalable, farmer-centric solutions that unlock India's agricultural potential.

Barriers	AgriStack as an Enabler	Opportunities
• Fragmented Data • High Acquisition Costs	• Interoperable • Farmer/crop/land Registry • Unified Farmer Service Interface (APIs) • Consent layer	• Precision Inputs • Climate Advisories • Market Access • Improved Credit

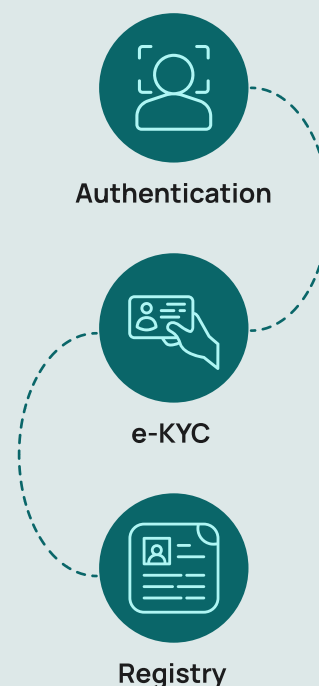
The AgriStack and the DPI Paradigm in Agriculture

AgriStack represents a critical expansion of India's DPI paradigm into the agricultural sector. Drawing from the architectural precedents of Aadhaar, UPI, DigiLocker, AgriStack aims to resolve longstanding inefficiencies in agricultural service delivery by establishing a unified, consent-based, and interoperable data infrastructure. Grounded in the 2021 India Digital Ecosystem of Agriculture (IDEA) framework, the initiative marks a shift from fragmented, scheme-centric digital systems toward a federated and modular model that centers the farmer as an authenticated participant in a broader digital ecosystem.

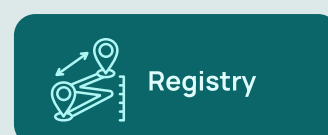
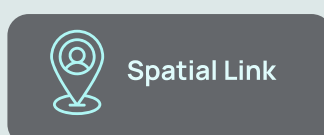
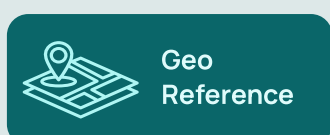


The architecture of AgriStack may be understood as resting on three interdependent pillars, each representing a foundational data registry: the Farmer Registry, the Land Parcel Registry, and the Crop Sown Registry. Together, these pillars constitute the core stack upon which subsequent services, applications, and innovations are built.

■ The **Farmer Registry** functions as the identity layer of the system. It assigns a unique Farmer ID to each cultivator, typically linked to Aadhaar, thereby establishing a verifiable identity record within the agricultural domain. Compiled by state governments with reference to existing administrative datasets—such as PM-KISAN, Soil Health Cards, and land records—the registry creates a reliable e-KYC framework for agriculture. Its core utility lies in its ability to authenticate beneficiaries, facilitate eligibility checks for government schemes, and enable direct benefit transfers with minimal leakage or duplication. The Farmer Registry, in effect, operationalizes identity verification within the agricultural sector, much as Aadhaar has done for welfare delivery more broadly.



■ The **Land Parcel Registry** introduces a spatial dimension to the system by geo-referencing individual plots of agricultural land and linking them to farmers via verified ownership or tenancy records. Digitized and maintained by State Revenue Departments, this registry enables location-specific service delivery—ensuring that subsidies, insurance, and procurement mechanisms are grounded in real, validated land-use data. Its interoperability with the Farmer Registry allows services to be accurately targeted not just to individuals, but to the land they cultivate. This spatial clarity is essential for the precision deployment of both public and private sector interventions.



■ The **Crop Sown Registry** adds a temporal layer, capturing seasonally updated data on cropping activity at the plot level. Populated through a combination of satellite imagery, mobile-based field surveys, and integrations with schemes such as PMFBY, this registry reflects dynamic, real-time information on what is being cultivated, where, and when. During the Kharif 2024 and Rabi 2024–25 seasons, for instance, crop surveys informed by this system covered more than 23.9 crore plots across over 400 districts. The registry underpins time-sensitive services such as insurance assessments, input planning, and market advisories, making it integral to adaptive and responsive agricultural governance.



Seeds Sown



Mobile Survey



Registry

These three registries, though maintained by state governments, adhere to nationally defined standards to ensure interoperability across jurisdictions. Together, they constitute a federated and layered digital infrastructure that enables verifiable, real-time service delivery while reducing information asymmetries and transaction costs.

Sitting atop this core stack is the **Unified Farmer Service Interface (UFSI)**—a standardized, open API framework that allows authorized public and private actors to build services on top of verified data. UFSI functions as the access and integration layer of AgriStack, streamlining data exchange and reducing onboarding friction for AgriTech startups, financial institutions, and service providers. Critically, all data flows through this interface are regulated by a

Consent Manager aligned with the Data Empowerment and Protection Architecture (DEPA). This governance layer ensures that data sharing is not only secure and auditable but also explicitly anchored in user consent, preserving privacy-by-design.



While structurally consistent with India's other DPI frameworks, AgriStack's complexity arises from the heterogeneity and volatility of agriculture itself. The sector's dependence on spatial, seasonal, and ecological variables demands continuous updates, real-time feedback loops, and dynamic registry synchronisation. This operational complexity, however, also creates significant opportunities: AgriStack's federated and interoperable infrastructure creates the foundation for innovations in climate adaptation, traceability, and sustainable agriculture. In doing so, it advances India's progress toward key Sustainable Development Goals, including SDG 2, SDG 12, and SDG 13.

The broader policy implications are equally significant. With accurate, authenticated data on landholding, crop patterns, and farmer identity, central and state governments can implement agricultural schemes with far greater precision and accountability. For instance, integration with PMFBY has already enhanced the accuracy of crop insurance assessments, while linkage to PM-KISAN has improved eligibility verification and benefit targeting. Initiatives such as the Krishi Decision Support System (Krishi-DSS), built atop AgriStack, are expected to leverage consolidated datasets including weather, soil health, pricing, cropping trends, to offer predictive analytics and localized advisories at scale.

Given the heterogeneity of Indian agriculture, with its diversity of crops, fragmented landholdings, and vast network of informal actors, the role of the private sector is not ancillary but foundational to AgriStack's success. Startups, Farmer Producer Organisations (FPOs), financial institutions, agri-input companies, and digital platforms must actively co-create this infrastructure by building interoperable services that can plug into the DPI. Co-creation is essential not only to enhance the relevance and uptake of digital solutions but also to ensure that the infrastructure remains responsive to ground-level volatility and region-specific needs.

Ultimately, AgriStack redefines the interface between the farmer and the state. It shifts the public sector's role from that of a direct input provider to a platform steward thereby facilitating open innovation, enabling trusted data ecosystems, and allowing a range of actors to deliver contextual, farmer-centric services. By consolidating fragmented data, enforcing interoperability, and embedding consent at the core, AgriStack lays the groundwork for a more intelligent, equitable, and outcome-oriented agricultural economy.



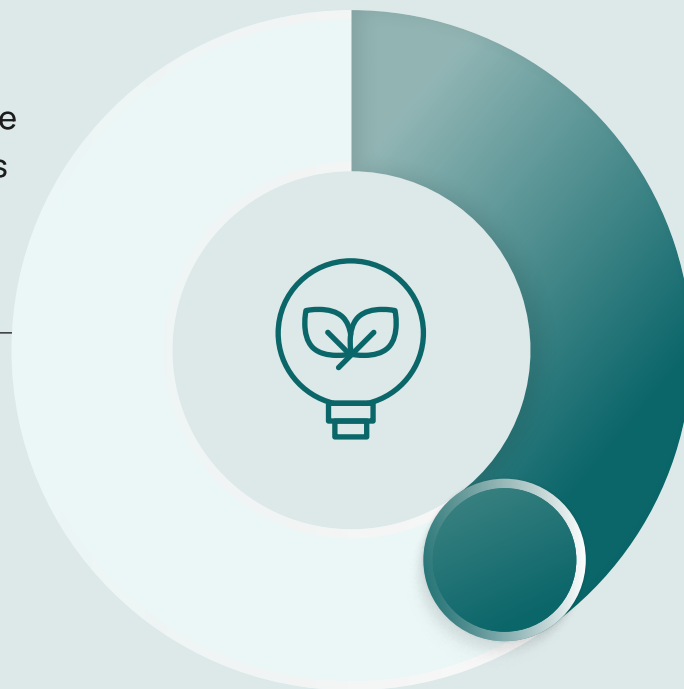
India's AgriTech Ecosystem: Promise and the Path to Scale

India's AgriTech ecosystem has witnessed notable expansion over the past decade, driven by increased rural connectivity, reform-oriented policy focus, and a steady rise in private investment. According to the Ministry of Agriculture and Farmer Welfare, as of 2023 more than 7,000 startups are currently active across agriculture and allied sectors, with over 2,800 registered under the Startup India initiative. According to the National Academy of Agricultural Sciences (NAAS), 38 AgriTech startups attained unicorn status within a single year, reflecting the sector's growing strategic importance.

According to the Ministry of Agriculture
and Farmer Welfare, as of 2023,

7K+

Startups are
currently active
across agriculture
and allied sectors



2.8K

Registered under the
Startup India initiative.

Startups initially focused on input delivery and advisory services are now moving toward full-stack platforms that integrate logistics, financial services, and market access. Input-related solutions have gained early traction, including tools for supply chain management, digitized inventory, and soil health advisory.

These platforms increasingly integrate satellite imagery, agro-climatic models, and IoT sensors to offer location- and crop-specific insights. Although adoption remains concentrated in high-value crops and digitally connected districts, services such as drone-based diagnostics and mechanization-as-a-service are becoming more accessible.

Agricultural finance represents one of the most active innovation domains. Lending continues to face barriers due to limited access to verifiable data on landholding, cropping patterns, and yields. A 2023 PwC report noted that 86 percent of agricultural loans still rely on manual processes and fragmented documentation.

In response, startups have begun to integrate alternative data—satellite imagery, historical cropping patterns, rainfall, and soil moisture—into credit scoring and insurance models.

Parametric and index-based insurance products, while still at the pilot stage, offer faster and more transparent claims based on environmental triggers rather than physical inspections. Market linkage platforms have also evolved from transactional procurement tools into integrated service nodes. Many now offer warehousing, embedded finance, quality grading, and logistics. These firms are repositioning themselves as anchor institutions within localized agri-value chains.

To frame this landscape structurally, NAAS categorizes AgriTech activity across seven thematic segments: input supply, mechanization, post-harvest and quality assessment, financial services, logistics, market linkages, and livestock and fisheries.

NAAS Segment	Use Case	Description	Startups/Companies
 Input Supply and Advisory	AI-driven advisory (non-satellite)	Crop, soil, and weather-based guidance using mobile or IoT-based models	BharatAgri, Fyllo, Cropin
	On-field edge computing	Real-time recommendations via edge devices and sensors	Fyllo, SatSure, AgWise
	Agroecological and soil-water advisory	Recommendations for sustainable farming practices and integrated resource management	Kheyti, Bhoomi Tech, Satyukt Analytics
	Smart irrigation and water efficiency	AI-IoT for irrigation scheduling, monitoring, and smart pumps	Fyllo, BharatAgri, Kritsnam Technologies
	Biological inputs and enhancers	Biofertilizers, biopesticides, microbial solutions	Esem Organic, Lemlei Enterprise, Twosis Garden
	Genetically enhanced seeds	Drought and pest-resistant crop varieties via gene editing and partnerships	Bioseed, Nuziveedu Seeds
 Farm Mechanization and Automation	Drone spraying and aerial imaging	Precision agriculture using drones for input delivery and farm mapping	Thanos Technologies, Salam Kisan
	Drone-based monitoring	Diagnostics and remote crop observation via UAVs	Marut Drones, General Aeronautics
 Production Enhancement and Smart Farming	Satellite-based crop diagnostics	Pest, nutrient, and crop health monitoring via remote sensing	Farmonaut, AgWise, SatSure
	Land use mapping and risk prediction	Geospatial classification for planning, zoning, and disaster risk	SatSure, Farmonaut
	Integrated advisory platforms	End-to-end apps for inputs, crop health, weather, and financial planning	Cropin, BharatAgri, Fyllo, DeHaat

NAAS Segment	Use Case	Description	Startups/Companies
 Post-Harvest Management and Processing	Shelf-life enhancement tech	Preservation technologies to extend perishables' viability	GreenPod Labs, Greenovative Foods
	Crop quality analytics	Assessment tools for pricing, traceability, and financial decisions	AgNext Technologies, Intello Labs
 Market Linkages & Logistics	Digital procurement and market access	Real-time platforms linking producers to buyers with pricing transparency	Villamart, DeHaat, AgriBazaar
	Embedded logistics and warehousing	Integrated storage, quality control, and transportation	DeHaat, AgriBazaar
 Financial Services (Agri-FinTech)	Credit and insurance underwriting via satellite	Data-driven models for farm loans and coverage estimation	SatSure, BharatRohan Airborne Innovations
	Parametric/ weather-index insurance	Trigger-based payouts using weather/yield indicators	SatSure, Skymet
	Analytics for credit and insurance	Tech tools to assess creditworthiness and coverage terms	AgNext Technologies, Intello Labs
 Alternative Food Systems	Plant-based proteins and alt-farming	Innovations in protein from plants, algae, and insects	GoodDot, Evo Foods, String Bio

Source: Compiled by author based on industry reports, startup directories, and NAAS Policy Paper 108 alignment.

Systemic frictions continue to constrain scale in India's AgriTech sector. Value chains remain fragmented, digital literacy is uneven, and institutional integration with banks, cooperatives, and government systems is inconsistent. Many startups operate in silos, relying on high-touch onboarding models that drive up costs. Without shared infrastructure and common standards, innovation remains localized and hard to replicate.

AgriStack offers a structural response to these barriers. By institutionalizing identity, land, and crop data through interoperable registries, it reduces the need for startups to build foundational datasets independently. When mapped to AgriStack's architecture, core AgriTech segments align clearly: input services and agronomy rely on the Crop Sown Registry, mechanization platforms draw from geo-referenced land records, and Agri-FinTech depends on the Farmer Registry and cropping histories. This interoperability lowers integration frictions and expands the scope for product innovation. Standardized datasets on soil health, crop cycles, and weather enable precision advisory, traceability, and risk-based financial services. Startups are participating in digital agriculture pilots, and multiple MoUs demonstrate growing interest in co-developing solutions. These partnerships offer more than market access—they allow startups to contribute to standards-setting and embed innovations within flagship government schemes.

In this evolving context, AgriStack repositions AgriTech as a core delivery partner. It reduces structural barriers, standardizes service layers, and creates the foundation for scalable, inclusive, and interoperable digital agriculture.





State as Catalyst: Policy Leadership in India's Digital Agri Transition

2010–11

- **Early Digital Foundations**

National e-Governance Plan in Agriculture (NeGP-A) launched – farmer portals, databases, and soil health card schemes seeded the concept of digital registries.

2018–19

- **Startup Linkages**

RKVY-RAFTAAR launched incubation programmes, formally connecting AgriTech startups to the emerging DPI vision.

2015–18

- **Conceptualisation Phase**

Farmer ID and land record digitisation pilots explored across states; policy papers and expert groups began framing the idea of an integrated “AgriStack.”

2019–21

- **AgriStack as a Policy Proposal**

- Ministry of Agriculture initiated consultations with states, industry, and civil society; first drafts of AgriStack architecture circulated. Debate centered on farmer consent, data ownership, and platform design.
- India Digital Ecosystem of Agriculture (IDEA) consultation paper published to formally articulate AgriStack's vision, principles, and governance framework.

2021–23

- **Pilot Experiments**

Early pilots tested AI-enabled advisories, pest alerts, market linkages, and crop mapping. These validated technical feasibility but revealed on-ground bottlenecks in onboarding, data standards, and state capacity.

2024

- **Digital Agriculture Mission (DAM)**

Union Cabinet embeds AgriStack in national strategy with a ₹2,817 crore budget outlay. DAM provided the institutional anchor for scaling AgriStack as Digital Public Infrastructure (DPI).

2024

- **National Rollout Begins**

- 14 states signed MoUs for implementation.
- 23 states formed Steering Committees to coordinate across departments.
- 22 states opened APIs for land record verification.
- 4.85 crore Farmer IDs generated (target: 11 crore by 2026–27).
- Digital crop surveys mapped 23.9 crore plots across 450+ districts.
- 55% of Indian villages completed cadastral digitisation.

The federated nature of agricultural governance, with states playing a pivotal role, makes alignment with AgriStack both a technical and institutional necessity. For AgriTech enterprises, this means preparing for a future where interoperability, trust frameworks, and verified data are foundational to operations. The challenge now is to bridge the gap between innovation and national scale, ensuring that startups are equipped to build on DPI rails, and that the state facilitates this transformation not only through investment, but also through proactive policy integration and responsive infrastructure.

Enabling Policy and Measures Implemented So Far

The foundation for AgriStack was laid over a decade. The National e-Governance Plan in Agriculture (NeGP-A), launched in 2010–11, initiated integration through farmer portals and databases. Initiatives like the soil health card and farmer ID became core inputs. In 2018–19, RKVY-RAFTAAR introduced incubation support for AgriTech startups. Between 2019 and 2024, over 1,700 startups were supported through Rs. 122.5 crore in grants via MANAGE, IARI, and 24 R-ABIs.

The Digital Agriculture Mission, launched in 2024 with Rs. 2,817 crore outlay, formally embedded AgriStack in national strategy. Early pilots tested AI-enabled advisories, pest alerts, market integration, and crop mapping. These demonstrated technical feasibility while revealing operational bottlenecks in onboarding, data integration, and state preparedness.

By 2024, fourteen states had signed MoUs. Over 4.85 crore Farmer IDs had been generated, with plans to reach 11 crore by 2026–27. Digital Crop Surveys scaled to 23.9 crore plots across over 450 districts. More than 55 percent of Indian villages had completed cadastral digitisation. In 2024, 23 states set up Steering Committees across Revenue and Agriculture Departments, while 22 states opened APIs for land record verification to operationalise AgriStack.

AgriStack represents a structural shift: from fragmented pilots to platform-based governance. For states, this requires aligning with federated protocols. For startups, it demands designing with interoperability, consent, and modularity. Together, these shifts define India's digital agricultural transformation.



Where the Gaps Remain: Policy Ambiguities and On-Ground Bottlenecks

Despite AgriStack's transformative potential, its operationalisation faces several intertwined challenges that could undermine its promise. These include institutional fragmentation, uneven state capacity, technological inflexibility, data governance ambiguity, and structural procurement barriers.

Fragmented Governance & Uneven State Capacity Agricultural data sits in silos across departments, with states rolling out AgriStack at very different speeds.	Fiscal Gaps & Lifecycle Costs Registry upkeep, API maintenance, and DEPA compliance need continuous funding, not scheme-driven bursts.	Procurement Misalignment Current norms reward big vendors and hardware, sidelining startups and open, modular solutions.
Ecological & Technical Inflexibility Centralised tech models ignore regional diversity, risking one-size-fits-all solutions that fail locally.	Absence of Co-Creation Platforms No structured sandboxes for states, startups, and civil society to test, iterate, and co-design solutions.	Vendor Lock-In Risks Dominance of large firms threatens open access to APIs and registries, limiting smaller innovators.
Data Governance Ambiguities States lack clarity on consent protocols, data-sharing norms, and enforcement, creating uncertainty.	Weak Data Sovereignty & Storage Norms Registry hosting and cloud storage risk falling outside India's jurisdiction, undermining farmer trust.	Identity, Access, and Inclusion Risks Weak KYC and grievance redress mechanisms risk exclusion of women, smallholders, and vulnerable groups.
Platform Capture & Competitive Asymmetry Opaque API access and onboarding protocols allow incumbents to consolidate power and squeeze startups.		

1

Fragmented Governance and Uneven State Capacity: Agriculture remains a state subject under the Indian Constitution. Unlike Aadhaar or UPI, AgriStack cannot rely on centralised rollout mechanisms. It must be operationalised through state governments, whose administrative vision, technical competence, and fiscal capacity vary widely. Some states have piloted remote sensing and farmer ID systems, while others struggle with underfunded departments and unclear implementation plans. This divergence leads to asynchronous rollout and risks diluting the federated coherence that AgriStack requires. Further complicating matters is the siloed nature of data governance. Key agricultural data is distributed across departments-agriculture, revenue, disaster management, animal husbandry-each with legacy workflows and non-interoperable systems. Without empowered coordinating bodies at the state level, registry layers cannot converge into usable systems. Interdepartmental coordination, unified data standards, and shared accountability remain elusive.

2

Fiscal Gaps and Lifecycle Costs: Developing the foundational registries-geo-tagged land records, verified farmer identities, and crop-level datasets-requires sustained fiscal and institutional support. Many states lack visibility into long-term costs for registry maintenance, API upkeep, or DEPA compliance. This creates risks of platform decay, where once-verified data becomes obsolete due to lapses in periodic updates. Budgeting cycles and scheme-driven funding models are poorly suited to the continuous investment DPI demands.

3

Procurement Misalignment with DPI Needs: Current public procurement norms favour large, hardware-oriented vendors, sidelining startups or niche service providers who often offer more adaptable and modular solutions. Even where startups win bids, they face uncontracted scope additions and delayed payments. The problem isn't just eligibility - it's architectural. Procurement templates have not evolved to incentivise interoperability, open standards, and service continuity. Without reform, innovation will remain limited to a narrow circle of well-capitalised actors.

4

Ecological and Technical Inflexibility: Agricultural practices and data are inherently local. Yet technical models developed in one zone (e.g., for paddy in Tamil Nadu) often fail when applied in another (e.g., millet in Maharashtra). AgriStack's national scale demands locally adapted models, not one-size-fits-all tools. Instead, we see a centralisation of solutioning, often involving a few dominant technology partners. This risks epistemic capture-the dominance of a single worldview-which marginalises local innovators and limits responsiveness to regional variation. A pluralistic innovation ecosystem is essential.

5

Absence of Co-Creation and Testing Platforms: Unlike fintech, where sandboxes and working groups supported DPI evolution, AgriStack lacks structured co-creation environments. There are few formal mechanisms where state officials, startups, and civil society actors can test ideas, co-design tools, or iterate on policy assumptions. Without such platforms, field-level pilots often fail to inform national standards. Innovation remains fragmented, delaying standardisation and the scaling of farmer-centric services.

6

Risk of Vendor Lock-In and Exclusion Early-stage AgriStack pilots included multinational corporations and large domestic firms. While these collaborations were framed as non-commercial, their continued dominance raises concerns about vendor lock-in, data monopolies, and exclusionary ecosystems. Startups and smaller firms may struggle to access APIs, farmer registries, or decision support infrastructure on equitable terms. Without clear onboarding protocols, inclusion criteria, and data access audits, AgriStack risks becoming a platform where a few actors control core infrastructure.

7

Data Governance Ambiguities: While DEPA provides a vision for consent-based access, its application in agriculture remains vague. States have little clarity on which datasets are shareable, with whom, and under what regulatory conditions. Consent protocols are poorly defined, and enforcement capacity is limited. The absence of a national data policy for agriculture creates inconsistency. Larger players may secure privileged access, while smaller innovators face regulatory uncertainty and constrained design flexibility.

8

Weak Data Sovereignty and Storage Norms: AgriStack's federated design hinges on sovereign data principles. But cloud storage, API governance, and registry hosting are not always aligned with localisation mandates. Without policy safeguards, infrastructure developed under AgriStack could be monetised outside Indian jurisdictions or locked behind proprietary platforms. This threatens long-term innovation and undermines farmer trust. Data must remain within India's legal jurisdiction, and registry access must be governed transparently.

9

Identity, Access, and Inclusion Risks: A weak digital identity layer creates significant downstream risks. Many state registries rely on self-declared or scheme-driven beneficiary lists, with limited KYC or field validation. If these identities become gateways to credit, insurance, or market linkages, misidentification will compound exclusion. Without grievance redress mechanisms, data portability, and audit trails, farmers may have no recourse in case of service denial. Vulnerable groups-especially women and marginal farmers-are disproportionately affected.

10

Platform Capture and Competitive Asymmetry: As registry data becomes the basis for service innovation, control over APIs, onboarding processes, and usage analytics will shape who can build what. If access norms remain opaque, incumbents may consolidate their positions, squeezing out smaller competitors. AgriStack must institutionalise competitive neutrality by enforcing open access, independent audits, and transparent service protocols. Otherwise, DPI will reproduce the very market distortions it seeks to overcome.



Unlocking Scale: A Strategic Agenda for Public Policy

Policy Priority 0: Establish the Centre of Excellence for AgriStack & Digital Agriculture (CEA)

Context:

India's agricultural digital transformation is fragmented across ministries, states, and pilots. Without a unifying anchor, innovation risks duplication, uneven adoption, and weak accountability. India's successes in digital payments (NPCI for UPI), digital health (NHA for NDHM), and open commerce (ONDC) show that scalable digital public infrastructure needs to be anchored under a central, multi-stakeholder institution that can safeguard neutrality, enforce standards, and accelerate adoption.

Recommendation:



- Establish a Centre of Excellence for AgriStack & Digital Agriculture (CEA), jointly under the Ministry of Agriculture and MeitY.
- Structure it as a Section 8 non-profit or statutory body with representation from government, startups, farmer organisations, and technical agencies.
- Mandate it to serve as the national custodian for AgriStack including defining standards, managing sandbox environments, overseeing registries and APIs, and enabling state adoption through transparent governance and shared resources.

Expected Outcomes:



- A single anchor for coherence and interoperability across state and central systems.
- Clear and trusted pathways for startups, farmers, and governments to engage with AgriStack.
- Stronger accountability, preventing duplication, vendor lock-in, or exclusion.

Precedents: NPCI unified payments innovation under UPI; NHA set health data standards through NDHM; ONDC ensured open, neutral access in digital commerce.



Policy Priority 1: Open Innovation and Startup Integration

Context:

Innovation across states is uneven; some have advanced pilots while others remain at early stages. Without a coordinated framework, AgriStack risks fragmentation and duplication. India's sandbox models in finance and commerce show how experimentation can scale responsibly when backed by regulatory trust.

Recommendation:



- Establish a National AgriStack Sandbox, coordinated through CEA, with controlled API access to verified registries such as Farmer ID and Crop Sown Registry.
- Define clear categories of eligible use cases (credit scoring, precision irrigation, satellite monitoring).
- Introduce structured evaluation to test interoperability, privacy compliance, and farmer-centricity.
- Expand the NeGPA Steering Committee into a multi-stakeholder certification forum, including startups, infrastructure agencies, and FPOs, to validate APIs and microservices.
- Modernise procurement frameworks (GFRs, GeM) to recognise API-first services, permit subscription/consumption contracts, and introduce new categories for AgriTech DPI services with interoperability scoring.

Expected Outcomes:



- A shared innovation layer reducing duplication and enabling scalable solutions.
- Transparent certification and faster integration of innovations into state systems.
- Lower entry barriers for startups and a shift from hardware-dominated procurement to modular, service-based contracting.

Precedents: RBI and SEBI sandboxes, ONDC's governance model, and NPCI's procurement innovations.



Policy Priority 2: Data Governance and Farmer Consent

Context:

Without a harmonised framework, farmers face risks of exclusion or misuse, and startups lack clarity. Lessons from DEPA in finance and health show that trusted consent architecture is essential for DPI.

Recommendation:



- Provide inclusive consent channels via CSCs, FPOs, and mobile apps.
- Assign independent API oversight under a neutral body, certifying security, monitoring misuse, and tiering access rights.
- Partner with BIS to standardise data formats for land, crop, and farmer registries.

Expected Outcomes:



- Stronger farmer trust and sovereignty over their data.
- Transparent and equitable API governance.
- Seamless interoperability for innovators across states.

Precedents: Account Aggregator in finance, NDHM in health, DigiLocker API oversight, and BIS standards for UPI.



Policy Priority 3: Measuring Outcomes and Reducing Risk

Context:

AgriStack's success depends not just on technical deployment but on measurable improvements in delivery, risk reduction, and policy design. Without outcome measurement, algorithm audits, and predictive analytics, the system risks underperformance or exclusion.

Recommendation:



- Launch an AgriStack Progress Website to track API usage, registry accuracy, DBT success rates, certified service integrations, with state-wise public reports.
- Mandate algorithmic explainability and risk audits for services using AgriStack data, including credit and insurance.
- Integrate predictive analytics and early-warning tools into AgriStack registries to support risk dashboards, parametric insurance triggers, and pre-emptive policy interventions.

Expected Outcomes:



- Evidence-based policymaking and accountability.
- Reduced bias in algorithms and greater transparency.
- Stronger resilience against climate and market shocks.

Precedents: NPCI's UPI dashboard, PM-KISAN DBT dashboards, EU AI regulations, and IMD early-warning systems.



Policy Priority 4: Infrastructure Access and Field-Level Enablement

Context:

AgriStack's impact depends on last-mile adoption. Without intermediaries and reliable scheme integration, smallholder farmers may remain excluded from digital benefits.

Recommendation:



- Designate CSC VLEs and FPOs as official onboarding partners, supporting registration, consent capture, and farmer access to services.
- Mandate integration of AgriStack into flagship schemes like PM-KISAN, RKVY, and PMFBY, enabling automated verification and real-time subsidy tracking.
- Facilitate financial and insurance integration by recognising AgriStack datasets as trusted inputs for credit underwriting and parametric insurance validation, in collaboration with RBI and IRDAI.

Expected Outcomes:



- Rapid scaling of farmer onboarding and registrations.
- Faster and more accurate delivery of agricultural schemes.
- Expanded access to credit and insurance through trusted datasets.

Precedents: Aadhaar-enabled CSC enrolments, DBT through UPI and Aadhaar, and Account Aggregator in finance.



Policy Priority 5: Human Capital and Institutional Readiness

Context:

Digital public infrastructure is only as effective as the people and institutions who operate it. Extension workers, state officers, and startups often lack the skills to manage registries, APIs, and consent mechanisms.

Recommendation:



- Develop AgriStack-focused training modules with MANAGE and SAMETIs, embedding registry management, consent handling, and API use cases into officer training.
- Introduce new Skill India roles such as AgriStack Integration Associate and Crop Data Quality Auditor, linked to certification and job placements.
- Provide sandbox access and technical mentoring for startups through structured programs under AIM and RKVY-RAFTAAR.

Expected Outcomes:



- A digitally skilled workforce driving AgriStack adoption.
- Employment opportunities for rural youth with new digital roles.
- Stronger innovation pipeline and faster scale-up of solutions.

Precedents: NPCI workshops for UPI rollout, PMKVY digital payments roles, and AIM sandbox programs.



Policy Priority 6: Safeguarding Public Value and Preventing Capture

Context:

AgriStack's core value lies in being an open, public-good infrastructure. Without safeguards, there is risk of vendor lock-in, monopolisation, or opaque governance.

Recommendation:



- Maintain public custodianship of core registries (farmer, land, crop) with transparent governance and equal API access for all compliant actors.
- Adopt open infrastructure norms, including open-source reference implementations, published onboarding guides, and periodic access audits.
- Commission independent audits by academic or public institutions, publishing findings on registry accuracy, consent compliance, and usage patterns.

Expected Outcomes:



- Equal access and competitive neutrality for innovators.
- Prevention of monopolistic capture.
- Public trust through transparency and accountability.

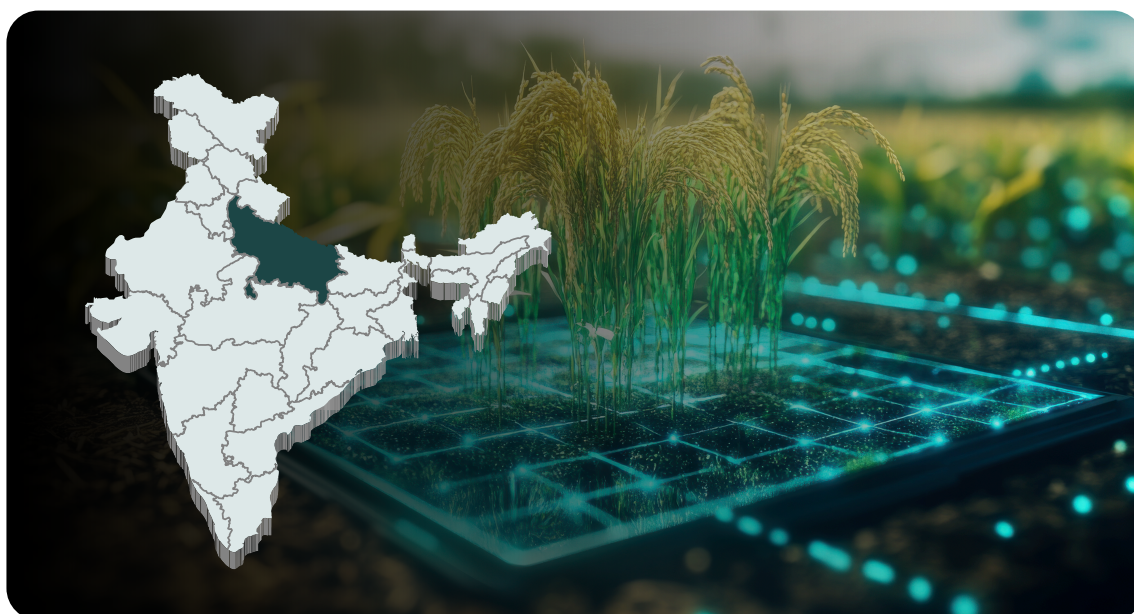
Precedents: Aadhaar and DigiLocker custodianship models, ONDC's open protocols, and UIDAI/UPI audit mechanisms.





DeepDive: SatSure and the Co-Creation of AgriStack's Crop Registry in Uttar Pradesh

SatSure is a geospatial analytics company that integrates satellite imagery, remote sensing, and artificial intelligence to generate decision-support tools for agriculture, climate risk, and financial services. In the agricultural sector, it offers services such as acreage estimation, crop classification, yield forecasting, and early warning alerts—functions that are central to real-time, data-driven agricultural governance.



Uttar Pradesh, as a leading state in AgriStack implementation, partnered with SatSure to digitize the Crop Sown Registry—one of the foundational layers of India's digital agriculture infrastructure. This registry provides verified, plot-level crop data essential for targeting inputs, evaluating credit risk, designing insurance schemes, and streamlining benefit delivery.

SatSure's methodology uses satellite-enabled surveys calibrated with phenology patterns, NDVI indices, and agro-climatic data. These tools enable accurate mapping of sown area, crop type, and sowing timelines across millions of plots. Unlike manual surveys, SatSure's approach produces frequently updated geospatial maps, feeding directly into the Crop Registry for automated crop verification, anomaly detection, and input targeting.

All datasets are designed to meet IDEA compliance, ensuring interoperability with central and state systems. This facilitates use across departments including agriculture, revenue, insurance, and disaster management. The federated data model ensures decentralized ownership while maintaining alignment with national standards.

In the context of crop insurance, high-resolution crop data supports validation of claims under the Pradhan Mantri Fasal Bima Yojana (PMFBY). SatSure's analytics allow insurers and government agencies to corroborate sowing data, detect anomalies, and trigger loss assessments with reduced reliance on physical crop-cutting experiments.

The Crop Registry also informs input subsidy planning and resource allocation. District officials use spatial data to assess varietal spread, stress exposure, and input uptake, improving planning in vulnerable zones such as eastern Uttar Pradesh. This supports timely irrigation, fertilizer application, and pest control strategies.

With AgriStack's Consent Manager framework, SatSure can access individual farmer data with consent to offer personalized advisories and risk products. This mechanism ensures compliance with data protection principles and facilitates ethical deployment of AI tools.

SatSure's integration into AgriStack demonstrates the role of technology firms as co-creators of public infrastructure. By contributing validated datasets and scalable models, firms like SatSure become institutional partners—helping states build durable, interoperable systems for agricultural governance.



DeepDive: Cropin and the Digitization of Agricultural Service Delivery in Karnataka

Cropin is a leading Indian AgriTech company delivering data-driven solutions across farm management, predictive analytics, and supply chain traceability. Its products including Cropin Grow, Intelligence, and Trace, combine satellite data, machine learning, and field-level inputs to enhance decision-making in agriculture. These tools are adopted by agribusinesses, financial institutions, and public agencies to improve operational efficiency and risk mitigation.



Karnataka provides a favorable environment for such integration. This is due to its early investments in e-governance, comprehensive digital land records, and active Farmer Producer Organisation (FPO) networks. Cropin has implemented multiple interventions in the state, each illustrating the potential for alignment with the AgriStack architecture. One initiative, conducted in collaboration with NABARD and the state government, involved developing a digital market linkage platform.

The aim was to improve price discovery and reduce dependency on intermediaries. Although the pilot engaged 1,200 farmers, it demonstrated a replicable model for digital procurement and logistics planning. In another effort, Cropin implemented traceability protocols for organic produce in districts such as Kolar and Chikkaballapur. Geo-tagged plot data was used to establish provenance, input authenticity, and export compliance.

This system enabled transparent certification and facilitated premium pricing in domestic and global markets. In rainfed areas of North Karnataka, such as Bagalkot and Gadag, the company deployed satellite-linked advisories that provided timely guidance on sowing, irrigation, and pest control.

These interventions are structurally aligned with AgriStack. Access to authenticated datasets from registries, including crop sown and landholding records, would improve predictive accuracy and service automation for Cropin. The Consent Manager and standardized APIs will further facilitate integration into public schemes such as the Pradhan Mantri Fasal Bima Yojana and input subsidy programs.

Karnataka's institutional structure, including the Bhoomi land records platform and e-Uparjan procurement systems, enhances the feasibility of such deployments. Cropin's collaboration with these systems highlights the viability of embedding startup-led innovation within public service frameworks.

This case demonstrates how AgriTech enterprises can evolve from service providers to ecosystem participants. When supported by federated infrastructure and enabling policy, startups can contribute meaningfully to state capacity, farmer empowerment, and inclusive agricultural transformation.

Conclusion



India's agricultural transformation hinges not only on digital public infrastructure like AgriStack but also on the capacity of its AgriTech ecosystem to deliver inclusive, scalable, and interoperable services. The rise of AgriTech reflects a structural response to longstanding gaps in credit, extension, insurance, and markets. Startups are delivering data-driven services such as satellite-informed advisories, AI-based yield forecasting, and traceability tools that improve efficiency and resilience, especially in high-risk zones.

However, innovation alone is not sufficient. Public policy must align to support open access, predictable governance, and competitive neutrality. States must adopt co-creation models, update procurement frameworks, and strengthen institutional capacity to manage digital ecosystems. AgriTech firms are becoming core delivery partners that require secure data access, consent-based protocols, and fiscal systems designed for modular service integration.

AgriTech also provides tools to implement policy goals like climate adaptation and gender equity through localized and responsive interventions. Precision irrigation platforms, traceability solutions, and community-owned services are examples. Ensuring inclusion across low-income states and rainfed regions remains essential.

India now has the opportunity to define a pluralistic model of agricultural modernization. This will require not only building digital platforms but also designing public institutions that embed openness, accountability, and long-term public value.

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