Digital Public Infrastructure (DPI) - AgriStack for Inclusive Development and Achieving Sustainability Goals

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How to Cite this Paper:

Mahesh, K. M., Aithal, P. S., Sharma, K. R. S. & Lakshman, K. (2026). Digital Public Infrastructure (DPI) - AgriStack for Inclusive Development and Achieving Sustainability Goals. *Poornaprajna International Journal of Emerging Technologies (PIJET), 3*(1), 11-31. DOI: https://doi.org/10.5281/zenodo.18743834

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ABSTRACT

Purpose: *The Government of India is promoting digital transformation in agriculture through initiatives such as e-NAM, NeGP-A, the Digital Agriculture Mission, and AgriStack, integrating technologies like AI, IoT, drones, and data analytics to enhance productivity, sustainability, and farmer livelihoods. With nearly 70% of rural households dependent on agriculture, Agriculture 4.0 and the 5C approach aim to strengthen collaboration, improve credit access, reduce costs, address climate change, and support inclusive growth while contributing significantly to India's economy and UN Sustainable Development Goals.*

Methodology/Approach: *The study typically uses a combination of case studies, policy analysis, and data-driven assessments to explore how AgriStack, a part of Digital Public Infrastructure (DPI), is applied in agriculture to promote inclusivity and sustainability. The approach might involve evaluating technological implementations and their impact on agricultural practices. The authors presented the DPI on Agristack in agriculture eco system and instrumental for the achieving sustainability.*

Findings/Results: *The research indicates that leveraging digital infrastructure like AgriStack can significantly enhance the productivity of farmers, improve access to information, and drive progress towards achieving the UN's Sustainable Development Goals (SDGs). It demonstrates the potential for technology to bridge gaps in agricultural services and support environmental sustainability.*

Originality/Value: *This paper provides unique insights into the role of digital frameworks in transforming the agricultural sector, particularly in emerging economies like India. 5C approach model and ABCD analysis gives more clarity on the DPI on Agristack.*

Paper Type: *Review based Research Analysis.*

Keywords: Agriculture 4.0; Digital Public Infrastructure-AgriStack; Agri Startups; UN Sustainable Development Goals; Digital Agriculture Mission, Digital Agriculture Technology

1. INTRODUCTION :

The government's digitalization policy aims to develop digital tools like DPI or AgriStack, providing innovative solutions to enhance productivity, foster public-private partnerships, and give farmers access to agriculture data for inclusive solutions for Profitability. Additionally, the policy seeks to promote sustainable agriculture practices, empower farmers, and simplify access to government schemes such as PM Kisan Samman Nidhi Scheme (PM-KISAN), Pradhan Mantri Fasal Bima Yojana (PMFBY), FPOs, Kisan Sarathi, Market Intervention Scheme, MSP, Namo Drone Didi, Soil Health Card, Paramparagat Krishi Vikas Yojana (PKVY), National Agriculture Market (e-NAM), National Mission for Sustainable Agriculture (NMSA), direct transfer of fertilizer subsidies to farmers through E-RUPI, and digital payment mechanisms for financial inclusion. Digital Agriculture Mission will support the

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various digital agriculture initiatives including Digital Public infrastructure or AgriStack will create inclusive in agriculture, it is data-driven to enhance the income of millions of farmers (Beriya (2022). [1]). Digital Public Infrastructure for Agriculture comprises the AgriStack, Krishi-DSS and Krishi Mapper (KM). AgriStack has three major foundation regrading databases including registering farmers, village maps and crops in fields. Currently, the agriculture sector provides livelihood to about 42.3 per cent of the population and contributes 18.2 per cent of the national GDP (as per Yojana September 2024) DPI is open source, open standard and interoperable public good similar to payment DPI of unified payment interface (UPI) DPI for agriculture will enable the administration to access farmer ID's geo-tagged farm plots and crop-sown in data in digital format Agriculture 4.0 has helped promote climate-smart agriculture practices to reduce the effects of climate change and protect the ecosystem. This is accomplished with the help of new-age agricultural startups, which enhance the efficiency of farmers using the Internet of Things (IoT), data analytics, robotics, precision farming Software as a Service (SaaS) and artificial intelligence (AI). Agriculture 4.0 also creates employment opportunities in the agriculture sector and is the foundation for the agriculture and food sector in the coming decades (Araujo et.al. (2021). [2]). Agriculture 4.0 has a great impact on the sustainability of the People, Planet and Production and also has more influence on social sustainability (Rose et al. (2021). [3]). The Indian Food economy is expected to grow at the rate of 8.1 % between 2024-28 (as per the BS report on food and service) due to urbanisation, GDP growth, young population and consumption pattern.

The Government of India has implemented various schemes and policies to boost productivity, enhance agricultural infrastructure, ensure fair prices through MSP, and promote sustainable agriculture. Additionally, the government is supporting Agri Startups for agriculture and allied activities such as fishery, horticulture, dairy farming, poultry, and milk production. Agriculture is the most significant contributor to the Indian economy. Recognitions of the Yellow Revolution (oilseed crops), Green Revolution (agricultural productivity), Blue Revolution (aquaculture), and White Revolution (milk production), the agriculture sector's contribution to the GDP stands at 18.2%, according to the Economic Survey 2023-24.

The Share of Agriculture and Allied Sector to the Total GVA of the Economy from 1990-91 to 2022-23, The share of agriculture and allied sector in the total Gross Value Added (GVA) of the economy has declined from 35% in 1990-91 to15% in 2022-23.

Table 1: Share of Agriculture and Allied Sector to the Total GVA

Year	Share of Agriculture and Allied Sector in Total GVA
1990-91	35
2000-01	26
2010-11	18
2020-21	16
2022-23	15

Source: Gov.com Ministry of Agriculture and Farmers welfare

Digital Public infrastructure provides equitable access to the public, and private and drives inclusion, green economy, innovation, and entrepreneurship, Digital Public Infrastructure provides the Four D's Digital identity, Digital payment, Data Sharing and Delivery of services. DPI is a set of shared digital solutions powered by open and interoperable standards with the DPI approach India can scale up opportunities in agriculture and allied sectors, transparent monitoring, economic growth, and governance and accelerate the Sustainable Development Goals (SDGs).

Table 2: Digital Public Infrastructure developed by different countries and its potential

Example of DPI	It's potential	Country
AADHAAR	Public Distribution System, Social pension, DBT of Government Schemes	India
Open Credit Enablement Network/O-ken	Democratization of credit and financial inclusion as well as lending requirements for MSMEs.	India
Ayushman Bharat Digital Mission (ABDM) based on API	Health ID and Vaccine Administration	India

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Digital Infrastructure for Knowledge Sharing (DIKSHA)	Educational Resources for Learners and Teachers	India
Unified Payment Interface (UPI)	Digital payment system for interbank, peer-to-peer, and person-to-merchant transactions.	India
LokOS	Run by National Rural Livelihood Mission to assist Self Help Group (SHG) in bookkeeping platform and Microfinance.	India
BharatBillPay-Based Open API	For bill payment of various government agencies. (water, gas, Phone, electricity)	India
ONDC-Open Network for Digital Commerce	E-commerce platform	India
National ID	Better Governance and management of Tax administration.	Ethiopia
FarmStack-DPG	Improving agricultural productivity by sharing Agri data	Ethiopia
Phil- National Identification System Philippines	Availing social welfare benefits, applying for passports, and registering to vote.	Philippines
NOVISSI	Digital Cash Transfer, Access to Healthcare	Government of Togo
FarmStack-KAOP-Kenya Agricultural Observatory Platform	Better management of the food supply chain, climate patterns, soil health, market linkages, water, and waste management.	Kenya
LINUX AgStack	Guide the Agriculture Farmers, Agri management firms, food traceability, carbon tracking, crop production, and other field-level analytics.	Linux Foundation Farm, San Francisco.
Bahmni or Open ELIS	For Health and wellbeing	Brazil
Health Data Hub	Verifiable IDs and Registries Health and well-being	France
OpenCerts- Digital Academic based on Blockchain Technology	Issue, verifying educational credentials/ certificates	Singapore

Source: UNDP and Author

Agriculture technology for productivity, a Pillar of the Indian economy and profitability, to enable inclusive, sustainability and resilience in agriculture and allied sectors for economic growth and the food system. Smart technology will provide a set of tools to address several areas, they are food security, crop losses, environmental impact, farm productivity and sustainability (Abbasir et al. (2022). [4]). NITI Aayag has predicated in a report that 2025 AI in agriculture would be worth \$2.6 BN and raise at peace of 22.5 per cent compound Annual Growth Rate (CAGR). AI in agriculture is enhancing productivity, transforming agriculture and allied sectors and creating more sustainability by dividing gender and digital gap. As per the article published by Indiaai.gov.in Harvesting Tomorrow, AI's Role in revolutionizing agriculture in India state, the government has initiated the following AI-related technology for agriculture.

(1) Digital Agriculture Project Under the National e-Governance Plan in Agriculture (NeGPA) Program.
(2) National Artificial Intelligence Mission (NAIM)
(3) AI-powered crop yield forecast model by NITI Aayog and IBM partnership
(4) Microsoft, state governments, and MeitY are collaborating on developing artificial intelligence sensors for intelligent agriculture.
(5) Drones will monitor soil and crop health as part of a collaboration between the Information Technology Research Academy (ITRA), the Department of Electronics and Information

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Technology (DEITY), the Ministry of Communication and Information Technology (MCIT), and the Indian Council of Agricultural Research (ICAR).

Table 3: Emerging Agriculture Technology

Emerging Agriculture Technology	Focus area
Remote Sensing	They are gathering essential data on soil moisture, crop health, and crop yields to provide actionable insights into the condition of their crops and soil.
Drones	For collecting valuable data, and helping farmers assess crop health, growth patterns, and potential problem areas.
Geospatial Technology	A significant role in creating maps and analyzing spatial data. These technologies assist farmers in gaining a better understanding of their land, planning irrigation systems, and optimizing planting patterns based on soil variability and topography.
Machine Learning	Machine learning algorithms help analyze complex datasets to predict factors such as crop yields. These insights empower farmers to make informed decisions about planting, fertilization, and pest control, leading to improved productivity.
Artificial Intelligence	AI-powered systems can automate irrigation, predict disease outbreaks, and optimize resource allocation, making crop management more precise and effective.
Precision Farming SaaS	SaaS technology helps farmers in Crop and livestock management, Weather monitoring and analysis, and Soil analysis and mapping to reduce costs, increase productivity, and improve their overall sustainability and environmental impact.
Data Analytics	Data analytics helps farmers adopt practices to reduce their ecological footprint, such as efficient water usage, soil conservation, and reduced use of chemical fertilizers and pesticides.

Source: inc42.com

The benefits of agricultural technology to the farmers are higher crop productivity, decreased water usage, reduced impact of pesticides on the national ecosystem, increased worker safety and skills, affordable food, improved food security, and enhanced quality of life for rural communities. Additionally, it creates new jobs and opens up wider markets for farmers' products.

1.1 Impact of Budge2024-25 on the Agriculture and Allied Sector for Viksit Bharat:

The government has prioritised the agriculture sector for the development of Viksit Bharat in the Budget 2024-25. This includes efforts to increase productivity in agriculture and allied sectors through three key approaches: Intervention, Innovation, and Invention. The focus is on developing climate-resilient varieties and enhancing agriculture research and education to improve farmers income and generate employment opportunities. In the Budget 2024-25, there is a specific emphasis on creating Digital Public Infrastructure for conducting digital crop surveys for the Kharif season in 400 districts and DPI provides data-driven insights on weather, environmental parameters, finance, and marketing to change the outlook on agriculture. AgriStack, an open-source digital infrastructure, aims to advance Indian agriculture and increase farmers income by making use of data more accessible to stakeholders. Additionally, initiatives such as issuing Jan Smart Kisan Credit Cards, providing financial support for setting up Nucleus Breeding Centers in collaboration with the National Bank for Agriculture and Rural Development (NABARD), and implementing a National Cooperative Policy for establishing Farmer Producer Organizations (FPOs) are included to support the rural economy and generate employment opportunities. It is also proposed that 1 crore women of SHGs be considered as Lakhpati Didis to support the rural economy further natural farming initiative and National Innovation fund to promote entrepreneurship in agricultural credit organisations.

The Budget for 2024-25 foundation for Viksit Bharat and inclusive growth by increasing the budgetary allocation 5 times more compared to 2013-14 to empower farmers and empower the Nation.

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The Budget for 2024-25 foundation for Viksit Bharat and inclusive growth by increasing the budgetary allocation 5 times more than in 2013-14 to empower farmers and the Nation. There has been an extraordinary fivefold increase in budgetary allocation to agriculture for the welfare of farmers and the generation of employment.

Table 4: Budget Allocation for Agriculture

Year	Budget allocation in crores (Rupees)
2013-14	29,687
2024-25	1,27,469.88

Sources: Kurukshetra, September 2024

1.2 Digital Initiatives of the Government of India for Agriculture and allied sectors:

Agriculture is considered the backbone of the Indian economy. It plays a vital role in national income, output, employment generation, and foreign exchange earnings. The agricultural sector provides the livelihood for 58% of the population. The successful implementation of government initiatives is crucial for the rapid development of a productive, competitive, and sustainable agriculture industry (Acharya Balkrishna et al. (2022). [5]). It is the most crucial sector of the Indian economy, providing not only food security for the increasing population but also serving as an exporter of agricultural products. To transform the farming sector and improve agriculture productivity, modern farm practices need to be adopted, and there should be a focus on promoting the purchase of modern agricultural machinery, tools, equipment, and agricultural marketing. According to the Economy Survey 2023-24, the Indian agriculture sector provides livelihood support to about 42.3% of the population and has a share of 18.2% of the country's GDP at current prices. Furthermore, ₹19.65 thousand crore was spent on agriculture research. The food grain production for 2023-24 is 328.9 million tons, and the domestic availability of edible oil has risen from 86.30 lakh tones in 2015-16 to 121.33 lakh tones in 2023-24. The government implemented the e-NAM Scheme and as of 14th March 2024, more than 1.77 Crore farmers and 2.56 Lakh traders have been registered on the e-NAM portal. The Government of India launched a scheme in 2020 with a budget of ₹6.86 thousand crore to establish and promote 10,000 Farmer Producer Organizations (FPOs) by 2027-28. As of 29th February 2024, 8,195 FPOs have registered under the new scheme. Equity grants totalling ₹157.4 crores have been released to 3,325 FPOs, and credit guarantee cover worth ₹278.2 crores has been issued to 1,185 FPOs. Additionally, the PM Programme for Restoration, Awareness Generation, Nourishment, and Amelioration of Mother Earth (PM-PRANAM) incentivizes states to reduce chemical fertilizer usage.

Digital farming involves the integration of technology and modern techniques in agricultural practices, the Government has introduced several digital initiatives to improve yields, income, and sustainability.

Table 5: The Government of India's Digital Agriculture Initiatives

Digital Agriculture Initiatives	Highlights
Digital Agriculture Mission	Technology for improving the lives of farmers and focusing on cutting-edge technology like AI, Drones, and remote sensing to enhance productivity, efficiency, sustainability and resilient agricultural future. The scheme is built on two foundational pillars: AgriStack, and Krishi Decision Support System.
Agri Tech Startups	For innovation and revolutionising farming practices to enhance efficiency, sustainability, and profitability in agriculture.
National e-Governance Plan in Agriculture (NeGP-A)	Providing relevant information and service through ICT to stakeholders to increase productivity and rapid agriculture development. The areas are government to Farmers (G2F).
Nemo Drone Didi	This Initiative aims to the empowerment of SHGs with agriculture drones for crop monitoring, spraying fertilizer, and sowing seeds. It equips rural SHG women with technology skills to foster inclusive growth and create opportunities for sustainable development.

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National Agriculture Market (e-NAM) Mandis	India's digital wholesale platform facilitates inter-mandi and inter-state trade. It is an online trading platform for agricultural commodities and promotes a timely payment system.
Kisan Suvidha APP	It provides information to farmers on weather, market price, Seeds, Pesticides, Fertilisers, farm machinery Soil Health Cards and the latest technologies developed by the Indian Agricultural Research Institute, Veterinary Centres and Diagnostic Labs.
Pradhan Mantri Kisan Samman Nidhi (PM_KISAN)	To support income to Small and Marginal farmers through DBT in three instalments.
Open Network for Digital Commerce	To empower the farmers and eliminate the exploiting middlemen. ONDC has linked with the Farmers Producer Organisation (FPO) to provide better market access.

1.3 The digital initiative of states:

(1) Integrated Digital Farmer Services Platform of Bihar: one stop platform for all Farmers requirements.
(2) Gujarat: Solar Electricity and sustainable energy requirements for irrigation.
(3) Krishi Bhagya Scheme of Karnataka to provide irrigation drip, sprinkler facilities managed through digital technology.
(4) Government has collaborated with IBM, Cisco and Microsoft to support farmers in digital technology for agriculture.

1.4 Impact of the Digital Public Infrastructure or AgriStack on Indian Agri Startups:

The Indian Government's Startup India initiative has introduced an accelerator for Agri-Startups and Agri-business. India is a global agricultural powerhouse, known for its diverse range of crops and high production quantities. Agriculture is a vital source of livelihood for the rural population and the largest agriculture exporter in the world. The government has set up thirteen Agri-Cell in Indian embassies on a real-time basis to improve exports. The ongoing technological revolution drives sustainability in agriculture and fosters more inclusivity in agri-entrepreneurship and the allied sector. To support agritech and rural-focused startups, the Indian government has established the AgriSURE Fund (AgriFund for Startups and Rural Enterprises). This fund is provided through NABARD and SEBI registered Category II Alternative Investment Fund (AIF), offering equity and debt funding for agritech and rural-focused startups. Agritech is anticipated to reach $ 25 Billion by 2025 to leverage the emerging technologies. These measures increase the agricultural output, reduce the cost of production, and save crop loss through crop insurance and diversification. Indian Agritech startups are showcasing innovative technology to increase productivity and sustainability through various innovative technologies like App voice response-based agriculture solutions, digital marketplace, AI-based agronomy service to increase the yields, SaaS-based agritech platform to provide real-time data to improve the decision-making process of the farmers, Digital-based end-to-end agri services (B2B), warehouse services, agri waste management, AI-based grading and quality check of the agriproducts, connecting farmers and mandis, biofertilizers, biopesticides, microbial products, drone-based soil testing, procurement and marketplace to paster the Agri startup ecosystem fostering collaborations and partnership and conducive policy for enhancing resilience and sustainability (Kumar, K. et.al (2024). [6], there are nearly 2800 agri startups in India (as per startup India database as of 2020. Startups are more focused on Green Technology (GT) to increase yield, improve product quality, eco-friendly techniques, and maintain soil fertility to mitigate environmental damage and promote sustainable agricultural development. Green Technology in areas of Organic farming, Agroforestry, Integrated Pest Management (IPM), solar energy for water pumping, lighting, Biogas technology, Green Nanotechnology, Smart irrigation systems, and Drones and digital sensors.

Agristack will bring together various stakeholders in the agriculture sector, It is a core component of the DPI to streamline all farmer-related information, and the availability of farmer-related data will also facilitate fintech startups providing loans, insurance, and creditworthiness of the borrowers. No Agri Startups were promoted under Rashtriya Vikas Yojana in the area of Agri innovation and Agri entrepreneurship by providing financial and technical assistance in the form of incubation to the

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startups. Total 1708 Agri startups in various fields of agriculture & allied sectors in States and Union territories.

Table 6: No. of Agriculture Startups in Different States and UTs of India

SL No	States and UTs	Total Number of Startups
1	Andhra Pradesh	61
2	Arunachal Pradesh	13
3	Assam	49
4	Bihar	48
5	Chhattisgarh	79
6	Goa	2
7	Gujarat	47
8	Haryana,	84
9	Himachal Pradesh	33
10	Jammu & Kashmir	24
11	Jharkhand	7
12	Karnataka	211
13	Kerala	97
14	Madhya Pradesh	68
15	Maharashtra	226
16	Manipur	22
17	Meghalaya	2
18	Mizoram	25
19	Nagaland	2
20	Odisha	61
21	Punjab	52
22	Rajasthan	66
23	Tamil Nadu	137
24	Telangana,	98
25	Tripura	13
26	Uttar Pradesh	86
27	Uttarakhand	32
28	West Bengal	17
29	Delhi NCR	41
30	Andaman and Nicobar	1
31	Chandigarh	3
32	Pondicherry	1
Total Agri Startup		1708

Source: https://pib.gov.in/PressReleaseIframePage.aspx?PRID=2037658

As per the Economic Survey 2024, Indian startups have filed more than 12000 patents, and over 13000 are working on diverse areas like AI, IoT, robotics, blockchain, geographic information Systems (GIS), and nanotechnology. More startups have emerged out of Tier 2 and Tier 3 cities. As per the Inc 42 report, India's agrotech startups are looking at a total market opportunity worth $24 Billion by 2025 and the government of India has liberalized drone operations under the Drones Rules 2021 and schemes like Drone Shakti 2022 and Kisan drones across 100 locations., Agriculture Accelerator Fund are are the pathway for Indian agritech industry for future of sustainable growth and innovation in agri and allied sectors.

Agritech Startups have raised $ 2.4 Billion across 285 deals in the Seed stage, Growth Stage, and Late Stage from 2014 to February 2024.

Table 7: Funding amount and Deal Count of Agri Startups in different stages

Stage	Funding Amount ($ Million)	Deal Count
Seed Stage	146	116

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Growth Stage	912	85
Late Stage	1299	41

Source: Inc42.com

1.5 Sustainable Agriculture for Achieving Sustainable Development Goals:

Sustainable agriculture ensures food security, addresses environmental concerns, and enhances former livelihood it has four dimensions: Ecological sustainability, Social Sustainability, Economic Sustainability, and Technology Sustainability. Sustainable Agriculture focuses on meeting the current production demands without compromising on the ability of future generations to meet their needs. United Nations adopted the 2030 agenda for Sustainable development based on 5Ps Planet, People, Prosperity, Peace and Partnership. Sustainability in agriculture can contribute to food and nutrition security, resilient global food systems, and the control and maintenance of the environment with sustainable practices, including the use of renewable resources, reducing energy costs and greenhouse gas emissions, and implementing circular economy principles, through both System and practices such as Agroforesting, Natural farming, organic farming, crop rotation and Vermicomposting, The data on agriculture provides a framework for sustainable agriculture, including technological innovation to mechanize labour-intensive processes and farmers' capacity building in knowledge-intensive practices (Gupta et al. (2021) [7]). The Police recommendation relating to sustainability agriculture will enhance the SDG The National Institution for Transforming India (NITI) Aayog, India's premier organisation, plays a collaborative role in progressing and monitoring the SDGs (Priyadarshini et al.2020). [8]).

2. REVIEW OF LITERATURE :

A significant number of studies have been conducted on the Digital Public Infrastructure (DPI) about the payment ecosystem, technology in agriculture, and sustainable development. However, there has been limited focus on AgriStack's impact on inclusivity and Sustainable Development Goals. This study aims to provide insights into the AgriStack within the Digital Public Infrastructure for enhancing the productivity and income of farmers through data-driven approaches. The keywords related to this study include Digital Agriculture, AgriStack, Agriculture 4.0, Sustainable Development Goals, and Smart Agriculture Technology, Key words can be found in the abstract and the title of the research article.

Table 8: Review of literature

S. No.	Focus	Reference
1	This article explores the concept of Agristack as part of India's digital agriculture strategy. The authors discuss how Agristack integrates various digital tools, such as IoT, big data, and AI, to provide comprehensive support for farmers. It reviews the potential of Agristack in enhancing farm productivity, transparency in value chains, and accessibility to financial and market services. The study highlights the challenges, including data privacy and smallholder inclusivity, and suggests policy frameworks for smooth implementation.	Singh, P., & Kumar, A. (2022) [9]
2	This review focuses on Agristack's role in transforming Indian agriculture by creating a centralized digital infrastructure. The authors analyze how Agristack can streamline the dissemination of agricultural information, offer personalized services to farmers, and reduce inefficiencies in supply chains. They also discuss potential challenges such as farmer data ownership, digital literacy, and the need for robust regulatory mechanisms to safeguard against misuse. The review concludes with recommendations for policy adjustments to maximize Agristack's benefits while minimizing risks.	Sharma, R., & Mishra, S. (2021) [10]
3	Indian agriculture is at a turning point, facing the dual challenge of ensuring environmentally sustainable and economically viable food systems. Precision agriculture, with tools like IoT, sensors, and predictive modeling, has improved farm efficiency but is limited to	Rao, E. P. (2022) [11]

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	farming. The emerging paradigm of digital agriculture, or Agriculture 4.0, expands this concept to the entire food system using AI, big data, robotics, and satellites. While other sectors in India have embraced digital technologies, agriculture lags behind. Digital solutions can transform Indian agriculture, from crop management to value chains and finance, driving sustainability and aligning with UN Sustainable Development Goals. This shift will be define roles: farmers as managers, agronomists as data analysts, AgriTech companies as technology providers, and the government as a digital enabler.	
4	Agriculture, one of the oldest professions, has greatly benefited from science and technology, enhancing productivity, quality, and competitiveness. Mechanization, particularly in tropical regions, has boosted production by reducing labour limitations, but smallholder farmers often face challenges with access, cost, and maintenance. In India, where landholdings are small, cooperation is key to using modern machinery like combine harvesters. Supporting farmers with better access to equipment and addressing affordability through policy can increase yields and reduce post-harvest losses. Agriculture remains vital to India's economic planning, as a successful harvest supports transport, trade, manufacturing, and overall economic growth.	Bais, P., & Bahadur, P. S. (2023) [12]
5	The Indian Agriculture Ministry is developing Agristack under the India Digital Ecosystem of Agriculture (IDEA) framework to enhance farmers' income and improve agricultural efficiency using digital technologies. Pilot projects are being conducted with tech companies and Agtechs. While the initiative is promising, concerns about data privacy, solution efficacy, and private sector involvement have been raised. The document recommends maintaining transparency, engaging in a consultative process with stakeholders, and conducting third-party evaluations to ensure the ecosystem truly benefits farmers.	Beriya, A. (2022) [13]
5	The digitalization of agriculture through technologies like IoT, AI, Big Data, and Blockchain is reshaping the sector's economic, social, and environmental sustainability. In many countries, cooperatives, which dominate this traditional sector, play a key role in adopting these technologies. This paper reviews the evolution of digital technologies and outlines the digital innovation process in agri-cooperatives to aid their decision-making. A digital diagnosis tool is introduced to assess cooperatives' innovation levels, with initial applications to two Spanish cooperatives, enhancing understanding of their digital transformation in smart agriculture.	Ciruela-Lorenzo et.al (2020) [14]
6	Europe's digital development cooperation in the Indo-Pacific offers a strategic response to long-term challenges and aligns with key European Commission priorities in third countries. The region's growing influence, the societal impact of disruptive technologies, China's expanding Digital Silk Road, and the US-China tech conflict highlight the need for stronger EU engagement. The EU's 2030 Digital Compass serves as a framework for collaboration, allowing Europe to coordinate with like-minded Indo-Pacific partners to advance mutual digital development goals. Strengthening this agenda enhances Europe's role in shaping the region's digital future.	Okano-Heijmans, M., & Vosse, W. (2021) [15]
7	The COVID-19 pandemic, along with global challenges such as climate change, pollution, and environmental disasters, has strained the agricultural sector. Technological advancements offer solutions to these interconnected issues, fostering the shift from traditional to digital agriculture. This review focuses on holistic solutions through the water-energy-food nexus, driving sustainable agricultural	Dayıoğlu, M. A., & Turker, U. (2021) [16]

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	transformation. The transition is framed in stages, with Agriculture 4.0 and precision agriculture at the forefront, leveraging IoT, AI, cloud computing, and big data. Innovations like IoT-based irrigation, blockchain for agriculture, drones, and renewable energy solutions like agrivoltaics are highlighted for their role in boosting productivity, efficiency, and environmental protection.	
8	Agricultural digitization promises increased yields and environmental sustainability by reducing chemical inputs, but its role in preventing food loss and waste is less clear. Technologies like smart packaging, Blockchain, and RFID tags track food spoilage and contamination, potentially reducing waste. A systematic literature review examined digital agriculture's impact on food loss and waste through four frameworks: environmental sustainability, economic efficiency, social equity, and governance. Findings revealed high investment costs and a digital divide limit widespread adoption, with economic gains and food security, not waste prevention, being primary motivators. More rigorous investigation is needed to align digital agriculture with food waste reduction and sustainable food systems.	Benyam, A. A., Soma, T., & Fraser, E. (2021) [17]
9	Mobile phones and the internet have transformed various sectors, including agriculture. This article, based on a World Bank report, presents a framework highlighting how information and communication technologies (ICTs) enhance inclusion, improve efficiency, and drive innovation by lowering transaction costs. A review of literature on ICT impacts in rural areas of developing countries shows that digital technologies help small-scale farmers access markets, improve knowledge through new extension services, and enhance supply chain management. However, while there are positive examples of "digital dividends" improving rural livelihoods, the expected large-scale adoption has been limited due to technology addressing only some of the challenges faced by farmers in poorer regions.	Deichmann, U., Goyal, A., & Mishra, D. (2016) [18]
8	The Indian food sector faces significant wastage—about 30% of farm products—due to inefficiencies in Small and Medium Enterprises (SMEs). SMEs struggle with financial constraints, a lack of technical skills, and insufficient investment. This study identifies key factors for applying Information Communication Technology (ICT) to promote sustainable growth in the sector. Using the Grey Decision-Making Trial and Evaluation Laboratory technique, the top factors influencing ICT adoption were found to be 'Government initiatives and policies,' 'Public-private partnerships,' and 'Encouragement to ICT service providers.' ICT-driven supply chain coordination and collaboration are also crucial. The findings emphasize the central role of government policies in improving the food supply chain and encouraging investment in the sector. This study guides managers in implementing ICT solutions for sustainable SME growth.	Singh, R. K (2019) [19]
11	Public-private partnership (PPP) infrastructure projects in India face challenges in advancing sustainability goals, particularly in social and environmental aspects. This study identifies shortcomings in the Indian PPP procurement process using sustainability principles. Through a grounded theory approach, the research highlights key challenges, including inadequate environmental and social impact assessments, lack of stakeholder involvement, high costs, improper risk allocation, and conflicts between public and private sectors. The findings emphasize the need for better transparency, accountability, and sustainability knowledge. The study provides practical insights for	Agarchand, N., & Laishram, B. (2017) [20]

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	improving PPP governance, policies, and mechanisms to ensure infrastructure development aligns with sustainability goals.	
12	Ecological infrastructure (EI) refers to ecosystems that provide essential services to society, functioning as natural alternatives or complements to built infrastructure. EI is vital for socio-economic development, addressing key issues such as food security, water provision, and poverty alleviation. Using South Africa and its National Development Plan as a case study, this paper highlights the role of EI in achieving sustainable development goals. A strategic, multi-sectoral investment approach is needed to allocate resources efficiently. Opportunities for investment include private sector engagement in landscape management and incorporating EI management costs into public sectors like water and infrastructure. Investing in EI aligns with global development and climate change funding, complementing traditional development investments.	Cumming, T. L (2017) [21]
14	This paper explores the impact of 4IR (Fourth Industrial Revolution) digital technologies and circular economy thinking on achieving the United Nations Sustainable Development Goals (SDGs). The review highlights how these technological advancements have transformed industries, healthcare, education, and communication over the past few decades. Combining 4IR technologies with circular economy principles, and fostering collaboration among international organizations, governments, and other stakeholders, offers opportunities for inclusive, sustainable growth aligned with the SDGs. While challenges exist, as noted in the discussion, the integration of these strategies provides new possibilities for innovation, efficiency, and sustainability, advancing efforts to meet global goals.	Hoosain, M. S., Paul, B. S., & Ramakrishna, S. (2020) [22]

3. RESEARCH GAP :

The growing body of literature on the digital transformation of agriculture and its potential benefits, several research gaps remain. Most studies highlight the role of Agristack and digital tools like IoT, AI, and big data in enhancing productivity and sustainability in agriculture, yet there is limited empirical evidence on the real-world impact of these technologies, particularly for smallholder farmers in developing countries like India. Challenges such as data privacy, inclusivity, and digital literacy are frequently mentioned, but detailed analyses of how these issues affect technology adoption and long-term viability are scarce. Additionally, there is a lack of studies that evaluate the outcomes of pilot projects and policy frameworks under the India Digital Ecosystem of Agriculture (IDEA). Moreover, the potential for digital tools to reduce food loss and waste, beyond yield improvement, remains underexplored. Research is also needed to assess the effectiveness of public-private partnerships in addressing infrastructure gaps and driving digital adoption in rural areas. A comprehensive understanding of how digital transformation can be made more inclusive, sustainable, and aligned with SDGs is key for future research.

4. RESEARCH OBJECTIVES :

This research article is exploratory and conceptual. The objectives analyzed for the research outcome are as follows:
  (1) To know the Digital Public Infrastructure (DPI)- AgriStack in the area of agriculture.
  (2) To Analyze the different countries' DPI
  (3) To find out the Impact of DPI on Agri Startups in India.
  (4) To Provide the insight about impact of DPI and the Government of India Agri Schemes for achieving Sustainable Development Goals (SDG's)
  (5) To analyse the Approach by using the ABCD listing framework.

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5. RESEARCH METHODOLOGY:

For a comprehensive understanding of the importance of Digital Public Infrastructure or AgriStack in the field of agriculture and achieving sustainable development goals, extensive academic literature, government publications and websites, and research articles have been analyzed, and secondary data have been collected for the research.

6. ANALYSIS :

6.1 Digital Public Infrastructure and Agriculture Schemes for Inclusive and Sustainability Development:

Digital Public Infrastructure accelerates progress towards the SDGs, enabling services to be delivered and empowering them to fasten inclusive sustainable growth through digital inclusion and driving the digital economy. The agricultural ecosystem has played a vital role in achieving Sustainable Development Goals in terms of achieving net-zero emissions by 2070, empowering farmers, adopting farming technology to combat climate change, transforming food production to eradicate poverty, maximum usage of agricultural land to reduce the greenhouse gas emissions (GHG), Sustainable Farming Practices. DPI in agriculture technology enhances farmers' livelihood by allowing them to access crop loans, digital crop estimates, and data facilities, connecting the buyers and farmers' products and creating an ecosystem to execute and deliver. Transformational agriculture with technology will help achieve environmental, economic, and social sustainable development goals (Hrustek, L. (2020). [23]). Digital Public Infrastructure will create an ecosystem to execute and deliver central government schemes and various stakeholders in agriculture are Farmers, Government Agencies, Agritech companies, Financial Institutions and agriculture schemes.

The government has formatted the National Mission for Sustainable Agriculture (NMSA), National Agricultural Policy, Per Drop More Crop (PDMC) and Soil Health Cards to enhance agricultural productivity, sustainable agriculture has focused on rainfed areas with better utilisation of resources, it is ecologically sound, economically viable, socially and Human needs. United Nations has laid out a transformative roadmap for Sustainable Development Goals (SDGs), this agenda consists of 17 interconnected goals with 169 targets covering economic, social and environmental development. NITI Aayog tells the SDG India Index to measure the progress achieved by the state towards achieving the SDG. According to IUCN, UNDP & WWF.1991, "Sustainable development is a process of Improving the quality of Human life within the framework of carrying capacity of the sustainable ecosystem" (Klarin (2018). [24]). Sustainable development appeals to determined efforts towards constructing an inclusive, sustainable and resilient future for people and the planet.

The AgriStack's Digital Public Infrastructure improves data sharing within the agricultural ecosystem, leading to greater efficiency and sustainable development. It addresses human development issues, promotes the digital economy, reduces environmental impact, facilitates access to government schemes, and provides real-time information on climate change.

Digital Public Infrastructure -will provide Innovation, bring startups, expand the digital economy, Data portability and Sustainable Development Goals. Digital Public infrastructure is the well-being of the People, Plant, and Policy and provides a platform for Partnerships. Digital Public Infrastructure along with schemes provides a pathway for achieving 10 out of 17 Sustainable Development Goals (SDGs).

Table 9: Digital Public Infrastructure and Government Schemes for achieving SDGS

Goals	Sustainable Development Goals	Digital Public Infrastructure and Government Schemes for achieving SDGS
1	No Poverty to end poverty in all forms	Aadhaar-enabled Direct Benefit Transfer (DBT) empowers people to access essential public services such as public food distribution. Additionally, initiatives like the PM Kisan Scheme and Crop Science contribute to food and nutritional security. Open Credit Enablement Network (OCEN) DPI facilitates the sharing of customers credit information among banks and financial institutions to streamline and expedite loan disbursement.

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2	Zero Hunger: end hunger, achieve food security and promote sustainable agriculture.	AgriStack will improve agriculture productivity by data sharing on crop performance, climate changes, and market information for securing price and soli health. Soil health card, Paramparagat Krishi Vikas Yojana- organic farming, International Year of Millets.
3	Good Health and well Being well-being of farmers and well-being for all.	Ayushman Bharat Digital Mission (ABDM) DPI is based on an API platform for the registration of health facilities for farmers under the Pradhan Mantri Jan Arogya Yojana (AB-PMJAY).
4	Quality Education for inclusive and equitable quality education	The government has outlined 2291 crore to prepare agricultural students to use the latest technology, big data, AI and digital DPI and agricultural education, management and social science. Digital Infrastructure for Knowledge Sharing (DIKSHA) DPI FOR EDUCATION.
5	Gender Equality	LoKOS DPI is provided by the National Rural Livelihood Mission (NRLM) bookkeeping platform to self-help groups (SHGs). It offers microfinance to women-led SHGs and UPI for money transfer, reducing the gender gap in agriculture and empowering rural women with technology. Namo Drone Didi schemes for women of SHGs.
6	Clean water and Sanitation	DIGIT-Digit Digital Infrastructure for Governance Impact and Transformation-DPG provides seamless access to public and sanitation services. M-Water provides real-time data on water resources and usage. Per Drop more Crop (PDMC) for increased water efficiency at form level.
7	Affordable and Clean Energy	OPENEI Open energy information it provides data on energy consumption and accessibility of energy for all. PM KUSUM- Pradhan Mantri Kisan Urja Suraksha Even Utthaan Mahabiyan for energy security for farmers.
8 &9	Decent Work and Economic Growth Industry, Innovation and Infrastructure	ONDC Open Network for Digital Commerce, Agriculture Infrastructure Fund (AIF) and Startups are providing technology support for agriculture and providing productive employment and sustainable economic growth. PRISM-Promoting Innovations in Individuals, Startups and MSMEs for inclusive development.
13	Climate Action	Climate Action Data Trust (CAD Trust) connects the carbon market and the Indian Government to set up the National Action Plan on Climate Change.

6.2 Theoretical Background on Digital Public Infrastructure (DPI) India Stack- A foundation for Agri- Stack:

India has developed the India Stack, which comprises three crucial Digital Public Infrastructures (DPI): Unified Payment Interface (UPI), Aadhaar Unique Identity, and Data Empowerment and Protection Architecture (DEPA). These three elements of DPI are Identity, Payments, and Data Exchange. This technology fosters inclusivity and accelerates the achievement of the Sustainable Development Goals (SDGs). The DPI is the outcome of collaborative efforts by multiple teams (Raghavan, V. et al. 2019) [25]. The Government of India played a pivotal role in the design of DPI and provided valuable insights for other countries in their digital transformation endeavours to support the Sustainable Development Goals (Alonso, C et al. 2023) [26]. The "stack type" architecture is a powerful combination that benefits not only Financial Inclusion but also social protection and improved access to Governmental programs (D'Silva, D et al, 2019) [27]. "India's digital Public Infrastructure India Stack" has expanded since 2009, across multiple sectors. India's DPI is a unique model, designed and publicly controlled but privately implemented, unlike the digital infrastructure of other countries, which is largely developed by public companies (Tiwari, S et al. 2023) [28]. India has developed open digital platforms known as "India Stack" to serve billions of Indians in real-time and at low cost. These nationwide digital platforms are

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created as public goods and are used by government agencies and businesses to safely interact with people using the internet and data. (Nilekani, (2018). [29]).

The Union Budget 2024-25 announces the government's commitment to implementing the AgriStack, a Digital Public Infrastructure for Agriculture. In line with this, India's Digital Ecosystem of Agriculture (IDEA) has developed a framework for constructing an Agri-Stack to improve the overall efficiency of the agriculture sector and raise farmers' incomes (Beriya (2022). [30]). The AgriStack aims to establish an open database of farm, farmer, and crop data to encourage innovation in Indian agriculture, in partnership with a technology firm (Balkrishna et al. (2023). [31]). Additionally, various states have developed a Digital Farmer Services (DFS) platform, such as the one in Bihar, which serves as a one-stop solution to farmers needs. The DPI AgriStack platform offers farmers access to a range of services, providing data-driven insights on market prices, financing options, weather forecasting, and soil health information.

7. CASE STUDY ANALYSIS :

7.1 Case study on Digital app Developed to help fisherman:
University of Southampton, Indian Council of Agricultural Research and Central Institute of Fisheries Technology and the universities of Exeter and Newcastle have developed the app and the app will have more features for sustainable fishing. It collect real time data from fishing location, it allows GPS location of where fish is available, climate change, weather updates and communicating with fellow fishers.

7.2 Case study on AgriStack Farmer ID and Digital Crop Survey:
AgriStack implementation 19 states have signed MOU with Central Government Ministry of Agriculture and pilot project have been Conducted in six states for creation of Farmers ID and Digital Crop Survey. Creating digital identities for 11 crore farmers over three years and Digital Crop Survey nationwide within 2years, covering 400 districts in FY 2024-25.
(Sources pib.gov.in)

8. CONCEPTUAL MODEL:

8.1 THE 5C APPROACH FOR DIGITAL PUBLIC INFRASTRUCTURE (DPI) - AGRISTACK:
The **5C approach** for Digital Public Infrastructure (DPI) in **AgriStack** can be structured to strengthen agriculture through **Collaboration, Credit Flow, Crop Survey, Climate Change (via startups), and Cost Reduction**. Each of these components plays a vital role in creating a robust and efficient system for supporting farmers, agricultural ecosystems, and agritech solutions.
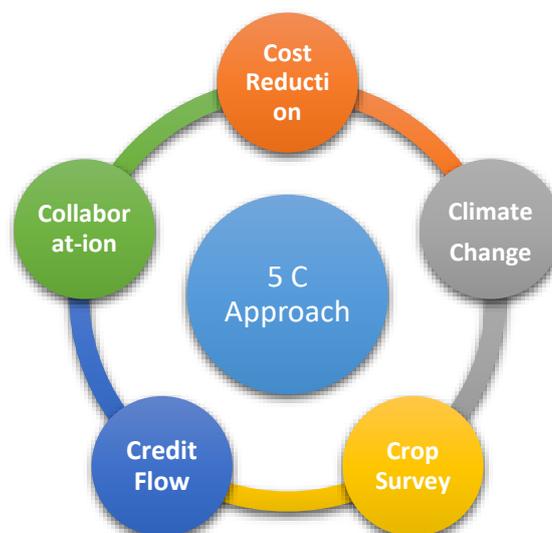

Fig. 1: 5C approach for Digital Public Infrastructure (DPI)

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Table 10: 5C APPROACH FOR DIGITAL PUBLIC INFRASTRUCTURE (DPI) -AGRISTACK

5 C's	Objective	How to Incorporate:
Collaboration	To foster a seamless exchange of data, knowledge, and resources across government bodies, private companies, farmer cooperatives, and agritech startups.	**Public-Private Partnerships (PPPs):** AgriStack should encourage collaborations between government agencies and private agritech startups to develop advanced solutions in precision agriculture, weather prediction, and soil health monitoring. **AgriData Platforms:** A centralized, open-data platform where various stakeholders can access and share agricultural data like market prices, weather conditions, soil health, and pest control measures in real time. For example, a startup working on pest control solutions can collaborate with a government extension service to rapidly distribute pest alert information to farmers. **Example: e-Choupal** (by ITC) is a successful example where digital infrastructure enabled collaboration between farmers and corporate buyers, leading to better price realization and supply chain efficiency.
Credit Flow	To ensure farmers have easy access to financial services like loans, insurance, and subsidies through a digitized, transparent credit system.	**Digital Credit Profiles:** AgriStack should facilitate the creation of digital credit profiles for farmers, using their farming history, land records, and crop yields. This can help financial institutions assess creditworthiness quickly and offer tailored loan products. **AgriFinTech Integration:** Integrating fintech platforms into AgriStack can streamline loan disbursements, insurance claims, and crop subsidies. This can ensure timely access to credit for smallholder farmers who often face delays. **Example:** The **Kisan Credit Card (KCC)**, combined with Aadhaar-based digital verification, can be integrated into AgriStack to automate credit approval processes, making loans more accessible and faster to obtain.
Crop Survey	To perform timely and accurate surveys of crop health, yields, and acreage, essential for policymaking, insurance claims, and market forecasting.	**Satellite and Drone Technology:** AgriStack should leverage satellite imagery, drones, and AI tools for regular and real-time crop monitoring. This can help detect crop diseases early, estimate yields, and ensure accurate reporting of farming data. **Ground-Level Data Collection:** Equip field officers and extension workers with mobile-based applications to collect crop data directly from the fields. Integration with IoT devices for soil and moisture sensors can further improve the precision of crop surveys. **Example:** In India, **Mahalanobis National Crop Forecast Centre (MNCFC)** uses satellite data for crop yield forecasting and can be a part of AgriStack to provide real-time crop survey information for insurance and planning purposes.

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Climate Change through Startups	To integrate climate-smart agriculture practices and innovations from startups to mitigate and adapt to climate change impacts on farming.	**Climate-Smart Agritech Solutions:** Startups focused on climate change can be integrated into AgriStack to provide innovative tools for farmers. These solutions may include precision irrigation systems, drought-resistant seed varieties, or digital advisory services on crop diversification based on climate forecasts. **Weather Prediction and Advisory Services:** Startups working in weather prediction using AI and big data can collaborate with AgriStack to provide localized weather forecasts and advisory services for farmers, helping them make informed decisions to mitigate risks associated with extreme weather events. **Example: Stellapps**, an Indian agritech startup, uses IoT to optimize dairy farming and improve resource efficiency in cattle management, which can reduce the carbon footprint in agriculture. Similarly, climate-focused startups can be encouraged to bring innovations to other farming sectors.
Cost Reduction	To lower the overall cost of farming by providing farmers with access to affordable resources, technology, and financial services.	**Subsidized Access to Technology:** AgriStack should include provisions for farmers to access subsidized agricultural machinery, seeds, fertilizers, and advisory services. This can be achieved by integrating the **Direct Benefit Transfer (DBT)** system into the platform to directly transfer subsidies to farmers accounts, reducing dependency on intermediaries. **Precision Agriculture:** Promote the use of precision agriculture techniques through AgriStack's integration with startups and technology providers. This can help reduce the overuse of fertilizers, pesticides, and water, thus lowering input costs while improving yields. **Example: DeHaan**, an agritech platform, connects farmers with input suppliers and buyers while also offering advisory services, reducing the overall cost of farming by eliminating middlemen and providing timely information on best practices.

9. ABCD ANALYSIS :

DIGITAL PUBLIC INFRASTRUCTURE –AGRISTACK FOR INCLUSIVE AND SUSTAINABLE DEVELOPMENT GOALS ANALYZED USING ABCD LISTING FRAMEWORK:

ABCD framework was used to analyse the advantages, benefits, constraints, and disadvantages (Aithal P.S et al.) [32-42] relating to the Digital public infrastructure the AgriStack for inclusive and sustainable development goals.

9.1 Advantages of Agristack:

(1) **Data-Driven Decisions:** Agristack provides farmers with real-time, data-driven insights for better crop management and resource allocation.

(2) **Access to Financial Services:** It improves access to credit, insurance, and subsidies by linking farmers data to digital financial services.

(3) **Enhanced Transparency:** Agristack fosters transparency in supply chains by tracking the production-to-market journey, reducing inefficiencies.

(4) **Personalized Advisory Services:** Farmers receive tailored recommendations on best practices for crop health, pest control, and market conditions based on their data.

(5) **Efficient Resource Use:** With precise information on weather, soil health, and water needs, Agristack helps in optimizing resource use and reducing waste.

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9.2 Benefits of Agristack:

(1) **Increased Farmer Income:** Data-enabled farming can help farmers increase yields and reduce losses, leading to higher incomes.
(2) **Sustainability:** By promoting precision agriculture, Agristack supports sustainable practices like efficient water and fertilizer use.
(3) **Inclusive Development:** Agristack's ability to reach remote farmers through mobile apps and platforms can reduce inequality in access to agricultural services.
(4) **Enhanced Food Security:** By improving productivity and reducing post-harvest losses, Agristack contributes to national food security.
(5) **Resilience to Climate Change:** With real-time weather data and predictive analytics, Agristack can help farmers adapt to climate variability and minimize risks.

9.3 Constraints of Agristack:

(1) **Digital Literacy:** Low digital literacy among farmers can limit their ability to effectively use Agristack's tools.
(2) **Data Privacy Issues:** There are concerns about the security and misuse of farmers' personal and financial data stored in the Agristack.
(3) **Infrastructural Gaps:** In rural areas with poor internet connectivity and power supply, Agristack's effectiveness is constrained.
(4) **Inclusivity:** Smallholder and marginal farmers might struggle to access Agristack due to the digital divide.
(5) **Dependence on Government:** Agristack relies heavily on government policies and interventions for successful implementation, making it vulnerable to political changes.

9.4 Disadvantages of Agristack:

(1) **Risk of Exclusion:** Small and marginal farmers without smartphones or internet access could be excluded from Agristack's benefits, widening the gap between rich and poor farmers.
(2) **Data Sovereignty Concerns:** Farmers may lose control over their data, leading to exploitation by corporations or government misuse.
(3) **Technological Dependence:** Over-reliance on technology could undermine traditional knowledge and farming methods that are better suited to local conditions.
(4) **Initial High Costs:** The implementation of digital technologies and infrastructure can be expensive, especially for smallholder farmers.
(5) **Complexity of Integration:** Integrating multiple data sources into a unified system like Agristack can be technically challenging and may face compatibility issues.

10. SUGGESTIONS/RECOMMENDATIONS :

The implementation of Digital Public Infrastructure through AgriStack has strong potential to transform Indian agriculture by making services more transparent, efficient, and farmer-centric. It is recommended that policymakers ensure inclusive digital access by improving rural connectivity and providing digital literacy programs for farmers. Data privacy and security mechanisms must be strengthened to build trust among stakeholders using AgriStack platforms. Collaboration between government agencies, agri-tech companies, and local institutions can enhance real-time decision-making and service delivery. Special attention should be given to small and marginal farmers so that technological benefits do not widen existing inequalities. Integrating climate-smart advisory services within AgriStack can support sustainable farming practices and resource conservation. Continuous monitoring and feedback systems should be introduced to evaluate the effectiveness of DPI initiatives at the grassroots level. A balanced approach combining technology, policy support, and farmer participation will help AgriStack contribute meaningfully toward inclusive growth and sustainability goals.

11. CONCLUSION :

For success of DPI - Central and State cooperation in data sharing and separate institutions in data computing under NiTi Aayoga and Digital ID to farmers to be implemented in collaboration

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Agricultural Cooperative society, Commercial Banks and Self-Help Group of Drona Didi and FPO for scalability of the project. MSP is to introduce in AgriStack for fixing the price depends upon the stock of food grains to promote more sustainability of the agriculture.

More strategic partnerships with Private software solution provider namely like TCS, Microsoft, IBM, agriculture University and district start-up for scability of the project. Allied agriculture sector more partnerships namely milk federation of states including private organisations.

Digital Public Infrastructure (DPI), exemplified by initiatives like Agristack, represents a pivotal shift in Indian agriculture towards greater inclusion and sustainable growth. Agristack aims to consolidate diverse digital tools such as IoT, AI, and big data into a comprehensive platform that supports farmers in making data-driven decisions, optimizing resource use, and improving access to financial and market services. This integration is crucial for addressing long-standing inefficiencies in agricultural value chains, improving productivity, and offering tailored services to farmers. By leveraging DPI, Agristack holds the potential to modernize the agricultural sector and empower farmers, making the entire ecosystem more responsive to their needs.

Agristack aligns closely with the Sustainable Development Goals (SDGs), particularly those related to zero hunger, responsible consumption, and climate action. By fostering precision agriculture and smart farming practices, Agristack can help optimize water usage, reduce reliance on chemical inputs, and enhance resilience to climate variability, thus contributing to sustainable agricultural practices. Furthermore, by making digital resources accessible to smallholder farmers, it supports the economic inclusion of marginalized communities, addressing the SDG of reducing inequality. The focus on creating a centralized digital infrastructure ensures transparency in value chains, enhances accountability, and supports the equitable distribution of resources and services, thus promoting social and economic sustainability. AgriStack technology innovations in issuing Farmers ID encourage the farmers to get loan from Financial institutions and it widens Financial Inclusion.

However, the successful implementation of Agristack requires overcoming challenges such as data privacy concerns, digital literacy gaps, and the digital divide between large and small-scale farmers. Ensuring that digital solutions are inclusive and effectively reach all stakeholders, especially farmers, is essential for Agristack to achieve its full potential. Strengthening regulatory frameworks, fostering public-private partnerships, and engaging in continuous consultations with stakeholders are necessary steps to address these challenges. With careful attention to these aspects, Agristack can serve as a catalyst for sustainable agricultural transformation, enabling India to progress towards its broader sustainability and development goals while ensuring that digital benefits reach all segments of the farming community.

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