Trends and Challenges of Agriculture Marketing in India

Dinesh Gehlot[1*], Chirag Singh[2]

Department of Economics, Chaudhary Charan Singh University, Meerut, Uttar Pradesh, India -250004
*Corresponding Author

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Abstract— *A sizable section of the population makes their living from agriculture, which is the foundation of the Indian economy. One of the main challenges facing the sector is marketing agricultural products, though. This research paper aims to address and comprehensively examine the numerous issues pertaining to agriculture marketing in India and its states. This study used secondary data from a number of sources, including the India state database, the Ministry of Statistics and Programme Implementation, the Government of India and the Ministry of Agriculture and Farmers Welfare, the Government of India. The Agricultural Produce Market Committee (APMC) Act and e-NAM (National Agriculture Market), two recent government policies and regulations aimed at reforming agriculture marketing, are also reviewed in this research paper. This research paper evaluates their efficiency in resolving the noted problems and makes recommendations for possible areas of development. The issues surrounding the marketing of agriculture in India and its states are thoroughly examined in this research paper. The main issues are highlighted, along with how they differ in different places and possible fixes. India's agricultural sector can become more resilient, effective, and profitable by addressing these problems, which will ultimately improve the lives of millions of farmers and support the country's economic expansion. India's agricultural market is evolving quickly, with different viewpoints emerging at the state and india levels. Enhancing farmers' livelihoods, implementing sustainable practices, and embracing technological innovations are the main priorities.*

JEL Classification: Q130, M31, M48, O3.

Keywords: Agriculture marketing, farmers, agricultural market, innovations, sustainable.

I. INTRODUCTION

Over time, India's agricultural sector has undergone a remarkable transformation, evolving from a largely subsistence-based industry into a vibrant and increasingly market-driven one. The past two years have seen brisk growth in the agriculture sector (Economic Survey, 2022-23). This sector, which employs the largest portion of the population, contributed a significant 18.8% to the country's Gross Value Added (GVA) in 2021–2022, with growth rates of 3.6% in 2020–2021 and 3.9% in 2021–2022 (Ramaswamy, 2022). A number of interrelated factors, such as shifting consumer preferences, technological advancements, policy changes, and globalisation, have driven this transformation in India's agricultural landscape. In addition to significantly impacting the livelihoods of millions, India's evolving agricultural market has positioned the country as a key player in the global agricultural market. Traditionally, Indian agriculture was characterised by small landholdings, antiquated farming methods, and a heavy reliance on monsoons. With a substantial portion of the population engaged in subsistence farming, food security was the primary concern. However, recent years have witnessed a noticeable shift towards a more market-oriented approach.

The growing understanding of agriculture as an essential part of the Indian economy has been one of the major forces behind this shift in perspective. It makes a sizable contribution to the GDP and job creation of the nation (Ministry of Agriculture and Farmers Welfare, 2022). A reevaluation of agriculture's place in the national development agenda has resulted from the realization that it can be a source of both prosperity and sustenance (Mukherjee, 2021). The agricultural landscape has changed significantly as a result of technological advancements and the adoption of modern agriculture (Singh & Pal, 2020; World Bank, 2021).

Agriculture market in India and the number of farmers using it: Agriculture plays a significant role in India's economy, contributing approximately 16–17% of the nation's Gross Domestic Product (GDP) (Ministry of Finance, 2022). Over half of

India's population relies on agriculture for their livelihood, making it the largest employer in the country. In fact, 58% of the labour force is employed in agriculture and related industries (National Sample Survey Office, 2021).

India's agricultural market is crucial for ensuring food security, producing essential crops like wheat and rice that form the backbone of the nation's food supply. The government purchases grains from farmers to distribute through the Public Distribution System (PDS) and other welfare programs, ensuring food accessibility across the country (Food Corporation of India, 2022). For millions of farmers nationwide, the agriculture market serves as their primary source of income, with the prices they receive for their produce significantly impacting their livelihoods. The National Agricultural Market (e-NAM) initiative aims to provide farmers with better access to markets. By offering a unified electronic trading platform, e-NAM enables farmers to sell their produce across different markets and states, reducing the reliance on middlemen and ensuring better prices (Ministry of Agriculture and Farmers Welfare, 2022).

Moreover, India is a major exporter of various agricultural products, including rice, wheat, spices, and cotton, contributing significantly to the global agricultural market. These exports not only increase foreign exchange revenue but also provide farmers with additional income (Export-Import Bank of India, 2021).

By September 2021, over 1,000 wholesale markets (mandis) across 18 states and union territories had adopted the e-NAM platform, drawing increasing attention from farmers and traders alike (Ministry of Agriculture and Farmers Welfare, 2021). Millions of farmers were already selling their produce on the e-NAM platform, reflecting its growing influence. However, many small and marginal farmers in remote and rural areas continue to rely on traditional local markets or intermediaries to sell their produce, despite the expanded access to formal markets provided by programs like e-NAM (Kumar & Joshi, 2022). The extent of participation in formal agricultural markets varies significantly across different geographic regions.

The adoption of formal agricultural markets varies widely among Indian states and regions, with farmers in areas with well-developed agricultural infrastructure and market connectivity more likely to participate in these markets (National Sample Survey Office, 2021; Singh & Gupta, 2020). Several factors, including government regulations, technological advancements, and shifts in market dynamics, can influence the degree to which farmers utilize formal agricultural markets over time (Sharma, 2021). Although there are ongoing initiatives to increase farmers' access to formal markets, the widespread adoption of such markets may take time (World Bank, 2021).

1.1 Marketing Infrastructure

Farmers are frequently unable to obtain accurate market prices across various markets, leading them to accept whatever prices traders offer (Niti Aayog, 2021). To address this issue, the government regularly broadcasts market prices on radio and television, and newspapers also inform farmers about the latest price changes (Ministry of Information and Broadcasting, 2021). Despite these efforts, many poor Indian farmers sell their produce immediately after harvest, even though prices are typically very low at that time (Sharma & Gupta, 2022).

The extensive network of middlemen in the agricultural market has significantly reduced the proportion of profits that farmers receive (Kumar, 2020). India's transport infrastructure is severely lacking, with only a few villages connected to mandis by railways or paved roads. As a result, produce often has to be transported using cumbersome conveyances like bullock carts. This type of transportation is impractical for long distances, forcing farmers to sell their harvests in nearby markets, even if the prices are extremely low (World Bank, 2021). This issue is particularly problematic for perishable goods, which cannot be stored for long periods (Singh & Verma, 2021).

1.2 Problems in agriculture marketing:

The majority of farmers today are struggling financially and are unable to afford high-quality pesticides and seeds from High Yielding Varieties (HYVs), which results in poor productivity (P. Lalita et al., 2020). The situation is exacerbated by the fact that markets often sell goods at very low prices or prices continue to decline. Market middlemen also take a significant portion of the farmers' output without adding value, further diminishing farmers' incomes and forcing them to borrow money from these intermediaries while selling their produce at reduced prices (P. Lalita et al., 2020).

In many villages, farmers lack access to proper storage or warehousing facilities. Due to inadequate storage options, 15 to 30 percent of agricultural produce is destroyed annually by pests or weather conditions (Nalange et al., 2019). Consequently, farmers are often compelled to sell their excess produce immediately after harvest at very low prices, which are unprofitable. Extreme poverty and limited access to appropriate credit facilities prevent most Indian farmers from waiting for better prices

(K. Manoj, 2018). This leads them to sell their produce under distress to local moneylenders and traders at significantly reduced prices (K. Manoj, 2018).

The current agricultural marketing system lacks sufficient storage facilities. The absence of proper storage means farmers must sell their products at low prices, as they cannot store them safely until market conditions improve. Inadequate and unscientific storage facilities contribute to substantial grain wastage, with pests causing about 20% to 30% of grains to be lost, costing farmers millions of dollars annually (Nalange et al., 2019).

The literature about the agricultural sector and its role in economic development are widely available. We have review them below

Prabhakara B.N. (2014), examines that the focus on market failure paved the way for market-driven liberalisation aimed at achieving "prices and institutions right." State-run marketing boards and producer marketing chains, which span from credit unions to farmer cooperatives to wholesale cooperatives, have emerged as a result. The state must devote all of its resources to bolstering the competitive marketing system before the producer can have access to market prices that are competitive.

Royce (2004), try to assess and explain that cooperative management authority is still limited because state agencies are still the primary suppliers of input and buyers of output. On-farm decision-making and member participation are significantly higher.

Ramkishen (2004) in his research paper, contended that the grower loses out on a good price for his produce during the peak marketing season due to inadequate food processing and storage, while consumers unnecessarily pay a higher price during the lean season.

Rajendran and Karthikesan (2014) conducted a study which revealed that small-scale farmers must be integrated into the market and educated about concepts such as supply and demand, which are fundamental to the economy, to prevent them from being excluded from the advantages of agricultural produce.

Thomas Sunny (2011) in his work “Growth and Composition of Indian Agriculture Exports during Reform Era," explains that the majority of countries rely heavily on Indian agricultural products for marketing, as they present significant opportunities. India's agricultural sector has grown significantly. The contribution of agriculture-related exports to the country's net exports had decreased significantly.

M. Vikram Kumar, Dr. P. Chenchu Reddy and A. M. Mahaboob Basha (2014), discusses the challenges faced by farmers in marketing their agricultural products in India. The paper highlights the importance of developing effective marketing strategies and information systems to help farmers sell their products at better prices. The authors suggest that the government should play a more active role in developing unique marketing strategies for the agricultural sector in India.

M. Selvaraj & M. Syed Ibrahim (2012) gives a thorough analysis of India's agriculture marketing situation as of right now. It covers a range of topics and difficulties facing the business, looks at how technology is affecting it, and offers case studies of creative marketing techniques in action. The report emphasises the significance of effective backward and forward integration with agriculture, which has produced production systems that are cost- and quality-competitive on a worldwide scale.

M. Shanmukh Raju, M. Rama Devy and P. V. Sathya Gopal (2022) A study in Andhra Pradesh assessed the knowledge of e-NAM registered farmers about the electronic trading portal. Most farmers were aware of registration and quality assaying fees and the ability to accept or reject bids. However, their overall knowledge level was moderate. Factors like education, extension contact, market orientation, income orientation, mass media exposure, risk orientation, and social participation were related to knowledge scores, collectively explaining about 59.90% of the variation. The study recommends providing training to enhance farmers' utilization of e-NAM.

Jaiprakash Bisena and Ranjit Kumar (2018) The paper reviews developments in Indian agricultural marketing with a focus on addressing challenges in implementing e-NAM, aiming to double farmers' income and reduce poverty in line with SDGs. The study identifies challenges in e-NAM implementation related to Infrastructure, Institution, and Information (3 I's) and recommends strengthening the supply chain with public-private interventions. It also suggests amending state APMC Acts to support e-tendering and raising awareness among farmers about the benefits of e-NAM.

Rakesh Rathore and Shubhaom Panda (2019) paper explain Agricultural marketing is of utmost importance to India's economy, providing employment for 65% of the workforce. This field encompasses primary, secondary, and terminal market functions. The paper delves into government initiatives and the growing demand for food products. Regulatory measures under the

Agricultural Produce Market Committee (APMC) Act promote both market regulation and contract farming. The electronic National Agriculture Market (e-NAM) is a significant force behind market modernization and integration.

The primary objective of this study is to identify the perception and present situation of agriculture marketing system in India and outline the issues in agriculture marketing in India, the another objective is to measures for improvement in agriculture marketing in India and participation of farmers in e-NEM.

II. RESEARCH METHODOLOGY

2.1 Source of Data:

Secondary Source of data has been used in the present research paper. The data used for the research has been extracted from reports generated from official website of Agricultural Markets and other published sources. This study carried based on secondary data such as books, journals and periodicals etc. For fulfilment of objectives, the researcher had a review of various published papers to assess and explore the contribution and implications of Agricultural Marketing on Indian economy. The basic Statistical tools and descriptive analysis is used in the research paper to define the objective of research.

The Compound annual Growth Rate (CAGR) of state-wise value of output of Indian economy has been estimated by using an extensively accepted exponential model, $y = ab^t e^u$. The Compound annual Growth Rate (CAGR) is usually estimated by using the following semi-log functional form:

$$\ln(y) = \ln(a) + t\ln(b) + u \quad (1)$$

Where, y represents dependent variable whose growth rate is to be estimated; t represents independent variable (time) and u represents disturbance or error term. Moreover, 'a' and 'b' are the parameters to be estimated. The CAGR in per cent term is estimated as:

$$CAGR = \{Antilog(b) - 1\} * 100 \quad (2)$$

III. RESULT ANALYSIS AND DISCUSSION

Agri-tech solutions, e-commerce, and digital platforms are becoming more and more prominent in Indian agriculture marketing. These trends provide market access and efficiency, but they also present certain obstacles, such as the need for policy support, infrastructure gaps, and digital literacy. For the agricultural marketing landscape to undergo a long-lasting and inclusive transformation, these gaps must be closed.

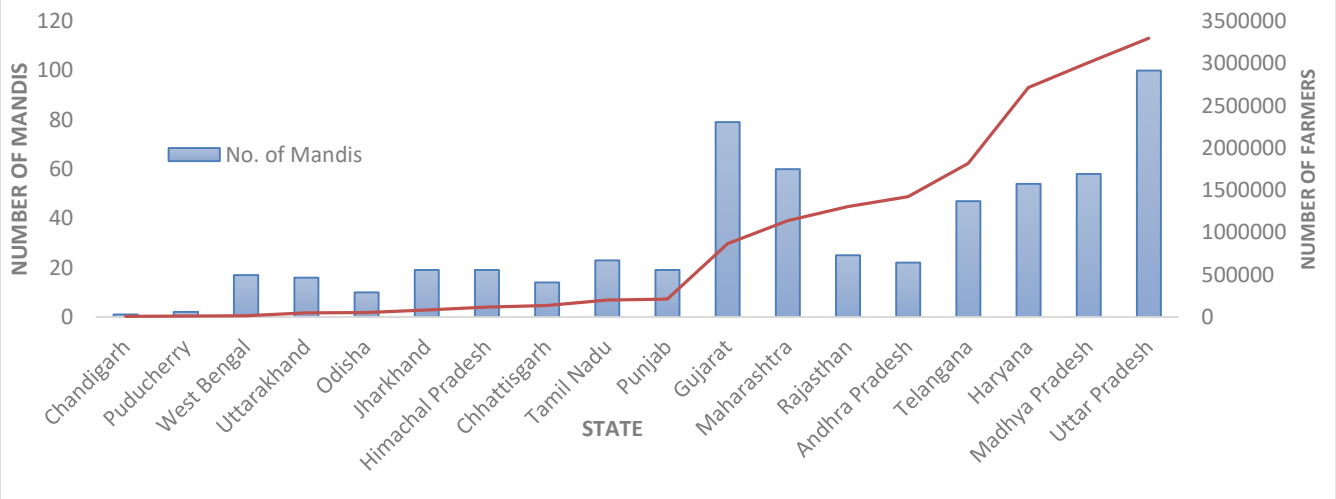

FIGURE 1; Selected State-wise Number of Mandis Integrated and Farmers Registered under National Agriculture Market (e-NAM) in India (As on 31.10.2019)

Source: Author's calculation based on database of Ministry of Agriculture & Farmers Welfare, Govt. of India.

The figure 1 presented in this study as shown in Figure 1 illustrates the integration of mandis (marketplaces) and the registration of farmers, under the National Agriculture Market (e NAM) in selected states of India up until October 31, 2019. The figure presents a bar chart with the x axis representing the states and the y axis representing the count of mandis and registered farmers. The bars colored in blue indicate the number of mandis while the orange bars represent the count of farmers registered

under e NAM. According to the figure Uttar Pradesh stands out as having the number of mandis under e NAM followed by Gujarat and Maharashtra. On the contrary Chandigarh has recorded a number of integrated mandis. In terms of farmer registrations under e NAM Uttar Pradesh again leads with a number, followed by Madhya Pradesh and Haryana. Conversely Chandigarh has reported fewer farmers being registered under e NAM. Overall this figure emphasizes how e NAM has made progress in integrating mandis and farmers across states in India. However it also indicates that there is still room, for increasing both integration and farmer registrations under e NAM particularly in states that currently have lower levels of integration.

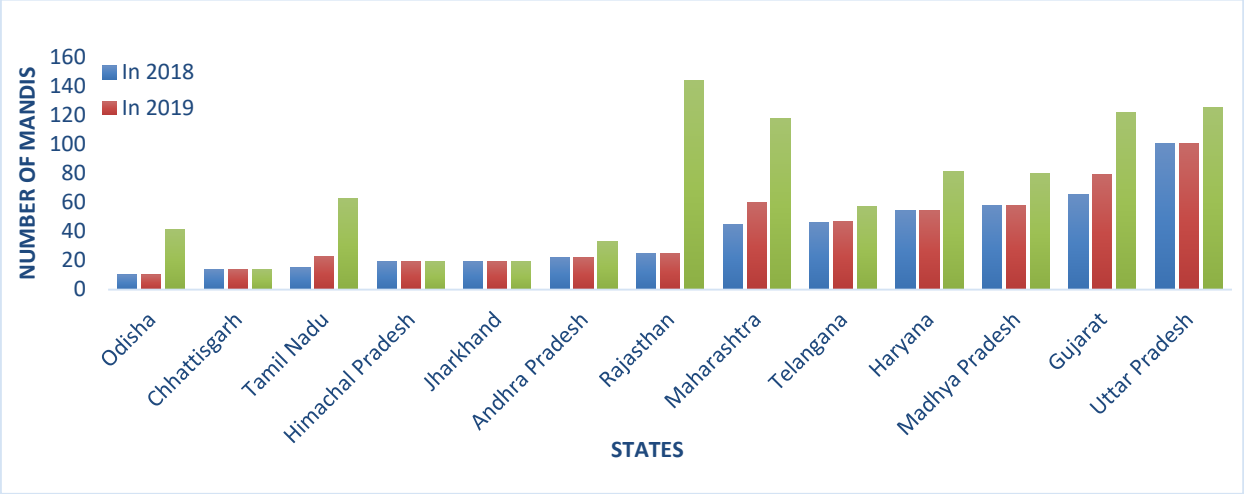

FIGURE 2: Selected State-wise Number of Mandis from the year of 2018, 2019 and 2022 in India.

Source: Author's calculation based on database of Ministry of Agriculture & Farmers Welfare, Govt. of India.

Figure 2 showing the number of mandis in a few Indian states during a three-year period. The number of mandis in 2018, 2019, and 2022 is represented by the blue, orange, and green bars, respectively. When comparing the number of mandis in various states throughout time, the figure is helpful. For instance, Uttar Pradesh (100) has the most mandis in 2018, followed by Gujarat (65), and Madhya Pradesh (58). In contrast, Tamil Nadu and Chhattisgarh had 14 and 15 mandis each, while Odisha had the fewest (10). The image also shows how the number of mandis has changed throughout time. For instance, the number of mandis in Rajasthan increased significantly from 25 in 2018 to 144 in 2022. In the same way, Maharashtra had 45 mandis in 2018 but 118 by 2022. All things considered, the figure offers a concise and clear depiction of the number of mandis in the various Indian states throughout time, making it an invaluable tool for scholars and decision-makers who wish to comprehend the workings of the country's agricultural markets. In summary, the figure indicates that e-NAM has achieved significant progress in the integration of mandis throughout India's many states. The graph also emphasises how important it is to keep pushing e-NAM and broadening its use nationwide, particularly in areas with lower integration levels.

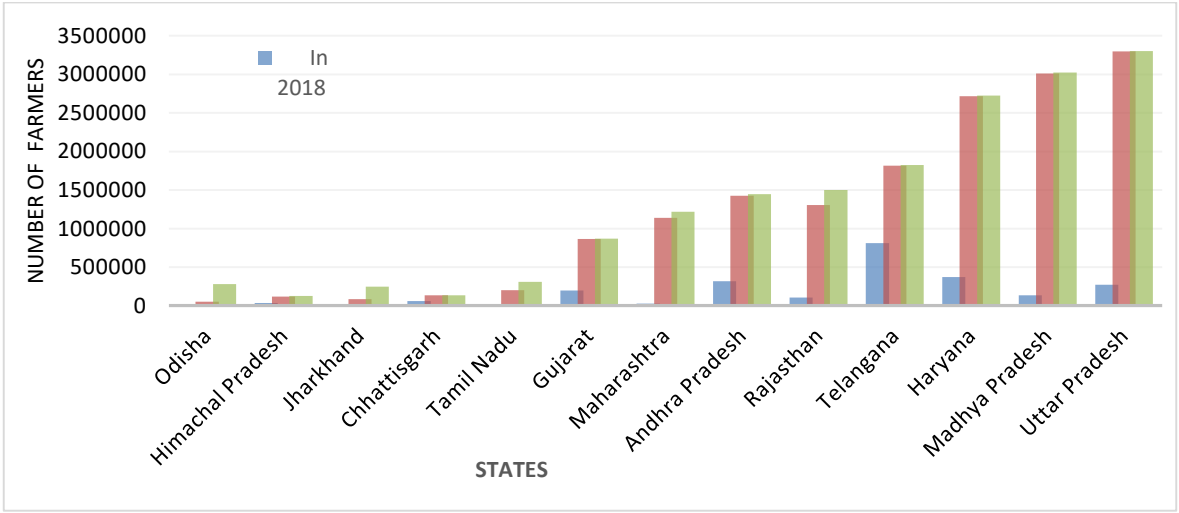

FIGURE 3: Selected State-wise Number of farmers Registered under National Agriculture Market (e-NAM) in India

Source: Author's calculation based on database of Ministry of Agriculture & Farmers Welfare, Govt. of India.

The number of farmers registered in each of India's states under the National Agriculture Market (e-NAM) is seen in Figure 3. Through the e-NAM internet platform, farmers may sell their goods directly to consumers, cutting out middlemen and associated costs. Figure 3 displays the statistics for the following years: 2018, 2019, and 2022. The chosen states are displayed on the x-axis, while the number of registered farmers is displayed on the y-axis. With more than 8.1 million farmers enrolled on the e-NAM platform in 2018, Telangana was the state with the most registered farmers. Uttar Pradesh, Andhra Pradesh, and Haryana were some of the other states having a large, registered farmer population. Most states saw increases in the number of registered farmers between 2018 and 2019, with Uttar Pradesh, Madhya Pradesh, and Haryana experiencing the biggest increases. Nonetheless, a few states, including Chhattisgarh and Tamil Nadu, do not appear to have seen a notable rise in the number of farmers who are registered. A forecast for 2022 is also included in the data in Figure. The forecast indicates that most states will continue to see increases in the number of registered farmers; Uttar Pradesh is estimated to have more than 3.5 million registered farmers by 2022. All things considered, Figure offers insightful data on farmers' acceptance and usage of the e-NAM platform across several Indian states.

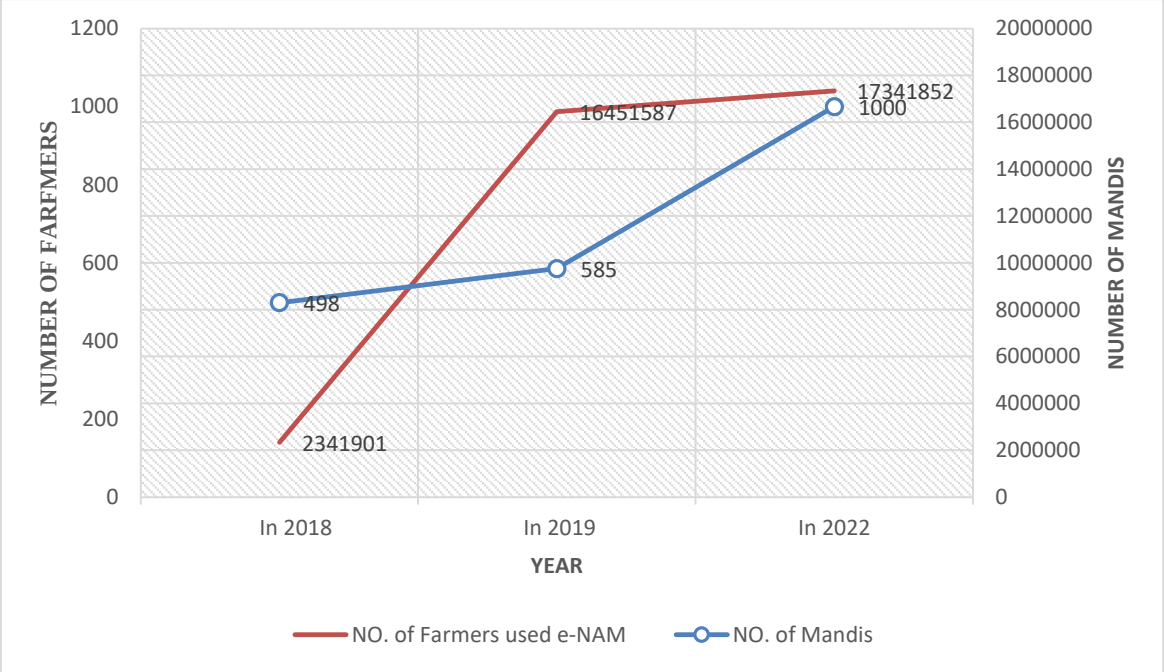

FIGURE 4: Trends of No. of Farmers used E- NAM and No. of Mandis during 2018, 2019 and 2022
Source: Author's calculation based on database of Ministry of Agriculture & Farmers Welfare, Govt. of India.

The figure 4 displays the trends of number of mandis integrated under e-NAM and the number of farmers using e-NAM in India in the years 2018, 2019, and 2022.Illustrates how e-NAM has significantly advanced the integration of farmers and mandis throughout India's many states. Nonetheless, there remains ample opportunity to augment the quantity of farmers and mandis included via e-NAM, particularly in states with reduced integration thresholds. As depicted in the picture, the number of farmers using e-NAM grew from 2.3 million in 2018 to 16.5 million in 2019 and then to 17.3 million in 2022. Comparably, from 498 in 2018 to 585 in 2019, and then to 1,000 in 2022, there were more mandis integrated under e-NAM. The graph shows how e-NAM has integrated farmers and mandis throughout India's many states, achieving notable success in this regard. Still, it indicates that there is more room to grow the number of farmers and mandis covered by e-NAM, particularly in states with lower integration levels. Ultimately, the graph indicates that e-NAM has been effective in enhancing price discovery, removing middlemen, and giving farmers more access to markets. The data also emphasizes the necessity of ongoing initiatives to improve e-NAM's visibility and expand its national reach.

TABLE 1

STORAGE INFRASTRUCTURE PROJECTS IN INDIAN STATES AND WOMEN BENEFICIARY IN YEAR OF 2022

States/UTs	No. of Women Beneficiaries	Capacity Created (MT)	Subsidy Released (Rupees in Lakh)
Andhra Pradesh	569	2779574.17	15556.25
Assam	45	140557.06	1468.71
Bihar	127	204881.51	1203.72
Chhattisgarh	37	45396.54	832.03
Gujarat	1461	1209118.26	7190.16
Haryana	281	1976707.53	13974.54
Himachal Pradesh	7	6173.83	74.7
Jammu and Kashmir	1	5000	25
Jharkhand	6	29046.3	121.52
Karnataka	652	809480.92	3960.38
Kerala	2	3625.25	18.26
Madhya Pradesh	1289	5862112.62	29113.33
Maharashtra	285	676958.44	2044.33
Meghalaya	2	5155.28	34.36
Odisha	86	220039.27	1119.61
Punjab	144	1255759.68	9558.92
Rajasthan	294	967144.49	4856.87
Tamil Nadu	123	567811.02	2828.7
Telangana	185	1088998.38	7476.21
Uttar Pradesh	96	506688.53	4136.58
Uttarakhand	96	336796.58	1872.14
West Bengal	22	53462.65	296.47
India	5809	18750488.34	107762.8

Source: Author's calculation based on database of Ministry of Statistics and Programme Implementation, Govt. of India.

The table 1 explains about storage infrastructure projects in various Indian states and union territories in the year 2022. For each state or union territory, the data includes the number of women beneficiaries, the storage capacity created in metric tonnes (MT), and the subsidy released in Indian Rupees (Lakh). With 569 women beneficiaries, Andhra Pradesh has the largest number, suggesting a major impact on women in the state. With only one or two, states like Jammu and Kashmir, Meghalaya, and Kerala have the fewest number of female beneficiaries. With a storage capacity of more than 5.8 million metric tonnes, Madhya Pradesh is the state with the largest contribution to the nation's storage infrastructure. The state also received the largest amount of subsidies, totaling more than 29,000 lakh rupees, which reflects the government's significant investment in the state's storage infrastructure. Kerala, Meghalaya, Jammu and Kashmir, and Himachal Pradesh have comparatively smaller storage capacities, most likely as a result of their less intensive agricultural and storage needs. Due to their smaller-scale projects, Kerala, Himachal Pradesh, and Jammu and Kashmir have received the least amount of subsidies. 5,809 women will have benefited from these storage infrastructure projects in India overall by 2022, demonstrating the cumulative effect on women's lives throughout the nation. The significant increase in storage facilities is indicated by the 18,750,488.34 MT total storage capacity created in India. A total of 107,762.8 Lakh Rupees have been released as subsidies in India, demonstrating the financial support given at the national level.

TABLE 2

CAGR OF STATE-WISE VALUE OF OUTPUT FROM AGRICULTURE AND ALLIED SECTORS IN INDIA

States/UTs	CAGR 2011-2016	CAGR2019-2021
Andaman & Nicobar Islands	0.658	4.97
Andhra Pradesh	6.162	6.66
Arunachal Pradesh	3.309	10.31
Assam	3.423	1.636
Bihar	1.73	3.253
Chandigarh	1.259	4.264
Chhattisgarh	3.69	3.782
Delhi	-8.321	-0.362
Goa	1.888	2.775
Gujarat	1.933	3.015
Haryana	0.76	3.456
Himachal Pradesh	5.055	1.892
Jharkhand	0.768	3.099
Karnataka	1.044	10.319
Kerala	-1.869	-0.668
Lakshadweep	7.911	-3.579
Madhya Pradesh	6.84	3.598
Maharashtra	-0.315	4.367
Manipur	1.198	0.222
Meghalaya	6.374	3.269
Mizoram	27.118	-2.487
Nagaland	2.611	1.425
Odisha	1.189	4.301
Puducherry	1.963	-0.24
Punjab	0.537	2.575
Rajasthan	3.815	5.544
Sikkim	-2.916	3.622
Tamil Nadu	4.501	5.986
Telangana	-1.416	9.271
Tripura	6.186	3.746
Uttar Pradesh	1.43	2.261
Uttarakhand	-0.27	1.868
West Bengal	1.86	2.734
India	2.218	4.207

Source: Author's calculation based on database of Ministry of Statistics and Programme Implementation, Govt. of India.

Table 2, shows the Compound Annual Growth Rate (CAGR) of the value of output from agriculture and allied sectors in various states and union territories (UTs) in India for two distinct time periods: from 2011 to 2016 and from 2019 to 2021. The CAGR in the Andaman and Nicobar Islands increased dramatically from 0.658 in 2011–2016 to 4.970 in 2019–2021, demonstrating robust growth in the agricultural and related sectors. Andhra Pradesh has maintained a comparatively high growth rate—6.162 and 6.660 CAGR-over the course of both time periods in order to support this growth. With the second-highest CAGR of 10.310 in 2019–2021, Arunachal Pradesh has demonstrated significant growth among the states. Urbanisation has created challenges for Delhi's agriculture sector, whose CAGR improved from -8.321 to -0.362. Encourage aquaponics,

rooftop gardens, and urban farming to make the most of available space. Create effective food supply networks to guarantee the city has a steady supply of fresh produce.

A few states and union territories, including Andaman & Nicobar Islands, Andhra Pradesh, Arunachal Pradesh, and Bihar, experienced a rise in compound annual growth rate (CAGR) between the previous and subsequent periods. This suggests that agriculture and related industries are expanding in a positive direction. Certain states, like Rajasthan, Gujarat, and Haryana, had growth rates that were steady throughout both times, if not particularly high. This suggests that their agricultural output has stabilised. In the later period, the CAGR decreased in states like Tamil Nadu and Karnataka. Sustained growth depends on comprehending the causes of these oscillations. States with decreasing or negative CAGR in their agricultural sectors included Delhi and Kerala. Their agricultural output has been impacted by urbanisation and other factors. Significant growth in the agriculture and related sectors is indicated by the notably high CAGR values in the later period for states like Goa, Karnataka, Meghalaya, and Telangana. While Sikkim and Lakshadweep's performance improved in the later period, it was still relatively low when compared to other states. Earlier, these states had negative CAGR values.

In order to effectively target interventions, policymakers and stakeholders must conduct a thorough analysis of the unique factors influencing growth in each region. Climate, infrastructure, adoption of new technologies, market accessibility, and policy support are just a few of the variables that greatly influence how well the agriculture sector performs in each state and UT.

IV. CONCLUSION AND RECOMMENDATIONS

This research paper concludes by highlighting notable advancements and accomplishments in India's agricultural integration and storage infrastructure. In terms of integrated mandis and registered farmers, Uttar Pradesh, Gujarat, and Maharashtra have emerged as leaders, highlighting the advancements achieved by the e-NAM initiative in fostering integration within the agricultural sector. The somewhat lower figures in Chandigarh, however, highlight the necessity of ongoing initiatives to improve integration and raise farmer registrations, especially in areas where participation is still low. The research paper also sheds light on the dynamic landscape of mandi integration in India, with notable increases in the number of integrated mandis in states like Rajasthan and Maharashtra over the years. This underscores the importance of sustaining and expanding e-NAM's reach across the country, with a particular focus on areas where integration levels are still lagging. Between 2018 and 2022, the number of farmers using e-NAM increased significantly from 2.3 million to 17.3 million, which is indicative of the program's important role in integrating farmers and mandis. A further indication of the benefits of e-NAM, such as better price discovery, less dependence on middlemen, and improved market access for farmers, is the rise in integrated mandis from 498 to 1,000. Even though significant progress has been made, there is still opportunity for growth, particularly in states with lower levels of integration.

The impact of the projects on women, with Andhra Pradesh leading the way in terms of the number of women beneficiaries, indicates that the state's women are benefiting from these initiatives, which may also be enhancing their prospects for employment and agriculture. Nonetheless, there are clear regional differences in the number of female recipients, storage capacity, and subsidies received, which highlights the need for more focused efforts to include women in these kinds of projects, especially in states like Kerala, Jammu and Kashmir, and Meghalaya. With a storage capacity of more than 5.8 million metric tonnes and the largest amount of subsidies received, Madhya Pradesh has made a remarkable contribution to the country's storage infrastructure, demonstrating the government's significant investment in this vital sector. By 2022, an estimated 5,809 women's lives will have been positively impacted by storage infrastructure projects, underscoring the important role these programmes play in empowering women in agriculture and storage. There has been a significant expansion of storage facilities in India, resulting in the creation of 18,750,488.34 metric tonnes of total storage capacity and the release of significant subsidies. This helps greatly with the nation's agricultural and storage needs in addition to addressing regional disparities. The significance of storage infrastructure projects and agricultural integration, as well as how they can empower women, reduce regional disparities, and help the country's agriculture industry. The government's dedication to enhancing India's agricultural and storage infrastructure is evident in the substantial investments and accomplishments in these fields, which will eventually improve the country's economy and people's quality of life.

The research paper suggests that policymakers and government must conduct a thorough analysis of the unique factors influencing growth in each region to effectively target interventions. The study recommends concentrating on states with less influence and smaller populations, such as Jammu and Kashmir, Himachal Pradesh, and Kerala, to implement smaller-scale storage infrastructure projects. The study also suggests that policymakers and stakeholders must continue to focus on improving the sector's performance through targeted interventions.

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