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Transforming Indian Agriculture through Digital Platforms

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ABSTRACT
Agriculture remains the most vital sector of the Indian economy, and for millions of producers, it is essentially a necessity for survival. Contemporary Indian agriculture encounters a multitude of challenges, including diminished productivity, inconsistent product quality, inadequate understanding of both domestic and international markets, and restricted access to information pertaining to diversified agriculture. Farmers require location-specific information in their native tongue throughout all phases of agriculture's cultivation process. Adoption of digital technology is one solution to these issues; it improves the pace of information transmission, networking, and communication at the farmers' doorsteps, and it provides them with accurate, easily digestible data. When applied to conditions in rural areas, digital communication technologies can aid in the improvement of communication by increasing participation and disseminating a variety of information to enhance individuals' knowledge and abilities. The Objectives of the study is to know the Digital Platforms used by farmers and to analyse the effect of digital technology on the efficiency of farmers. The study concludes that there is a positive impact of digital technologies on the efficiency of farmers in agriculture.
Keywords: *ICT, eNam, Agricultural Produce Market Committee (APMC)*

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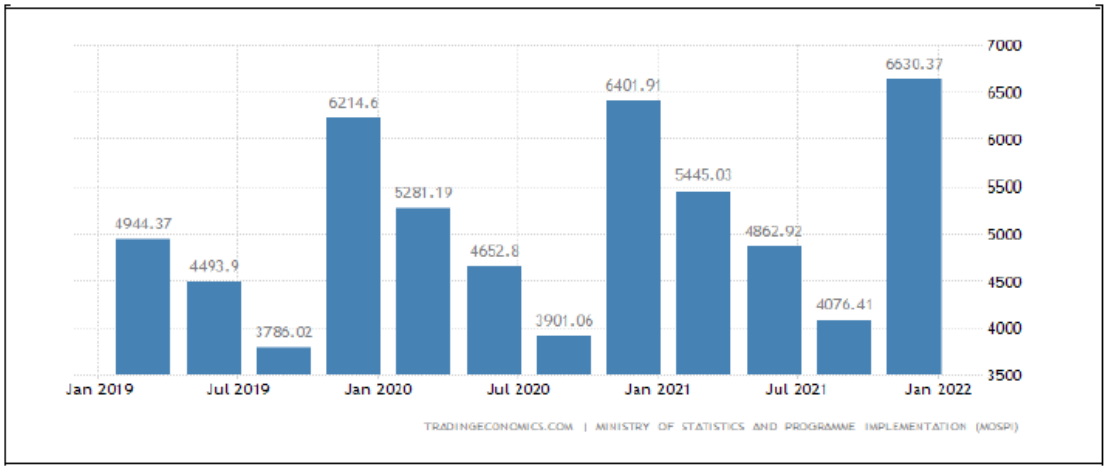
I. INTRODUCTION

Approximately 58% of India's population is employed in agriculture, making it their primary form of income. Share of agriculture and allied sectors in gross value added (GVA) of India at current prices stood at 18.3 % in FY23-24. Nowadays, more and more new advanced technologies are used for agricultural development, such as satellites, the Internet, mobile phone and social media. The use of the technologies and divides in both developed and developing nations can be used to improve agricultural information and farming methods with transformational development.

Digital agriculture holds promise for increasing productivity, consistency, and efficiency in the utilization of resources and time. This has significant positive effects on farmers as well as broader global social benefits. Digital technologies involved in e-commerce platforms, e-extension services, warehouse receipt systems, blockchain-enabled food traceability systems. It can also help governments improve the efficiency and effectiveness of existing policies and programmes, and to design better ones. For instance, freely available and high-quality satellite imagery dramatically reduces the cost of monitoring many agricultural activities. It can also support in agriculture and food products, by connecting private sector suppliers to new markets, and enabling new ways for governments to monitor and ensure compliance with standards and to provide faster and moreefficient border procedures that are essential for perishable products.

India is growing at a rapid pace, so the use of technology in the growing sectors of the country. India has been in a continuous tryst with its farming infrastructure, practices and associated communities since independence. With the sector still contributing around 14-20% to the national GDP of the country over few decades.



It is estimated that India's agriculture sector accounts only for around 14 percent of the country's economy but for 42 percent of total employment. As around 55 percent of India's arable land depends on precipitation, the amount of rainfall during the monsoon season is very important for economic activity.

Agriculture Productivity is measured as the ratio of Agriculture outputs to inputs. while individual products are usually measured by weight, which is known as crop yield, varying products make measuring overall agricultural output difficult. India has a major share in the Agricultural sector. It has a large share in the Production of food grains.

II. REVIEW OF LITERATURE

Matt Shakhovskoy (2021), "Agricultural "platforms" in a digital era: defining the landscape". To provide some light on the industry, the author of this paper examines the rise of platforms in smallholder-related farm marketplaces. Nearly two decades of scholarly and commercial study on structure models and network impacts have greatly impacted the conclusions in this paper.

In recent years, efforts to transform the sector has led to the propagation of several mobile-based applications and services. A recent digitalisation report by the Technical Centre for Agriculture and Rural Cooperation (Digitalisation of African Agriculture, 2019) revealed that 33 million smallholder farmers are currently reached by digital applications as of 2019 and this is projected to reach 200 million by 2030.

"Agricultural Statistics at a Glance 2021" In this research, G.O.I., data on several facets of Indian agriculture were analyzed. It offers an extensive database on crucial factors such as area, productivity and output of different crops in different States, land-use statistics, international trade, credit, insurance, and price support and procurement. Large farmers in India have holdings that average 17.37 hectares, whereas small and marginal farmers' holdings average only 0.38 hectares. These farmers are unable to produce enough crop farming to create jobs and revenue (Dev, 2017). About 44% of India's land is farmed by small and marginal holding farmers, who also generate more than half of the nation's fruits and vegetables as well as 60% of the nation's food grain output (49% of rice, 40% of wheat, 29% of coarse cereals, and 27% of pulses) (Agricultural census, 2014).

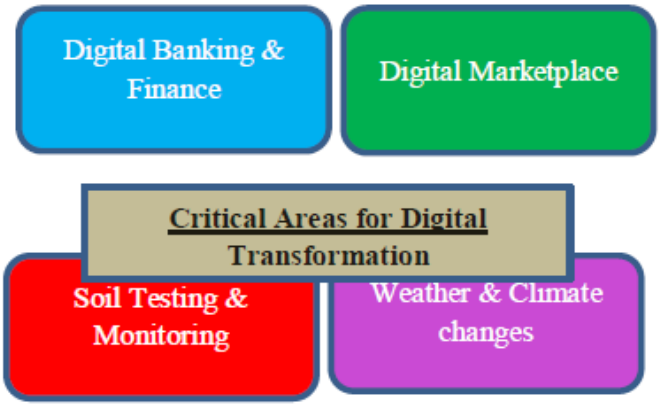
Objectives of the study

The objective of the research is to know the Digital Platforms used by farmers and to analyse the effect of digital technology on the efficiency of farmers.

Data sources and methodology:

The data used for the analysis were secondary in nature and collected from various published records from Department of Economics and Statistics, Ministry of Agriculture and farmers welfare, Agriculture report, department of IT, www.agricoop.nic.in, www.niti.gov.in ,etc. Collected data have been analysed through various statistical and econometrics tools such as absolute change, relative change, percentage method.

DIGITAL PLATFORMS FOR INDIAN AGRICULTURE



1. Digital Banking and Finance

Digital finance can play in providing a more cost-effective and secure method for financial transactions in the agricultural sector. Mobile phones in rural India have led to increased interest in mobile financial services (MFS), such as mobile money and mobile banking, such services are used toimprove agricultural finance.

(https://www.openpr.com/)

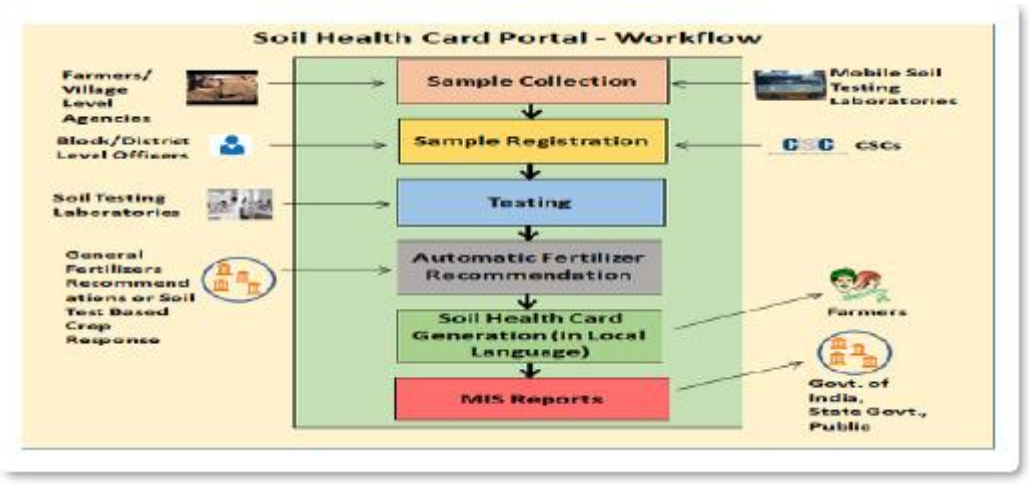
2. Digital Marketplace

National Agriculture Market (eNAM) is an electronic system that unifies the Agricultural Produce Market Committee (APMC) mandis that already exist so that agricultural commodities can be traded on a national scale. As on December 2021, 1.69 crore (17 million) farmers and 1.55 lakh (0.155 million) traders were registered on the eNAM platform. There are six types of commodities that are traded on the eNAM platform. It provides a virtual platform to farmers and traders for performing commerce and trade activities across India. The types of commodities included are food grains/cereals, oilseeds, fruits, vegetables, spices, etc. A total of 175 commodities come under these **Here are few apps for e-Marketing for agricultural produce**

3. Soil Testing & Monitoring

- **Soil Health card Portal**

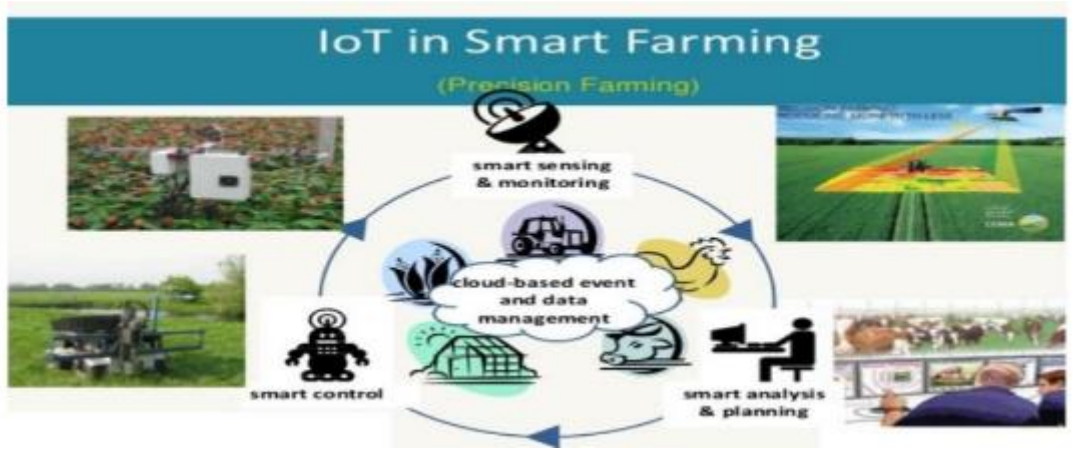
The Soil Health Card Scheme provides producers with numerous benefits. There are numerous producers in India who are unsure of which crops to cultivate in order to achieve the highest possible yield. The purpose of a Soil Health Card is to evaluate the present condition of soil health and ascertain the ways in which land management influences soil health changes. A Soil Health Card exhibits indicators of soil health along with the corresponding descriptive terms. The report will detail the condition of the soil in relation to twelve parameters: physical parameters (pH, EC, and OC), secondary nutrients (Zn, Fe, Cu, Mn, Bo), and macronutrients (N, P, and K).



(https://www.nic.in/)

- **Soil Monitoring with IoT**

Monitoring the soil using IoT sensors in that, by using the same existing soils pH rate, Temperature, water level can be monitored using the wireless sensors. It uses technology to empower farmers and producers to maximise yield, reduce disease and optimise resources. IoT sensors can measure soil temperature, NPK, volumetric water content, photosynthetic radiation, soil water potential and soil oxygen levels.



(https://www.arcweb.com)

4. Weather & Climate Changes

In its first Climate Change Action Plan (2016-2020), as well as the forthcoming update covering 2021-2025, The World Bank has made a commitment to collaborate with nations in order to implement climate-smart agriculture practices that simultaneously improve resilience, productivity, and emissions reduction. 52% of World Bank financing allocated to agriculture in 2020 was also designated for climate adaptation and mitigation.

S.No	Technology	Adaptation/mitigation potential
1.	**Water-smart**	Interventions that improve water use efficiency
a)	Rainwater Harvesting (RH)	Collection of rainwater not allowing to run-off and usefor agricultural in rainfed/dry areas and other purposes on-site
b)	Drip Irrigation (DI)	Application of water directly to the root zone of cropsand minimize water loss
c)	Laser Land Levelling (LL)	Levelling the field ensures uniform distribution of water in the field and reduces water loss (also improvesnutrient use efficiency
d)	Furrow Irrigated Bed Planting(FIBP)	This method offers more effective control overirrigation and drainage as well as rainwater management during the monsoon (also improvesnutrient use efficiency)
e)	Drainage Management (DM)	Removal of excess water (flood) through water control structure
2.	**Energy-smart**	Interventions that improve energy use efficiency
a)	Zero Tillage/Minimum Tillage(ZT/MT)	Reduces amount of energy use in land preparation. Inlong-run, it also improves water infiltration and organic matter retention into the soil.
3.	**Nutrient-smart**	Interventions that improve nutrient use efficiency.
a)	Site Specific Integrated NutrientManagement (SINM)	Optimum supply of soil nutrients over time and spacematching to the requirements of crops with right product, rate, time and place.
b)	Green Manuring (GM)	Cultivation of legumes in a cropping system. Thispractice improves nitrogen supply and soil quality.
c)	Leaf Color Chart (LCC)	Quantify the required amount of nitrogen use based on greenness of crops. Mostly used for split dose application in rice but also applicable for maize and wheat crops to detect nitrogen deficiency.
d)	Intercropping with Legumes(ICL)	Cultivation of legumes with other main crops inalternate rows or mixed. This practice improves nitrogen supply and soil quality.
4.	**Carbon-smart**	Interventions that reduce GHG emissions
a)	Agro Forestry (AF)	Promote carbon sequestration including sustainable landuse management
b)	b) Concentrate Feeding for Livestock (CF)	Reduces nutrient losses and livestock requires low amount of feed
c)	Fodder Management (FM)	Promote carbon sequestration including sustainable landuse management
d)	Integrated Pest Management (IPM)	Reduces use of chemicals
5.	**Weather- smart**	smart Interventions that provide services related toincome security and weather advisories to farmers.

a)	Climate Smart Housing for Livestock (CSH)	Protection of livestock from extreme climatic events (e.g., heat/cold stresses)
b)	Weather based Crop Agro-advisory (CA)	Climate information-based value added agro-advisoriesto the farmer
c)	Crop Insurance (CI)	Crop-specific insurance to compensate income loss due vagaries of weather
6.	**Knowledge-smart**	Use of combination of science and local knowledge
a)	Contingent Crop Planning (CC)	Climatic risk management plan to cope with majorweather-related contingencies like drought, flood, heat/cold stresses during the crop season
b)	Improved Crop Varieties (ICV)	Crop varieties that are tolerant to drought, flood andheat/cold stresses
c)	Seed and Fodder Banks (SFB)	Conservation of seeds of crops and fodders to manage climatic risks

(Source: Adopted from Khatri-Chhetri, et al.,2017)

Some other Digital Platforms

There is a growing integration of digital technologies into the agricultural value chain, and producers are becoming more knowledgeable due to the implementation of diverse strategies that ensure convenient access to technology and data. The following technologies are elaborated upon:

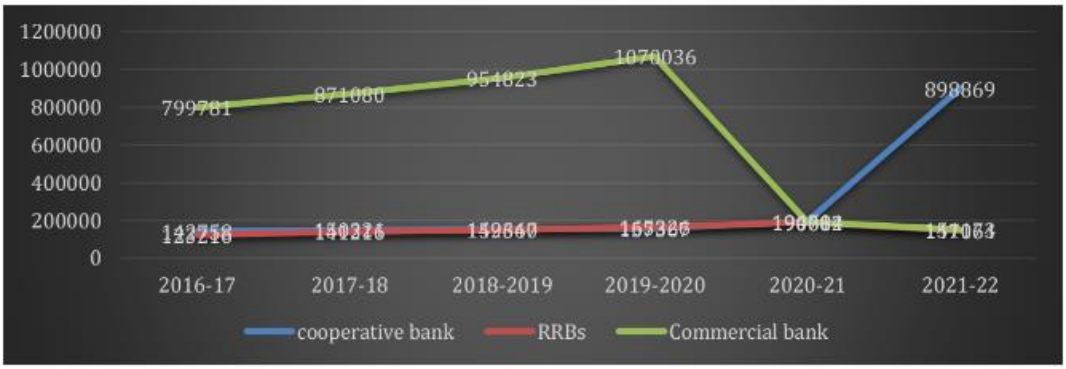
1. **Remote sensing in Agriculture**: By detecting the solar radiation that reflect from objects on the ground, visible, near-infrared, and short-wave infrared sensors were initially employed in remote sensing to generate images of the earth's surface. Additionally, the ability to detect and identify thermal signatures of farmed crops and animals has progressed. In a similar fashion, ocean temperature maps are employed to illustrate chlorophyll distribution and upwelling in order to identify productive zones along the coast, and side-looking airborne radar is utilized to detect shoals of surface-swimming fish, among other applications.
2. **Agricultural Biotechnology**: A lot of crop yield gets wasted due to pests and plant diseases. Although agrochemicals are utilized in fields, they are not the best solution when it comes to sustainability. It improves the quality of crops and livestock. Scientific techniques like plant breeding, hybridization, genetic engineering, and tissue culture facilitate the identification of better traits in plants more rapidly. CRISPR-Cas9 is a genome editing technology that allows high target specificity with improved speed and precision.
3. **Geographical information system (GIS):** GIS is a special platform that enables working with different data linked to a geographically mapped place or area on Earth. Typically, it is a collection of computer tools. These days, sophisticated technology for computers can facilitate quick computer analysis and query-based information providing for usage at individual farms as well as across huge regions. gathering information on agricultural acreage, yield, illness, and health, as well as keeping a geodatabase of farmers.
4. **Drones in agriculture:** Drone surveillance and remote interventions based on image analysis and connected sensors communicating data with the drone, aimed at providing more frequent, cost-effective remote monitoring of large areas and enabling remote interventions to boost yield and reduce losses from pests as well as optimizing deployment costs.
5. **Artificial Intelligence:** Automation is elevated to a higher level with the incorporation of analysis and learning based on historical and current data by Artificial Intelligence (AI). Additionally, it expands the potential for automation to encompass decision making processes, which involve interpreting the integration of diverse and numerous pieces of information in order to achieve a desired set of results, which may be variable in nature. Decision making is facilitated by AI via digital and machine learning processes.
6. **Autonomous- farming machinery:** Self-operated machinery and robots able to perform targeted interventions based on connected- sensor data, GPS data, and machinery analysis, aimed at optimizing resource usage, reducing labour requirements, and boosting yield through more precise and individualized interventions.
7. **The Jio Agri (JioKrishi):** Platform was introduced in February 2020, gives farmers more authority by digitizing the agricultural ecosystem throughout the whole value chain. The platform's advanced functions use data from several sources, feed the data into AI/ML algorithms, and deliver accurate, personalized advise. The platform's main function employs stand-alone application data to provide recommendations.
8. **Direct Benefit Transfer (DBT) Central Agri Portal:** - The DBT Agri platform, which was introduced in January 2013, is a single, national platform for agricultural programs. The portal provides government subsidies to assist farmers in purchasing modern farm equipment.

TO ANALYSE THE EFFECT OF DIGITAL TECHNOLOGY ON THE EFFICIENCY OF THE FARMERS

1. Digital Banking and finance: The survey revealed the behavioural traits, apprehensions and openness of customers in using different financial products and services. For instance, 19 percent of those surveyed revealed that they feared losing money in transactions, and 43 percent were more open to using mobile money

for recharging services or paying bills.

Flow of Institutional credit to Agriculture sector



State-wise National Agricultural Insurance scheme (NAIS) Cumulative upto Rabi 2015-2016

S.No	States/UTs	Numbers of farmers benefitted (in lakh)	S.No	States/UTs	Numbers of farmers benefitted (in lakh)
51.	Andhra Pradesh	7,030,691	16.	Manipur	29,932
2.	A & N Island	1,102	17.	Meghalaya	3,600
3.	Assam	66,123	18.	Mizoram	119
4.	Bihar	4,559,247	19.	Odisha	4,408,909
5.	Chhattisgarh	2,389,516	20.	Puducherry	7,269
6.	Goa	702	21.	Rajasthan	5,200,566
7.	Gujarat	5,500,924	22.	Sikkim	86
8.	Haryana	129,424	23.	Tamil Nadu	3,260,202
9.	Himachal Pradesh	114,714	24.	Telangana	539,401
10.	Jammu & Kashmir	4,492	25.	Tripura	3,450
11.	Jharkhand	2,582,643	26.	Uttar Pradesh	4,517,617
12.	Karnataka	6,100,272	27.	Uttarakhand	119,370
13.	Kerela	85,472	28.	West Bengal	3,594,384
14.	Madhya Pradesh	9,988,946		**Total**	**85,051,682**
15.	**Maharashtra**	**24,812,509**			

(Source: Department of Agriculture & Farmers Welfare)

2. Digital Marketplace: The National Agriculture Market platform is currently present in 18 states and three union territories in India. In total, a 1,000 mandis are covered in the National Agriculture Market platform, as per a report by CCS National Institute of Agricultural Marketing.

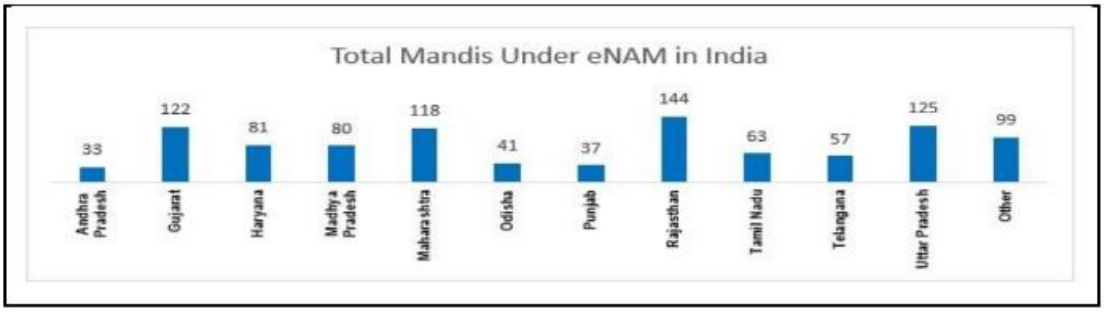
e-NAM coverage as on 30th November, 2020

S.No	States	Integrated mandis	S.No	States	Integratedmandis
1.	Andhra Pradesh	33	13.	Rajasthan	144
2.	Chhattisgarh	14	14.	Tamil Nadu	63
3.	Gujarat	122	15.	Telangana	57
4.	Haryana	81	16.	Uttar Pradesh	125
5.	Himachal Pradesh	19	17.	Uttarakhand	16
6.	Jharkhand	19	18.	West Bengal	18
7.	Karnataka	2			
8.	Kerala	6		**Union Territory (UT)**	
9.	Madhya Pradesh	80	1.	Chandigarh	1

10.	Maharashtra	118	2.	J&K	2
11.	Odisha	41	3.	Puducherry	2
12.	Punjab	37		**Total**	**1000**

(Source: Department of Agriculture & Farmers Welfare)

The state and UT-wise number of mandis covered are shown in the following chart:



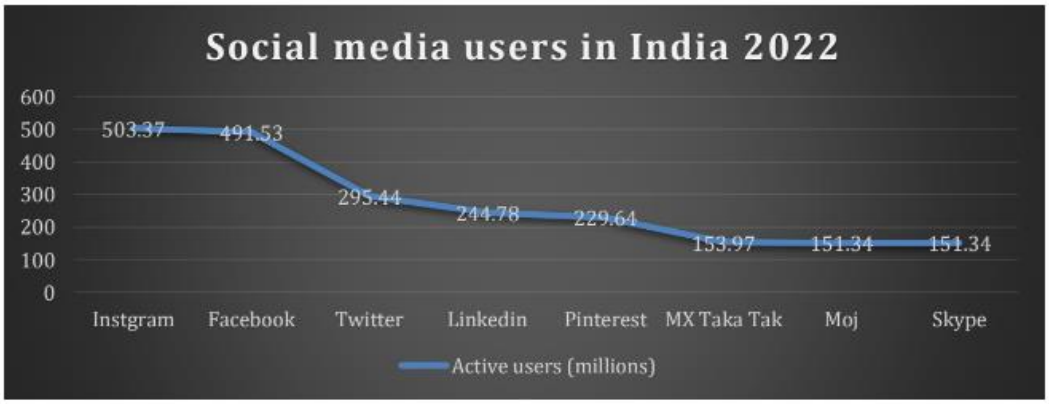
(Source: https://www.enam.gov.in)

Most Used Social Media Platforms in India 2022

The Government of India have been implementing various programs and schemes to connect rural areas with social media by giving them adequate training and awareness. In India, the number of social media users in 2020 are nearly three times higher than 2015 (Sandhya Keelery, 2020). The major reason for this growth is the evolution of the smartphones over the period. Smart phone usage in India has continuously increased over year and is estimated to reach 448 million by 2023 (Shangliao Sun, 2021).

S.no	Platform	Percentage	Active users (in millions)
1.	Instagram	76.50%	503.37
2.	Facebook	74.70%	491.53
3.	Twitter	44.90%	295.44
4.	LinkedIn	37.20%	244.78
5.	Pinterest	34.90%	229.64
6.	MX TakaTak	23.40%	153.97
7.	Moj	23.00%	151.34
8.	Skype	23.00%	151.34

(Source: www.statista.com)



3. Soil Testing & Monitoring:

S.No.	State/UTs	Target for Soil SamplesCollection, Testing & Distribution of SHCs during 2019-20	No. of SoilSamples Collected (2019-20)	No. of Soil Samples Tested (2019-20)	No. of SHCs Distributed (2019-20)
1.	Andaman &Nicobar	1007	1007	1007	1007
2.	Andhra Pradesh	225970	226487	226487	226487
3.	Arunachal Pradesh	5432	225	225	225
4.	Assam	69457	62000	58500	58500
5.	Bihar	154814	122119	122119	122119
6.	Chhattisgarh	59302	59302	59302	59302
7.	Goa	2900	2360	1950	1950
8.	Gujarat	63591	63591	63591	63591
9.	Haryana	25235	25235	25235	25235
10	Himachal Pradesh	18725	19671	19671	19671
11.	Jammu & Kashmir and Ladak	70246	70246	70246	70246
12.	Jharkhand	58572	58572	58572	58572
13.	Karnataka	65034	65034	65034	65034
14.	Kerala	167200	59000	0	0
15.	Madhya Pradesh	144507	127585	127585	127585
16.	Maharashtra	201837	201837	201837	201837
17.	Manipur	10010	10010	10010	10010
18.	Meghalaya	3243	3243	3243	3243
19.	Mizoram	2119	2119	2119	2119
20.	Nagaland	27304	27304	27304	27304
21.	Odisha	162405	162405	99567	94190
22.	Puducherry	2504	2508	2508	2508
23.	Punjab	17793	17793	17793	17793
24.	Rajasthan	86341	86341	86341	104774
25.	Sikkim	2936	2936	2936	2936
26.	Tamil Nadu	58317	58317	58317	58317
27.	Telangana	110664	110664	110664	110664
28.	Tripura	15602	15602	15602	15602
29.	Uttar Pradesh	255517	255517	255517	255517
30.	Uttarakhand	13605	13645	13645	13645
31.	West Bengal	143265	58259	4520	0
	Total	**2245454**	**1990934**	**1811447**	**1819983**

(Source: Department of Agriculture & Farmers Welfare)

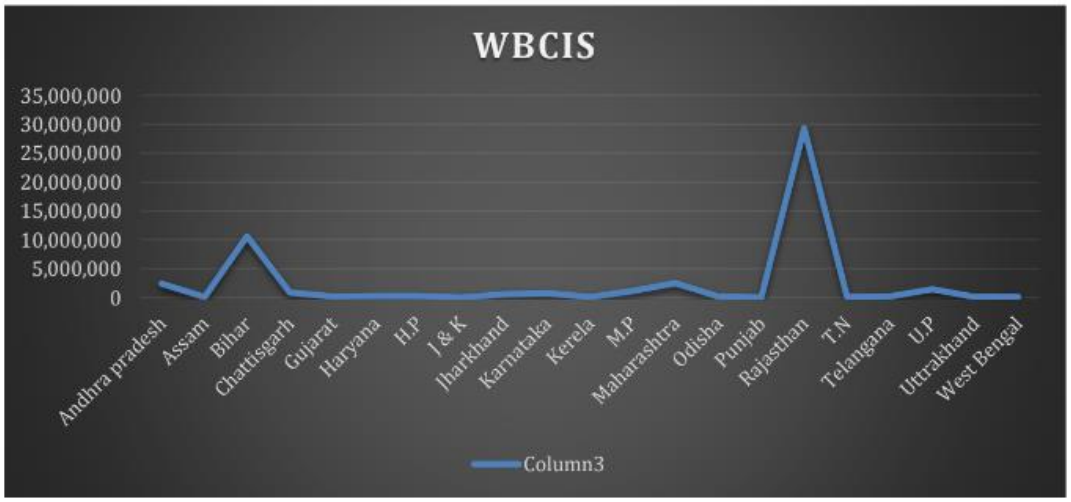
4. Weather & Climate changes

State-wise Weather based crop Insurance Scheme (WBCIS)- Cumulative upto Rabi 2015-16benefitted by farmers (in lakh)

S. No	States/UTs	Numbers of farmers benefitted (in lakh)	S.No	States/UTs	Numbers of farmers benefitted (in lakh)
1.	Andhra Pradesh	2387860	12.	Madhya Pradesh	1152948
2.	Assam	46988	13.	Maharashtra	2546866
3.	Bihar	10634599	14.	Odisha	215814
4.	Chhattisgarh	842974	15.	Punjab	-

5.	Gujarat	170576	16.	Rajasthan	29319448
6.	Haryana	249853	17.	Tamil Nadu	72798
7.	Himachal Pradesh	275904	18.	Telangana	157734
8.	Jammu & Kashmir	1364	19.	Uttar Pradesh	1394020
9.	Jharkhand	526610	20.	Uttarakhand	116083
10.	Karnataka	792321	21.	West Bengal	71012
11.	Kerela	128575		**Total**	**51104347**

(Source: Department of Agriculture & Farmers Welfare)



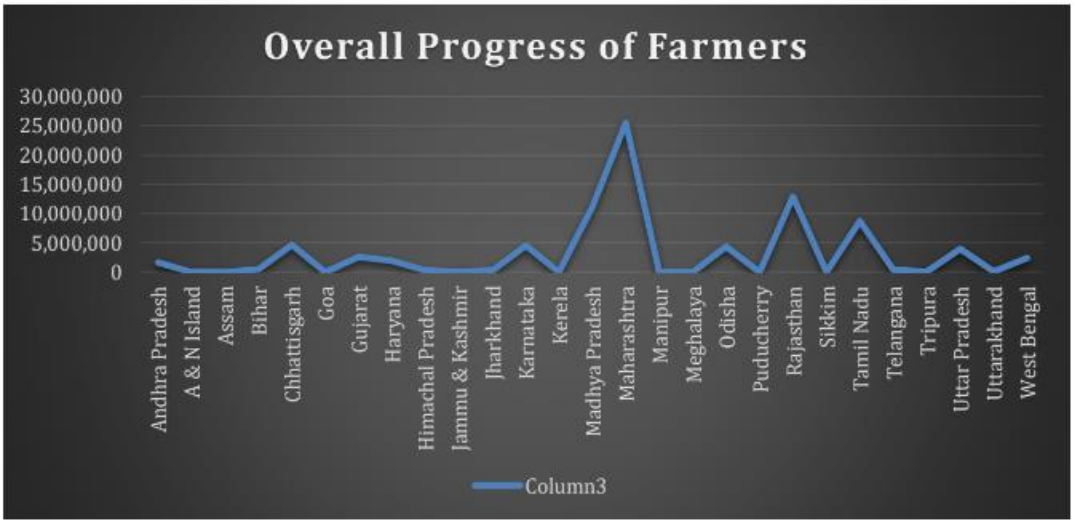
OVERALL EFFICIENCY OF THE FARMERS

State-wise Progress under Pradhan Mantri Fasal Bima Yojana (PMFBY)- Cumulativeupto Rabi 2020-21

S.No	States/ UTs	No. of farmers Applicants Benefitted (in lakh)
1.	Andhra Pradesh	1,631,095
2.	A & N Island	314
3.	Assam	10,556
4.	Bihar	434,462
5.	Chhattisgarh	4,658,704
6.	Goa	658
7.	Gujarat	2,554,905
8.	Haryana	1,934,826
9.	Himachal Pradesh	288,876
10.	Jammu & Kashmir	48,097
11.	Jharkhand	303,901
12.	Karnataka	4,560,846
13.	Kerela	25,018
14.	Madhya Pradesh	11,094,957
15.	Maharashtra	25,538,909
16.	Manipur	15,164
17.	Meghalaya	953
18.	Odisha	4,383,510
19.	Puducherry	14,295
20.	Rajasthan	12,913,209
21.	Sikkim	295
22.	Tamil Nadu	8,680,945
23.	Telangana	407,285

24.	Tripura	43,972
25.	Uttar Pradesh	3,946,981
26.	Uttarakhand	120,265
27.	West Bengal	2,447,064
	Total	**86,060,062**

(Source: Department of Agriculture & Farmers Welfare)



III. CONCLUSION

Agriculture is one of the indispensable sectors in our country. As the Government of India is pushing more towards digitalization, having electronic modes and platforms will help the country reach its digitally empowered India goal. Although, the actual trade takes place through mandis, having a digital platform reduces the cost of transformation and improves knowledge and awareness of real- time prices of the commodities. Moreover, by removing middlemen, farmers and traders can directly receive payments. Since agriculture is one of the most important sectors in the Indian economy, contributing to about 18.8% of the country's Gross value Added (GVA), betterment in operations and consolidating the markets in the form of eNAM will boost trade in the agriculture sector and facilitate farmers for smooth marketing of their produce across India. Climate change majorly affects the poor and marginal farmers who make their livelihoods from agriculture. Technology and smart practices can help mitigate risks caused by climate change, among others. India is constantly making efforts to formulate and implement policies to make agriculture more sustainable. AI has the potential to completely revolutionise the existing trends in agriculture and farming.

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