Assessing the Farmers' Participation and Challenges in Linking Agricultural Produce Market Committee (APMC) Markets by e-National Agricultural Market (e-NAM): Evidence from the State of Goa

BITS Pilani, K.K. Birla Goa Campus

आर्थिक विश्लेषण और अनुसंधान विभाग

Department of Economic Analysis & Research

राष्ट्रीय कृषि और ग्रामीण विकास बैंक, मुंबई

National Bank for Agriculture and Rural Development, Mumbai

2025

NABARD RESEARCH STUDY

Assessing the farmers' participation and challenges in linking Agricultural Produce Market Committee (APMC) mandi markets by e-National Agricultural Market (e-NAM): Evidence from the state of Goa

R & D Project Funded by

Dr. R. L. Manogna

डॉ. आर एल मनोगना

Department of Economic Analysis and Research

आर्थिक विश्लेषण और अनुसंधान विभाग

National Bank for Agriculture and Rural Development,Mumbai

राष्ट्रीय कृषि और ग्रामीण विकास बैंक, मुंबई

2025

DISCLAIMER

This study has been supported by the National Bank for Agriculture and Rural Development (NABARD) under its Research and Development (R&D) Fund. The contents of this publication can be used for research and academic purposes only with due permission and acknowledgement. They should not be used for commercial purposes. NABARD does not hold any responsibility for the facts and figures contained in the book. The views are of the authors alone and should not be purported to be those of NABARD.

TABLE OF CONTENTS

Assessing the Farmers' Participation and Challenges in Linking Agricultural Produce Market Committee (APMC) Mandi Markets by e-National Agricultural Market (e-NAM): Evidence from the State of Goa

About NABARD Research Study Series

The NABARD Research Study Series has been started to enable wider dissemination of research conducted/sponsored by NABARD on the thrust areas of Agriculture and Rural Development among researchers and stakeholders. The study titled Assessing the Farmers' Participation and Challenges in Linking Agricultural Produce Market Committee (APMC) Mandi Markets by e-National Agricultural Market (e-NAM): Evidence from the State of Goa is the fifty-sixth in the series.

The National Agriculture Market (e-NAM) is a transformative initiative aimed at integrating India's agricultural markets through digital connectivity. While e-NAM has successfully unified markets in several states, Goa faces distinct challenges in its adoption. The report examines the implementation of e-NAM in Goa, assessing its potential to streamline agricultural trade and market efficiency while addressing challenges unique to the state. It explores the participation of smallholder farmers, pricing benefits, market accessibility, and the role of Negotiable Warehouse Receipts (NWRs) in improving liquidity and price realization. By identifying key obstacles and presenting strategic policy recommendations, the study aims to enhance e-NAM's adoption and impact within Goa's agricultural ecosystem.

This study explores key factors contributing to an inclusive digital agricultural marketplace, including digital training, regional outreach, mandi upgrades, financial assistance, and administrative ease. Long-term effectiveness relies on policy incentives, service integration, internet expansion, private partnerships, and stakeholder engagement. Findings highlight regional disparities in e-NAM's impact, emphasizing the role of education and technology access in adoption.

Strengthening stakeholder engagement and integrating e-NAM with existing market structures will ensure broader adoption, helping farmers access fair pricing, transparent transactions, and sustainable economic opportunities.

Hope this report would make a good reading and help in generating debate on issues of policy relevance. Let us know your feedback.

Kuldeep Singh

Chief General Manager

Department of Economic Analysis and Research

Acknowledgements

Prof. R. L. Manogna

Assistant Professor,

Department of Economics and Finance

BITS Pilani K. K. Birla Goa Campus.

List of Tables

List of Figures

Executive Summary

e-NAM is aimed to unify India's agricultural markets through digital integration. In order to establish a single national market for agricultural products, the National Agriculture Market (eNAM), a pan-India electronic trade web, links the current APMC mandis. Despite its success in several states, Goa's implementation of e-NAM faces notable challenges. This report explores these challenges and the role of negotiable warehouse receipts (NWRs) in enhancing market efficiency. The National Agriculture Market (e-NAM) is an online trading platform designed to integrate existing Agricultural Produce Market Committees (APMCs) across India, creating a unified market for agricultural commodities. Managed by the Small Farmers Agribusiness Consortium (SFAC) under the Ministry of Agriculture and Farmers' Welfare, e-NAM seeks to streamline marketing processes, enhance transparency, and enable real-time price discovery by linking markets across the country. This platform benefits multiple stakeholders, including APMCs, farmers, traders, and Farmer Producer Organizations (FPOs), by simplifying trade procedures, ensuring fair pricing through electronic auctions, and facilitating prompt online payments. The key stakeholders in agricultural marketing include farmers, traders, Agricultural Produce Market Committees (APMCs), assaying bodies, Farmer Producer Organizations (FPOs), banks, logistics operators, warehouses, and mandi boards. Agricultural marketing has evolved significantly over time, transitioning from traditional barter and local village markets to advanced systems incorporating ICT, digital marketing, and global virtual platforms (Ranjith Kumar et al., 2020). With production often concentrated in one area while consumption occurs year-round in various locations, effective agricultural marketing has become essential. It plays a crucial role in ensuring that both consumers and farmers achieve better pricing and efficiency throughout the supply chain.

The study evaluates the implementation and benefits of e-NAM for farmers and stakeholders in Goa's APMC mandis. It aims to understand smallholder participation, measure the benefits in terms of pricing and viability, and identify necessary interventions for broader adoption. Additionally, it addresses challenges in connecting e-NAM across states and assesses the potential of Negotiable Warehouse Receipts (NWRs) in Goa. The findings will be summarized with strategic policy recommendations to enhance e-NAM's effectiveness and adoption in the state.

Summary of Findings

We examined the adoption and benefits of the e-NAM (Electronic National Agriculture Market) platform within Goa's Agricultural Produce Market Committees (APMCs). e-NAM aims to streamline agricultural marketing by connecting farmers, traders, and officials, thereby enhancing market efficiency and transparency. e-NAM offers several advantages to farmers, including higher price realization due to broader market access, the convenience of online payments, time savings from reduced travel and paperwork, improved quality assessment facilities, and increased transparency in transactions. This underscores e-NAM's potential to provide tangible financial benefits and expanded market opportunities.

Adoption and Operational Challenges

The effectiveness of e-NAM adoption is influenced by various factors, including regional market dynamics and crop types. Effective adoption requires targeted training programs tailored to farmers' specific needs, such as content relevance, methodology, language, and location. Studies highlight that increased awareness and capacity building are essential for successful e-NAM implementation. Farmers in different regions report varying levels of benefit, with those in northern areas seeing better price realization. This suggests that regional disparities affect the platform's impact and points to the need for tailored interventions. A Chi-Square test was used to evaluate the relationship between stakeholder awareness of e-NAM and its effectiveness. Data from 174 farmers, 30 officials, and 30 traders were analyzed. The test revealed significant differences in awareness: 66.7% of farmers and 83.3% of traders were not aware of the e-NAM portal, whereas all officials were aware. The Pearson Chi-Square statistic of 55.1407 (p-value = 0.000) indicates a statistically significant association between stakeholder type and awareness of the e-NAM portal. This suggests that information dissemination and engagement vary significantly across different stakeholder groups. The low awareness levels among farmers and traders indicate a need for improved information dissemination strategies. Officials' full awareness highlights their crucial role in promoting e-NAM. Targeted outreach, including local language media and digital platforms, is necessary to increase awareness among farmers and traders. The analysis suggests that while technological compatibility positively influences perceived usefulness, increased user knowledge may not always enhance perception, possibly due to complexities discovered during

use. The availability of help, though a positive feature, does not significantly impact user perceptions in this context. Despite the benefits, e-NAM faces adoption constraints, particularly among smallholder farmers who remain unaware of the platform's incentives. Regional disparities also affect the platform's impact. Future strategies should focus on bridging awareness gaps, enhancing digital literacy, and addressing specific needs of underserved farmer populations. Policymakers must ensure comprehensive implementation strategies to extend e-NAM's benefits broadly.

The analysis reveals significant insights into how smallholders interact with e-NAM. Awareness and registration behaviors are strongly influenced by educational attainment and, to a lesser extent, age. Key findings include:

Awareness of e-NAM: The logistic regression model indicates that both age and education are crucial determinants of awareness about e-NAM. Older individuals and those with higher education levels are more likely to be aware of the portal. This suggests that experience and educational background play a role in understanding and accessing digital agricultural platforms.

Registration on e-NAM: When it comes to actual registration on the e-NAM platform, education proves to be a significant factor. Individuals with higher levels of formal education are more likely to register on e-NAM. In contrast, age does not show a significant effect on registration, indicating that factors other than age might influence an individual's decision to register.

Policy Implications: The findings highlight a need for targeted interventions to improve e-NAM adoption among less educated and younger farmers. Strategies should focus on bridging the educational gap and enhancing digital literacy to facilitate broader engagement with the platform.

Educational Initiatives: Given the strong link between education and both awareness and registration, educational programs that inform and train farmers about e-NAM could enhance participation rates. These programs should be accessible and tailored to the needs of different demographic groups.

Technology Accessibility: Ensuring that technological tools and resources are available and user-friendly is critical. This includes providing support and assistance to farmers with lower educational backgrounds to navigate and utilize the e-NAM portal effectively.

Focused Outreach: Outreach efforts should be directed towards younger and less educated farmers to increase their awareness and registration on e-NAM. Customized communication strategies and hands-on support could improve their engagement with the platform.

Economic Impact of e-NAM on Farmer Price and Viability

The e-NAM (Electronic National Agriculture Market) portal represents a significant advancement in agricultural markets by providing farmers with real-time price information and facilitating transparent transactions. This has helped bridge the gap between farmers and traders, promoting competition and reducing transaction costs. Despite these benefits, many farmers continue to prefer traditional market practices, primarily due to a lack of awareness and understanding of e-NAM's advantages. The paired t-test analysis assesses the impact of e-NAM registration on price outcomes by comparing farmers who visit Agricultural Produce Market Committees (APMCs) with those who do not. Results show a significant difference in registration rates: farmers who visit APMCs are all registered with e-NAM, whereas a lower proportion of non-visitors are registered. The statistically significant p-value (0.0031) indicates that visiting APMC Mandis is associated with higher e-NAM registration. This association suggests that physical market interactions play a crucial role in promoting digital platform adoption, as farmers exposed to e-NAM within APMCs are more likely to register and utilize the portal.

Cost-Benefit Analysis

The cost-benefit analysis evaluates the perceived financial viability of e-NAM among farmers, traders, and officials. The analysis reveals a negative mean net benefit of -0.55, indicating that, on average, respondents view the costs of using e-NAM as outweighing the benefits. This negative perception is driven by significant variability in individual opinions and the differing levels of familiarity with e-NAM across respondent groups. Despite the potential advantages of e-NAM, such as reduced transaction costs and improved market access, the negative net benefit suggests that further efforts are needed to demonstrate the tangible benefits and address concerns related to resource requirements. ANOVA results reveal significant relationships between age, education level, smartphone ownership, and e-NAM usage. The analysis indicates that younger, more educated respondents with smartphones are more likely to engage with e-NAM. Specifically:

Higher education is associated with younger age groups and greater engagement with e-NAM. Smartphone ownership significantly influences e-NAM usage, with younger individuals more likely to own and use smartphones. Registration rates are higher among certain age groups, reflecting a generational divide in technological adoption. Younger respondents, who are more adept at using smartphones, are more engaged with e-NAM. These findings underscore the importance of technological literacy and access in influencing e-NAM adoption. Enhancing digital literacy and improving access to smartphones, particularly among older and less educated farmers and traders, are crucial for increasing e-NAM usage. The economic impact analysis highlights that while e-NAM has the potential to improve market efficiency and farmer viability, its benefits are not fully realized due to limited adoption and negative perceptions among some stakeholders. Targeted educational programs and outreach initiatives are essential to raise awareness and demonstrate the benefits of e-NAM. Addressing concerns related to resource requirements and providing practical demonstrations of e-NAM's advantages could help shift perceptions and enhance the platform's overall financial viability and effectiveness.

Strategies for Enhancing e-NAM Adoption in Goa

To advance e-NAM adoption in Goa, there are several strategies focusing on infrastructure, software, education, comprehensive planning, and research. The successful scaling of e-NAM in Goa depends on aligning mandis with WDRA-accredited warehouses and cold storage. The infrastructure must support major commodities and integrate essential services such as banking, grading, and warehousing. This integration is crucial for creating a cohesive national market that facilitates seamless trade. Upgrading the e-NAM software is vital to extend beyond basic transactions. The system should manage both internal and external trade aspects, automate processes, and address inter-mandi disputes. These improvements will streamline operations and enhance market integration. Educating farmers on e-NAM's functionalities is critical. Tailored training programs should be developed to help farmers, especially those with limited tech skills, learn how to register, list produce, participate in auctions, and negotiate prices. Effective training will improve market access and transparency. A holistic strategy is required, including incentives for users and engagement with banks. Addressing barriers such as regulatory restrictions and integrating logistics services is necessary to fully realize e-NAM's

potential as a national market platform. Ongoing research is needed to identify barriers and effective strategies for e-NAM adoption. Understanding how e-NAM influences marketing strategies, crop choices, and market access will help refine the platform to better serve stakeholders.

The National Agriculture Market Scheme (e-NAM) seeks to modernize agricultural trading by creating a unified digital marketplace. However, the adoption of e-NAM in Goa is hindered by several challenges. Stakeholders, including farmers, traders, and commission agents, face significant obstacles. Farmers, who are supposed to benefit from improved market access and better price discovery, struggle with digital literacy. Despite the growth in smartphone and internet usage, many farmers find the e-NAM app complex and have limited engagement with the platform. This low adoption rate suggests that digital literacy programs are crucial. Additionally, the dependency on intermediaries like commission agents persists, undermining e-NAM's goal of enabling direct transactions between farmers and buyers. Traders exhibit reluctance due to concerns about increased tax liabilities and transparency requirements. The shift to digital platforms exposes traders to more scrutiny, which deters full adoption. Commission agents fear that e-NAM's direct trading model threatens their traditional role, contributing to resistance within this group. Technological and infrastructural constraints also impede e-NAM's effectiveness. The platform suffers from a lack of standardized price discovery methods and scepticism towards digital assessments, with many stakeholders preferring traditional practices. Rural areas, including Goa, face connectivity issues, which further restrict the platform's usability. The existing version of e-NAM lacks advanced features, and integrating technologies like AI and IoT could significantly enhance its functionality and appeal. The gap analysis reveals that users perceive e-NAM as less efficient and more cumbersome compared to traditional methods. Issues such as language difficulties, software performance, and perceived risks in adopting e-NAM highlight areas needing improvement. Notably, training requirements are perceived as minimal, but enhancing overall efficiency and addressing concerns could boost adoption rates.

e-NAM's primary goal is to integrate local mandis into a national platform, facilitating seamless connectivity and efficient trading. Warehouse-based trading, introduced in April 2020, allows farmers to store produce in accredited warehouses and trade using electronic negotiable warehouse receipts (e-NWRs). This system aims to reduce

logistics costs, minimize post-harvest losses, and provide greater market flexibility. In Andhra Pradesh and Telangana, this model has streamlined trading and improved market access. However, Goa's e-NAM implementation has struggled with inadequate infrastructure. Local mandis lack essential facilities such as electronic bidding systems, weighment integration, and electronic gate passes, which hinder effective operation. The absence of integrated warehouses further complicates the situation, as farmers cannot fully utilize warehouse-based trading benefits. This inadequacy limits farmers' ability to store produce and access market opportunities, contributing to market congestion and inefficiencies.

Negotiable Warehouse Receipts (NWRs) are designed to provide financial and operational benefits by allowing farmers to use stored produce as collateral for loans. This system supports financial flexibility, enabling farmers to avoid distress sales and sell produce when market conditions are favourable. Accredited warehouses ensure quality and maintain proper records, enhancing market trust. In Goa, the lack of warehouse integration with e-NAM prevents farmers from leveraging these benefits, limiting their financial stability and market participation. The network analysis reveals a high need for warehousing across states, with mixed experiences regarding access and costs. Most respondents require warehousing, but access varies, and associated charges present a barrier. The feasibility study underscores the critical need for warehousing and highlights mixed feasibility considerations, stressing the importance of addressing infrastructure and cost issues. To overcome these challenges, several targeted recommendations are proposed. Developing infrastructure to support e-NAM and NWRs, encouraging private sector participation, implementing capacity-building programs, and engaging stakeholders are essential steps. A robust monitoring and evaluation framework will ensure effective implementation and address emerging issues.

Policy Focus and Solutions

1. Digital Training: Implement targeted digital literacy and skills training programs conducted in local languages, using hands-on sessions and practical demonstrations to help farmers and traders master the e-NAM platform and its features.

2. Regional Outreach: Launch comprehensive regional outreach campaigns through local media channels and community networks that share relatable success stories,

highlight benefits, and build trust in the platform among small landholding farmers and traders.

3. Mobile Optimization: Enhance the e-NAM portal to be fully mobile-responsive and incorporate offline capabilities, ensuring that farmers in areas with limited internet connectivity can access and use the platform seamlessly.

4. Mandi Upgrade: Invest in upgrading mandis serving small farmers by installing reliable digital infrastructure such as electronic weighing bridges, automated record-keeping systems, and ensuring consistent, robust internet connectivity to improve operational efficiency.

5. Financial Support: Introduce targeted financial support measures, including subsidies and low-interest loan schemes, to assist small farmers in acquiring the necessary digital devices and technology needed to effectively participate in e-NAM.

6. Administrative Ease: Simplify and streamline administrative procedures for e-NAM registration and transactions, reducing bureaucratic hurdles and making the onboarding process smoother and more accessible for new users.

7. Policy Incentives: Enact policy reforms that offer tangible benefits like tax incentives and reduced transaction fees, thereby creating a more attractive and supportive environment for small landholding farmers and traders to transition to digital trading.

8. Service Integration: Integrate e-NAM with existing agricultural extension services by establishing one-stop support centers that provide market intelligence, technical assistance, and advisory services, ensuring that users receive comprehensive support throughout the process.

9. Internet Expansion: Prioritize the expansion of high-speed internet in rural areas by working with telecom providers to improve connectivity in mandis and farming regions, ensuring that all users have access to reliable digital services.

10. Private Partnerships: Foster strategic partnerships with private sector companies and technology innovators to develop customized digital solutions for e-NAM, offering incentives for research and development that address the unique challenges of small-scale agricultural markets.

11. Stakeholder Engagement: Create a continuous feedback loop by engaging with farmers, traders, and mandi operators through regular consultations and workshops, ensuring that policy adjustments and platform enhancements remain responsive to the evolving needs of the agricultural community.

Chapter 1: Introduction

Agriculture in Goa at a Glance

Goa, a tiny state on the west coast of India, spans an area of 3,610 sq. km. It is bordered by the Sahyadri Mountains to the east, the Arabian Sea to the west, Maharashtra to the north, and Karnataka to the south. Goa, known for its rich biodiversity, was under Portuguese rule for nearly 450 years until its liberation in 1961. Over the past 50 years since liberation, Goa has made remarkable progress in the agricultural sector, alongside various other economic advancements. The Gross State Domestic Product (GSDP) of Goa stands at Rs. 80,000 per annum. While tourism and mining are at the forefront of employment generation, agriculture provides livelihood support to almost 12 lakh people. Agriculture and forests cover nearly 65% of Goa's total area, contributing significantly to keeping the state green.

At the time of liberation, about 70% of the population was engaged in agriculture as their full-time occupation. Paddy was the predominant crop, followed by cashew and coconut. However, the cropping pattern has evolved, with cashew now being cultivated on nearly 55,000 hectares and paddy on about 31,000 hectares. The cultivation of horticultural crops has gained importance due to better returns, lower risk, and their suitability for part-time farming.

Agriculture Development Programme

The State of Goa provides substantial assistance to agriculture at all levels to ensure significant returns for rural people. The Department of Agriculture, headquartered at Tonca, Panaji, implements developmental programs through Zonal Agricultural Offices in each taluka. These programs include plant production centers, machinery provision centers, and training centers at the district level. Soil testing laboratories issue soil health cards for major and micro-nutrients. Due to a shortage of manual labor, there is a growing dependence on machinery for agricultural activities. With small land holdings (80% of farmers owning less than 1 hectare), smaller machines are preferred, and the government provides financial assistance for such equipment. The government also promotes large-scale cultivation by providing assistance for seeds, pesticides, manures, and land preparation. Goa uniquely assures farmers of support prices for paddy, coconut, arecanut, oil palm, and sugarcane, protecting them from

market price collapses. Farmers receive assistance at taluka-level offices located in Pernem, Bardez, Bicholim, Sattari, Tiswadi, Sakhali, Salcete, Ponda, Sanguem, Canacona, Quepem, and Dharbandora.

Agro Processing: Processing adds value to agricultural produce. Cashew kernel processing, feni extraction, and fruit processing (mango, kokum, jamun) are significant agro-industries. Agro cottage industries producing papad, pickles, medicine, masala, and other products are also emerging.

Marketing: Agricultural produce in Goa is marketed through government market yards, co-operative societies, private dealers, and local markets.

Agro Tourism in Goa: Goa is globally renowned for its tourism and is becoming a preferred agro-eco-tourism destination. Farmers with agricultural bases, spice plantations, horticultural plantations, floriculture, and natural resources like rivers, ponds, rich biodiversity, jungles with diverse flora and fauna, adventurous sports, and a healthy, peaceful environment are venturing into agro-tourism. Visitors and tourists favor these settings for relaxation and rejuvenation over weekends.

Goa Agricultural Produce and Livestock Marketing Board (GAPLMB)

The Portuguese rule in Goa came to an end in December 1961, marking the beginning of a new era of comprehensive progress in the territory's economic, industrial, and agricultural sectors. Prior to liberation, agriculture was the primary occupation in Goa, with the cultivation of significant crops such as paddy, coconut, cashewnut, betelnut, banana, pineapple, mango, kokum, chillies, and various vegetables. These crops held substantial commercial importance. Despite the predominance of agriculture, it was a neglected sector with little effort invested in improving the economic conditions of the farming community. Trade was predominantly conducted within villages, with traders controlling the marketable surplus and limiting the producers' ability to secure fair prices for their produce. Malpractices such as short weighting, unauthorized deductions, and exorbitant commission rates were common. The lack of marketing facilities further exacerbated the difficulties faced by producer-sellers.

In light of these challenges, following liberation, the Government of Goa conducted a thorough study of the situation. To enhance the economic conditions of the farming community, it was determined that regulating trade activities, as had been done in several other Indian states, would be a viable solution. Consequently, the introduction

of the Agricultural Produce Market Act was considered necessary. To promote integrated development in the marketing of agricultural produce and to protect the economic interests of producer-sellers in Goa, the government extended the Maharashtra Agricultural Produce Marketing (Regulation) Act of 1963 to the state, then a Union Territory, in 1968. This extension came with suitable modifications to tailor the act to Goa's specific needs. The act officially came into effect on September 16, 1968, and was accompanied by the formulation of the Goa Agricultural Produce Marketing (Regulation) Rules in 1969.

The primary objective of this act is to ensure that producer farmers receive better prices for their produce and to eliminate malpractices in the buying and selling of agricultural commodities. By regulating these practices, the act aims to create a fair and transparent market environment that safeguards the interests of producers, thereby contributing to the overall economic improvement of the farming community in Goa.

Market Regulation

The regulation of agricultural markets in Goa began in 1968 with the application of the Maharashtra Agricultural Produce Marketing (Regulation) Act of 1963, which was extended to the then Union Territory. This regulatory activity was initiated to streamline and control the marketing of agricultural produce, ensuring fair trade practices and protecting the interests of farmers. In 1969, the Goa Agricultural Produce Market Committee was established, tasked with the creation and management of market yards. To date, the Marketing Board has successfully established eight market yards: the main yard in Margao and sub-market yards in Ponda, Sanquelim, Mapusa, Curchorem, Valpoi, Canacona, and Pernem. Additionally, there are plans to establish a market yard in Banastarim, further enhancing the state's agricultural trade infrastructure.

Currently, all 27 notified commodities are traded in these market yards, signifying the progress achieved in market regulation. The centralization of trade has been notably successful at the sub-yards in Ponda, Curchorem, Valpoi, Canacona, and Pernem, where trade activities are now concentrated. However, the centralization efforts at the Margao and Mapusa yards have encountered challenges, primarily due to the reluctance of coconut traders to move their trade to these designated yards. To address

this, the Marketing Board has employed various persuasive methods to encourage traders to relocate their activities. The Board remains optimistic that it will eventually centralize the coconut trade at the Margao Main Yard and the trade of bananas, coconuts, and cashewnuts at the Mapusa Sub Market Yard. The overall progress in market regulation in Goa highlights the effectiveness of the implemented measures and the ongoing efforts to enhance the agricultural marketing infrastructure. With a total of eight market yards established and plans for further expansion, the state continues to work towards a more organized and equitable market system for its agricultural producers.

About Goa Agricultural Produce and Livestock Marketing Board (GAPLMB)

The Goa Agricultural Produce and Livestock Marketing Board was established to foster integrated development in the marketing of agricultural produce and to protect the economic interests of producers and sellers in Goa. In 1968, the government extended the Maharashtra Agricultural Produce Marketing (Regulation) Act of 1963 to Goa, which was then a Union Territory. This act, with necessary modifications, was applied from September 16, 1968, and the Goa Agricultural Produce Marketing (Regulation) Rules were framed in 1969. The primary objective of enacting this market act was to protect producer-sellers from exploitation and ensure they receive better prices for their produce. The act aimed to provide scientific marketing facilities, thus improving the overall trading process for agricultural commodities. Before the implementation of this act, producers faced numerous challenges, including unfair pricing, malpractices by middlemen, and a lack of proper market infrastructure. The introduction of the act marked a significant shift towards a more regulated and transparent market system. Shri. Satyavan K. Dessai is the Secretary of The Goa Agricultural Produce and Livestock Marketing Board, which is based in Arlem, Raia, Salcete, Goa. This organization plays a crucial role in overseeing agricultural produce and livestock marketing in the region.

The Marketing Board has successfully implemented various measures outlined in the act to eliminate these malpractices. One of the key benefits has been the provision of fair prices to producers, ensuring they are adequately compensated for their hard work. This has been achieved through the establishment of market yards and check posts, which facilitate organized trading and reduce the influence of middlemen. These infrastructures provide a controlled environment where prices are determined based

on transparent auction processes, thereby minimizing the chances of unfair pricing. Additionally, the Marketing Board has focused on providing scientific marketing facilities. This includes proper storage solutions, grading and sorting mechanisms, and other necessary infrastructure that helps maintain the quality of produce until it is sold. Such facilities not only protect the produce from damage but also ensure that the commodities meet market standards, thus fetching better prices. By implementing these measures, the Goa Agricultural Produce and Livestock Marketing Board has significantly improved the marketing landscape for agricultural produce in Goa. The Board's efforts have not only eradicated many of the malpractices that producers previously faced but have also ensured that the economic interests of the farming community are safeguarded. This has led to a more robust and fair agricultural market system, promoting the welfare of producers and contributing to the overall development of the agricultural sector in Goa.

Yards and Check Posts

The establishment of market yards and check posts in Goa has played a crucial role in enhancing the agricultural trade infrastructure. There are a total of eight market yards and four check posts. The Margao Main Yard at Arlem in Margao began its operations on January 18, 1979. Earlier, on April 4, 1973, the Ponda Sub Market Yard at Curti Ponda had already started functioning. Following this, the Sanquelim Sub Market Yard at Gongewal, Sanquelim, became operational on April 4, 1974. Subsequently, the Mapusa Sub Market Yard, located behind the Municipal Market in Mapusa, commenced on June 6, 1984. Further developments saw the Curchorem Sub Market Yard in Curchorem starting on May 16, 1986, and the Canacona Sub Market Yard in Canacona beginning on February 26, 1997. The Valpoi Sub Market Yard in Valpoi opened its doors on October 15, 1997, while the Pernem Sub Market Yard in Pernem also serves the agricultural community, though its date of establishment is not specified.
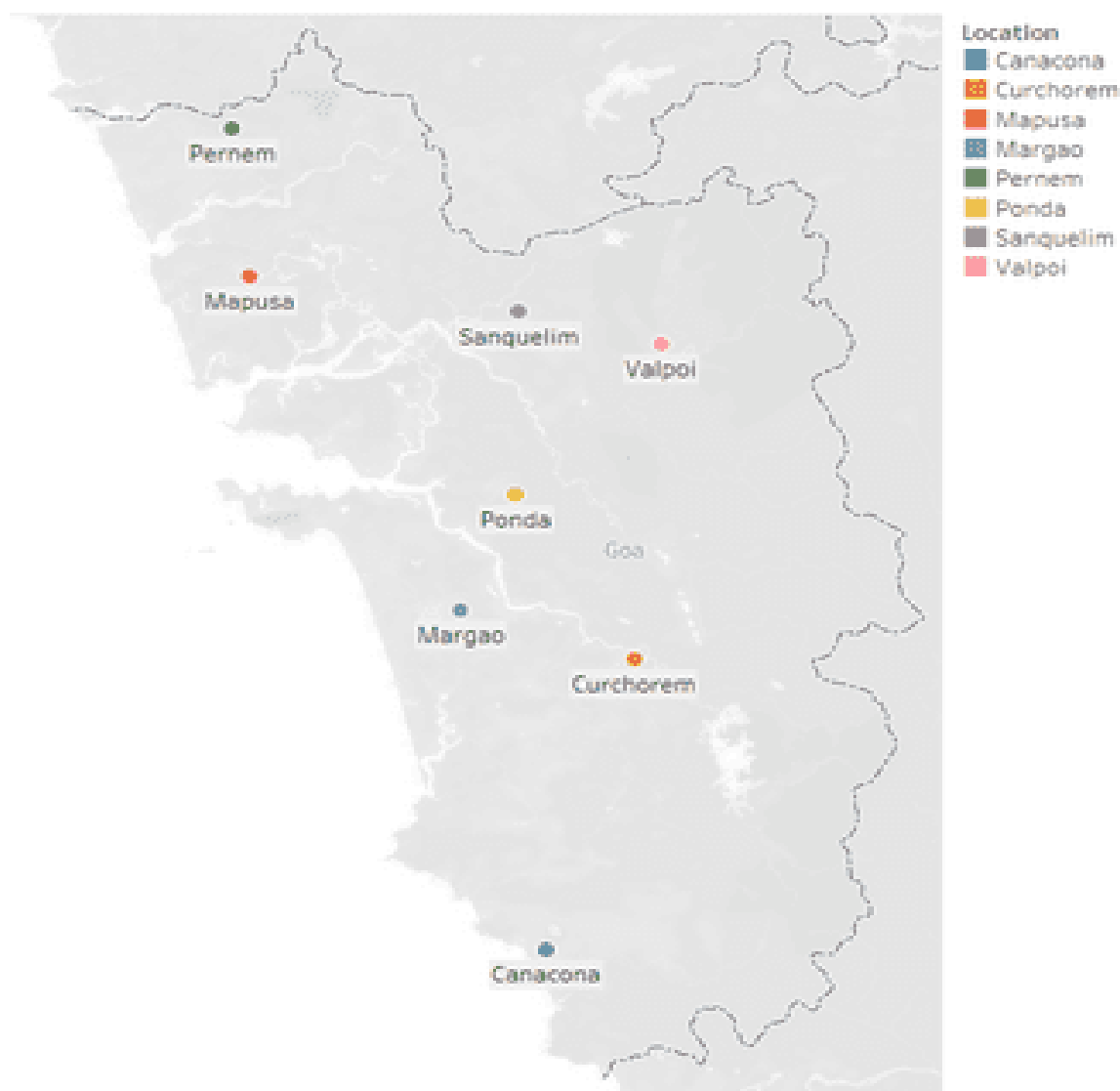
Figure 1: APMC Yards in the State of Goa

In addition to market yards, check posts have been strategically placed to regulate and facilitate the movement of agricultural produce. The Patradevi Check post, Mollem Check post, Pollem Check post, and Keri Check post are pivotal in monitoring and managing the inflow and outflow of goods, ensuring compliance with regulatory standards and providing necessary support to the agricultural supply chain. These infrastructures collectively contribute to a more organized and efficient marketing system, benefiting both producers and consumers by ensuring better price realization and quality control. With eight market yards and four check posts in total, the agricultural trade in Goa is well-supported and regulated.

Facilities

Presently, the regulation of agricultural commodities in Goa encompasses 27 notified commodities within the market area. These commodities, carefully selected for their significance in the region's agricultural economy, are subject to systematic regulation to ensure fair trading practices and to support the agricultural community effectively. The market yards are equipped with a range of facilities to enhance the trading experience for both buyers and sellers. Among the essential amenities provided are spacious auction platforms, which offer ample space for the organized and transparent auctioning of goods. Traders and producers can utilize small and big stalls, catering to different scales of business operations. To address storage needs, there are godowns available, ensuring that produce can be safely stored under appropriate conditions.

The infrastructure also includes an office building that houses administrative functions and provides a central point for market operations. The entire market area is enclosed by a compound wall, enhancing security and management. Basic amenities such as electricity, water, and sanitary arrangements are well-maintained to ensure a hygienic and functional environment. Additionally, a canteen facility is available, providing refreshments and meals to traders, farmers, and visitors. Specialized facilities include a fumigation chamber for the treatment of betelnuts, ensuring they meet quality standards before sale. A betelnut grading machine is also provided to assist in the classification and quality assessment of betelnuts. For the convenience of farmers who travel to the market, a farmers' rest house is available, offering a place to rest and refresh. Security is a priority, with watchman quarters provided to ensure the presence of security personnel.

The market infrastructure is further supported by asphalt roads, facilitating smooth transportation within the market area. Wells are available to ensure a consistent water supply. Additionally, a banking institution is present within the market yard, providing essential financial services to traders and farmers, making transactions easier and more secure. Overall, the comprehensive range of facilities in Goa's market yards underscores the commitment to creating a conducive and efficient trading environment. These amenities not only support the logistical needs of trading but also enhance the overall experience for all stakeholders involved in the agricultural market system.

Schemes

The Goa Agricultural Produce and Livestock Marketing Board has implemented "The Agricultural Produce Arrival Incentive Scheme" to support and encourage the producers and sellers of key commodities such as coconut, betelnut, and cashewnut. This scheme, introduced in the financial year 2007-08, provides cash incentives to eligible producers, and it has been extended annually to ensure continuous support to the agricultural community.

Under this scheme, coconut producers and sellers are entitled to receive Rs. 100 per thousand nuts. To qualify for the incentive, the producer must have a lot of at least 500 nuts. The maximum incentive that a producer can claim under this category is capped at Rs. 2000. For betelnut producers and sellers, the scheme offers an incentive of 50 paise per kilogram of betelnut. To be eligible, the producer must have a minimum lot of 40 kilograms. Similar to the coconut incentive, the maximum amount that can be claimed by a betelnut producer is Rs. 2000. Producers and sellers of raw cashewnuts are also included in the scheme. They are eligible for an incentive of 25 paise per kilogram of raw cashewnuts. The minimum lot size required to claim this incentive is 40 kilograms, for which the producer will receive Rs. 15. The maximum incentive for raw cashewnut producers is likewise capped at Rs. 2000.

This scheme is designed to provide financial support directly to the producers, helping them to cover costs and encouraging the production and sale of these important commodities. By offering cash incentives, the Goa Agricultural Produce and Livestock Marketing Board aims to improve the economic viability of agricultural activities, thereby boosting the overall productivity and income of the farming community. The regular extension of the scheme reflects the government's commitment to sustaining agricultural growth and supporting the livelihoods of farmers in Goa.

e-NAM

The National Agriculture Market (e-NAM) is a comprehensive electronic trading platform designed to connect existing Agricultural Produce and Livestock Market Committees (APMCs) across India, establishing a unified national market for agricultural commodities (Arora 2013). This initiative is led by the Small Farmers Agribusiness Consortium (SFAC) under the Ministry of Agriculture and Farmers' Welfare, Government of India. e-NAM aims to promote uniformity in agricultural marketing by streamlining procedures across integrated markets, which helps

eliminate information asymmetry between buyers and sellers. By creating a more transparent and efficient market environment, e-NAM facilitates real-time price discovery based on actual supply and demand (Acharya et al., 2011). The mission of e-NAM involves integrating APMCs nationwide through a common online market platform, thereby facilitating pan-India trade in agricultural commodities (Chand 2016). This integration ensures better price discovery through a transparent auction process that considers the quality of produce. Additionally, e-NAM supports timely online payments, making transactions more efficient and ensuring that the process is completed promptly, thus enhancing overall market transparency and efficiency.
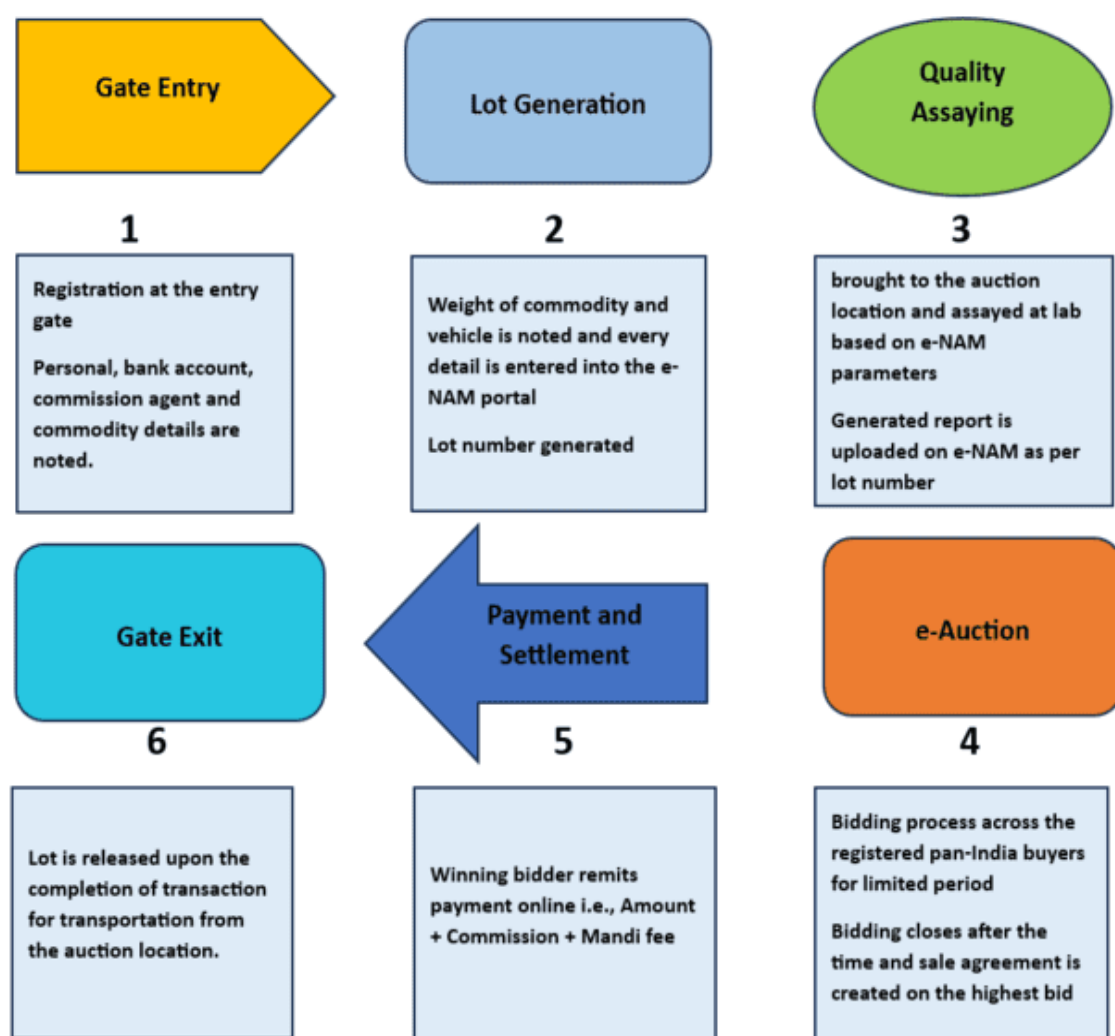
Figure 2: e-NAM process flow

Figure 3: e-NAM Platform Screenshot

e-NAM Stakeholders

1. APMC

The e-NAM (National Agriculture Market) initiative involves various stakeholders, including Agricultural Produce and Livestock Market Committees (APMCs) (Reddy 2018). An APMC is a regulatory body established under the Agricultural Produce and Livestock Market (APLM) Act, aimed at managing and overseeing the market activities related to agricultural produce and livestock. The purpose of these committees is to ensure the orderly and regulated marketing of these commodities, which is essential for maintaining market stability and fairness. An APMC Yard, also known as a Regulated Market Committee (RMC) Yard, refers to any location within the market area that is managed by a Market Committee (Kalamkar 2019). This includes not only physical spaces such as structures, enclosures, and open areas but also facilities such as warehouses, silos, pack houses, and units dedicated to cleaning, grading, packaging, and processing. The comprehensive management of these facilities is crucial for regulating the marketing processes of the notified agricultural produce and livestock (Ranjith Kumar et al., 2020). As of now, the e-NAM network integrates 1389 markets spread across 23 states and 4 Union Territories. This extensive network demonstrates

the widespread adoption and impact of the e-NAM platform in enhancing market efficiency and transparency (e-NAM).

For APMCs to become part of the e-NAM network, several reforms need to be implemented within their APMC Acts. These reforms include the introduction of a single unified trading license that is valid across the entire state, which simplifies the trading process and reduces administrative burdens. Additionally, there must be a single point levy of market fees throughout the state to ensure uniformity and fairness in fee collection. Another important reform is the provision for e-auction or e-trading, which serves as a modern and efficient method for price discovery in the market. The benefits of e-NAM for APMCs are significant. The platform offers free software for system integration and automation of transaction recording, which streamlines operations and enhances accuracy. APMCs receive complete and up-to-date information on trade activities, including real-time arrival recording, which helps in better market planning and decision-making. e-NAM also allows for the analysis of price trends, arrival patterns, and trading activities, providing valuable insights for improving market strategies. The automation of financial record-keeping reduces manual errors and administrative costs, and the overall reduction in manpower requirements contributes to increased operational efficiency.

2. Farmers

Farmers can participate in the e-NAM (National Agriculture Market) platform through several convenient registration methods. Registration can be completed online via the e-NAM portal at www.enam.gov.in, through the e-NAM mobile application, or directly at the mandi registration gate entry. To register at an e-NAM mandi, farmers need to visit their nearest e-NAM mandi with the appropriate documents. The registration process itself is straightforward and incurs no fees. Required details include personal information such as name, sex, address, date of birth, mobile number, and bank details. Essential documents for registration include a passbook or a cheque leaf, and any government-issued identity proof. The e-NAM platform offers numerous benefits for farmers. It promotes transparency in trade by providing better price discovery mechanisms. Farmers gain access to a broader market and a larger pool of buyers, enabling them to make more informed selling decisions. Real-time information on prices and arrivals at nearby mandis helps farmers stay updated on market conditions. Additionally, the platform facilitates quicker payments, which supports the

development of a healthy financial profile for farmers. e-NAM enhances the chances of securing better prices for produce through transparent bidding processes and increased competition from buyers across various markets. This system grants farmers greater negotiation power and ensures that prices are more reflective of the quality of their produce, thanks to the practice of assaying. Payments for produce sold through e-NAM are streamlined via electronic methods such as RTGS, NEFT, and BHIM UPI. These online payment systems ensure that funds are transferred instantly to the seller's bank account, making the transaction process efficient. The time it takes to sell produce can vary, though e-NAM aims to expedite the process. The system records all arrivals digitally and assigns unique LOT IDs, which can be tracked from a mobile device until the sale is completed. While digitization helps speed up transactions, the overall duration depends on factors such as the volume of arrivals at the mandi and the specific season.

3. Traders

Traders can register on the e-NAM (National Agriculture Market) platform through multiple convenient methods. Registration can be completed online via the e-NAM portal at www.enam.gov.in, through the e-NAM mobile application, or by physically visiting a mandi for on-site registration. There are no fees associated with registration on e-NAM. Traders must provide basic mandatory details, including their name, sex, address, date of birth, mobile number, and bank details. Additionally, required documents include a passbook or cancelled cheque, a government-issued ID card, a trading license, and other relevant documents. e-NAM offers several benefits to buyers and traders. It extends their reach to other mandis, thereby providing access to a larger pool of sellers. Traders can tap into a more extensive and integrated market network, benefit from real-time information on the arrival, quality, and price of commodities, and enjoy the convenience of conducting business through the mobile app. The platform also facilitates online banking and payments, enhancing ease of transactions.

Figure 4: Traders' outlet in the Goa Agricultural Produce and Livestock Marketing Board, Ponda sub-yard.

To secure better quality produce, e-NAM provides quality assaying services for 219 commodities based on parameters specified by the Directorate of Marketing and Inspection (DMI). Traders can assess the quality of produce through assaying certificates issued by the authorities, which are accessible on the mobile app. Payments to sellers are encouraged through electronic methods, including RTGS, NEFT, debit or credit cards, and BHIM. These e-payment options ensure swift and secure transactions. Trading on e-NAM is conducted electronically through a transparent bidding process, which enhances the fairness and efficiency of market transactions. To register for a trader's license, applicants must submit several documents, including a copy of the company's registration (whether partnership, private, or public limited), the Memorandum of Association or related articles for private limited companies, and the latest annual audited balance sheet. Additionally, applicants need to provide two passport-sized photos, a bank guarantee or cash security deposit of Rs. 10,000/-, a photo ID (such as an election card or Aadhaar card), and an authority letter for the authorized signatory. The registration fee is Rs. 530, and the application form can be obtained at the office for Rs. 10.

4. FPOs

Farmer Producer Organizations (FPOs) can register on the e-NAM (National Agriculture Market) platform through several methods. Registration can be completed via the e-NAM portal at www.enam.gov.in, through the e-NAM mobile application, or

by visiting a nearest e-NAM mandi in person. For registration, FPOs or Farmer Producer Companies (FPCs) need to provide specific details, including the name of the organization, and the name, address, email ID, and contact number of the authorized person, such as the Managing Director, CEO, or Manager. Additionally, bank account details are required, including the name of the bank, branch, account number, and IFSC code. The concept of Farmer Producer Organizations (FPOs) is designed to enable farmers, who are the producers of agricultural products, to come together and form groups. This initiative is supported by the Small Farmers' Agribusiness Consortium (SFAC), which operates under the Department of Agriculture and Cooperation, Ministry of Agriculture, Government of India. The SFAC is responsible for assisting state governments in the formation and support of FPOs, facilitating better organization and resource management among farmers. The primary role of FPOs is to serve as aggregators for their member farmers. They help in managing various aspects of the agricultural value chain, from inputs to outputs, which enhances economies of scale and strengthens the bargaining power of member farmers. FPOs also play a crucial role in organizing logistics for unsold lots, ensuring efficient distribution and market access for their members.

Figure 5: One of the FPO organization in the state of Goa, Sanquelim office

FPOs and FPCs benefit from e-NAM in multiple ways. They can aggregate produce from their members and sell it through e-trading platforms either as single or multiple

lots, depending on market requirements. Payments for the transactions are made directly to the FPO's or FPC's bank account, which can then be distributed among the individual member farmers. The Union Budget for 2017-18 also allocated provisions for setting up collection, sorting, grading, and packing facilities at FPO premises. Additionally, FPOs are provided with a personalized dashboard on e-NAM and access to real-time information on the arrival, quality, and price of commodities. As of now, there are 3,366 FPOs registered on the e-NAM platform, indicating a significant level of engagement with the system. Payments for transactions are streamlined through e-NAM. All payments are credited to a single bank account of the FPO or FPC. After receiving the payment, the FPO or FPC is responsible for disbursing the funds to individual member farmers. FPOs and FPCs are also provided access to the e-NAM Dashboard, where they can view Management Information System (MIS) reports and other trade-related reports, facilitating transparency and efficient management of their operations.

5. Mandi Board

To integrate their mandis with the e-NAM (National Agriculture Market) platform, State Agriculture Marketing Boards (mandi boards) must adhere to specific reforms in their Agricultural Produce and Livestock Market Committee (APMC) Act. These reforms include implementing a unified single trading license that is valid across the entire state, instituting a single point levy of market fees throughout the state, and incorporating provisions for e-auction or e-trading as a method for price discovery. As of now, 23 states and 4 Union Territories have successfully joined the e-NAM network. Mandi boards benefit significantly from e-NAM through system integration and automation of transaction recording. This integration provides comprehensive and detailed information on trade and farmers, enabling mandi boards to effectively analyze price trends, arrival patterns, and trading activities. The automation of financial records further streamlines operations and improves accuracy in financial management. Currently, there are 27 mandi boards across India. To join the e-NAM platform, a mandi board must follow the operational guidelines set forth by the Government of India. These guidelines outline the necessary steps and compliance requirements for integration with the e-NAM system. Adhering to these guidelines ensures that the mandi board can successfully implement e-NAM functionalities and benefit from the platform's features.

About Goa Bagayatdar Sahakari Kharedi Vikri Saunstha Maryadit

Goa Bagayatdar Sahakari Kharedi Vikri Saunstha Maryadit stands as Goa's largest cooperative society, deeply rooted in the spirit of cooperation from the grassroots to the apex level. Our mission is to assist farmers in thriving through the timely supply of reliable agricultural inputs and the production of high-quality horticultural products while expanding our distribution network. Established on July 31, 1964, under the name "Central Supari S.K.V. Society Ltd." in Ponda, Goa, the society began with an initial capital of Rs. 10,500 contributed by 116 members. By the end of its first year, the membership had grown to 250, with a share capital increase to Rs. 31,800, including a Rs. 15,000 contributions from the Government of Goa. Initially focused on securing better prices for arecanut produced by its members, the society recorded a modest profit of Rs. 800 in its first year with a small staff of just two employees.

In 1975, a significant change occurred when the government decided to merge the "Goa Coconut Producers Co-op. Marketing and Processing Society" at Margao with the Supari Society. Consequently, the society's name was changed to "Goa Bagayatdar S.K.V. Society Ltd." Later, with an increase in paid-up capital, it was renamed "Goa Bagayatdar Sahakari Kharedi Vikri Saunstha Maryadit." Our primary objectives are to secure optimal prices for

members' horticultural produce, supply consumers with quality goods at reasonable rates, and provide a marketplace for goods produced by small-scale and home industries, thus generating employment and fostering economic prosperity and socio-economic development in rural areas. We offer our employees the best terms and conditions and contribute significantly to government revenue through sales tax, GST, income tax, TDS, and market fees. Moreover, we act as a medium for implementing various government schemes for horticulturists, providing commodities to the general public under one roof and maintaining price stability and control in the market.

The society prides itself on observing and implementing the core principles of cooperation essential for the cooperative sector. These principles include voluntary and open membership, democratic member control, autonomy and independence, member economic participation, education, training, and information, cooperation among cooperatives, concern for community, and socio-economic development. Our membership is open to any horticulturist cultivating horticultural land in Goa. Annual General Body meetings are well-attended and interactive, reflecting the active participation of members from

across the state. Through our unparalleled dedication and commitment to work and people, we provide farmers and other cooperative society members with maximum remuneration for their horticultural produce while offering consumers quality goods at competitive rates. In an increasingly competitive environment, we continue to thrive and evolve, building on our foundation of cooperative culture, networking, market insight, and respect for both producers and consumers.

The election of the Board of Directors for the Goa Bagayatdar Sahakari Kharedi Vikri Saunstha Maryadit occurs every five years. During these elections, the Chairman and Vice-Chairman are elected from among the directors. The society operates without any political interference or pressure from the government or external agencies. A notable aspect of its financial management is the maintenance of substantial reserves, as members have consistently preferred a low dividend rate. Additionally, the society provides price incentives for horticultural produce procured from its members. To enhance the skills and knowledge of its members, the society organizes training sessions in collaboration with the Agriculture Department, ICAR, and reputable agricultural and fertilizer industries. These training programs include visits to progressive farms in neighboring states. The society is a member of the Goa Rajya Sahakari Union, and some smaller societies are members of the Goa Bagayatdar Sahakari Kharedi Vikri Saunstha Maryadit. It aims to offer the best prices for horticultural produce and provide quality goods to the community at reasonable rates. To encourage education, the society awards academic achievements to the children of members and staff annually.

The society supports small-scale industries and self-help groups by selling their products in its Bagayatdar Bazar (supermarkets), thereby promoting the socio-economic development of rural populations. Significant revenue contributions are made to state funds through GST, income tax, TDS, and market cess. Initially focused on trading arecanut (supari) from Goa, the society has expanded its commercial activities due to market competition and changing government policies. It now engages in the buying and selling of various agricultural products such as arecanut, cashewnut, coconut, black pepper, otum sol, kokum sol, paddy, and copra. The society also sells agricultural inputs like fertilizers, pesticides, seeds, cattle feed, agricultural equipment, irrigation systems, grocery items, consumables, clothing, stationery, footwear, rainwear, sports goods, plastic items, steel utensils, toys, and gifts.

Additionally, it provides loans through a credit counter and facilitates the buying and selling of locally produced fruits and vegetables. To support small entrepreneurs, especially from rural areas, the society offers a ready marketplace for their products. It also engages in nursery activities, supplying farmers with seeds, grafts, and plants of various varieties. The society deals in organic cashew farming as well. The society operates seven outlets located in Ponda, Curchorem, Canacona, Valpoi, Sanquelim, Mapusa, and Pernem within the market yards of the Goa State Agriculture Marketing Board. It also has its own outlets in Bicholim, Assnora, Marcel, Mardhol, Shiroda, and Netravali. These outlets are involved in the buying, storing, and selling of horticultural produce like arecanut, cashewnut, coconut, black pepper, paddy, copra, otum sol, and kokum sol. Members receive daily purchase rates for agricultural and horticultural produce through mobile SMS, the website, and SMS notifications. The Goa State Agriculture Marketing Board provides fumigation and grading facilities for arecanut at Ponda and Sanquelim market yards. In the agriculture section, the society sells fertilizers, pesticides, seeds, grafts, plants, cattle feed, agricultural equipment, and irrigation systems. It also offers services such as coconut dehusking and grading, coconut copra and arecanut sorting, arecanut fumigation and grading, and the provision of irrigation and cattle feed. Through its comprehensive range of activities, the society supports both the agricultural productivity and socio-economic development of its members and the broader community.

Objective of the present study

1. To examine the extent of operation, adoption and realization of extended benefits of e-NAM to farmers and other key stakeholders in the selected APMC mandis in Goa.

2. To determine the pattern of participation by smallholders in this new electronic market system.

3. To estimate the benefits arising from the participation by the farmers in the e-NAM platform in terms of price and viability.

4. To suggest possible interventions required for the large-scale adoption of e-NAM in Goa.

5. To identify the inherent challenges involved in the large-scale adoption of e-NAM in Goa and suggest possible interventions required to mitigate the issues.

6. To recognize challenges associated with connecting e-NAM of different states with each other for trading and explore whether Negotiable Warehouse Receipts (NWRs) work in Goa.

Organization of the Report

The remainder of this report is organized as follows. Chapter 2 delves into the data collection methods, sampling techniques, and the overall methodology adopted for the study. The analysis begins in Chapter 3, which examines the extent of operation, adoption, and realization of the extended benefits of e-NAM in the selected APMC mandis in Goa. Chapter 4 analyzes the pattern of participation by smallholders in the e-NAM platform, followed by Chapter 5, which estimates the benefits that farmers derive from participating in the platform, particularly in terms of price and viability. Chapter 6 identifies the challenges involved in the large-scale adoption of e-NAM in Goa and suggests possible interventions to address these issues. The exploration of challenges related to inter-state connectivity of e-NAM platforms and the effectiveness of Negotiable Warehouse Receipts (NWRs) in Goa is provided in Chapter 7. Finally, Chapter 8 concludes the study with a summary of the findings, followed by strategic policy recommendations aimed at enhancing the adoption and effectiveness of e-NAM in Goa.

Chapter 2: Assessment of e-NAM Adoption and Benefits in Goa's APMC Mandis

Introduction

The e-NAM (Electronic National Agriculture Market) platform aims to revolutionize agricultural marketing by facilitating seamless interactions among farmers, intermediaries, and government officials. Effective operation within e-NAM is crucial for these stakeholders to fully realize the platform's benefits. This chapter evaluates the extent of e-NAM's operation, adoption, and the realization of its extended benefits in Goa's APMC mandis. e-NAM is designed to offer several advantages to farmers. These benefits include higher price realization due to broader market access, the convenience of online payments, time savings from reduced travel and paperwork, improved facilities for assessing the quality of produce, and enhanced transparency in the sale process. This indicates that the e-NAM platform provides tangible financial benefits and increased market opportunities for farmers.

While the potential benefits of e-NAM are substantial, the effective adoption of the platform hinges on several factors. Farmers from different regions may experience varying levels of benefit based on their crop type and regional market dynamics. To maximize the benefits of e-NAM, it is imperative that the government considers need-based training for farmers. This training should be tailored to the farmers' specific needs, including the content, methodology, language, and location. A well-structured training program can enhance farmers' ability to utilize the e-NAM platform effectively and reap its full benefits. Studies have emphasized the need for awareness creation and capacity building as essential components for successful e-NAM implementation. The adoption of the e-NAM portal has significantly impacted the agricultural market by providing crucial price information for various agricultural products, which has minimized the gap between farmers and traders (Rohtash Kumar et al., 2023).

This chapter aims to assess the overall adoption and benefits of e-NAM across different stakeholder groups. Using the combined data from farmers, traders, and officials allows for a comprehensive analysis that includes perspectives from all relevant parties. To assess the e-NAM adoption in the state of Goa the analysis uses the Chi-Square test to explore the relationship between different stakeholder groups (farmers,

traders, and officials) and their awareness of the e-NAM portal, a critical digital initiative aimed at improving the efficiency and transparency of agricultural markets in India. The objective is to assess whether the level of awareness about the e-NAM portal varies significantly across these groups, which could have important implications for the portal's adoption and overall effectiveness. The data comprises three categories of respondents: 174 farmers, 30 officials, and 30 traders. The variable which measures the awareness of the e-NAM portal, with 1 indicating awareness (Yes) and 0 indicating lack of awareness (No). The distribution of awareness across the different stakeholder groups is presented in the following contingency table:

Statistical Analysis:

In evaluating the impact of e-NAM, appropriate statistical tools and techniques were employed. Data collected during the 2023-24 period were analyzed using a chi-square test to examine hypotheses related to the adoption and benefits of e-NAM. This analysis helps in understanding the statistical significance of various factors influencing e-NAM's effectiveness and adoption. For instance, hypotheses regarding the relationship between farmers' engagement with e-NAM and their economic outcomes were tested to provide empirical evidence supporting the platform's impact.

Chi-Square Test

The Chi-Square test was conducted to determine if there is a statistically significant association between the type of respondent and their awareness of the e-NAM portal. The test produced a Pearson Chi-Square statistic of 55.1407 with a corresponding p-value (Pr) of 0.000. The p-value is significantly lower than the conventional significance level of 0.05, leading to the rejection of the null hypothesis. This result indicates that there is a statistically significant relationship between the stakeholder group and awareness of the e-NAM portal. In other words, awareness of the e-NAM portal is not evenly distributed across the different respondent categories.

Table 1: Chi-Square test for the association between the type of respondent and their awareness of the e-NAM portal

Respondent	Awareness (0=Not Aware)	Awareness (1=Aware)	Total
Farmer	116	58	174
Official	0	30	30
Trader	25	5	30
Total	141	93	234
Chi-Square Statistic	55.1407		
Degrees of Freedom (df)	2		
P-Value (Significance)	0.000***		

The analysis reveals substantial differences in e-NAM portal awareness among farmers, traders, and officials. The results indicate the following:

Of the 174 farmer respondents, 116 (66.7%) are not aware of the e-NAM portal, while 58 (33.3%) are aware. This suggests that a significant proportion of farmers, who are key beneficiaries of the e-NAM portal, lack awareness of this important digital resource. This could be due to several factors, including limited access to information, digital literacy challenges, or insufficient outreach efforts. All 30 official respondents reported being aware of the e-NAM portal, indicating full awareness within this group.
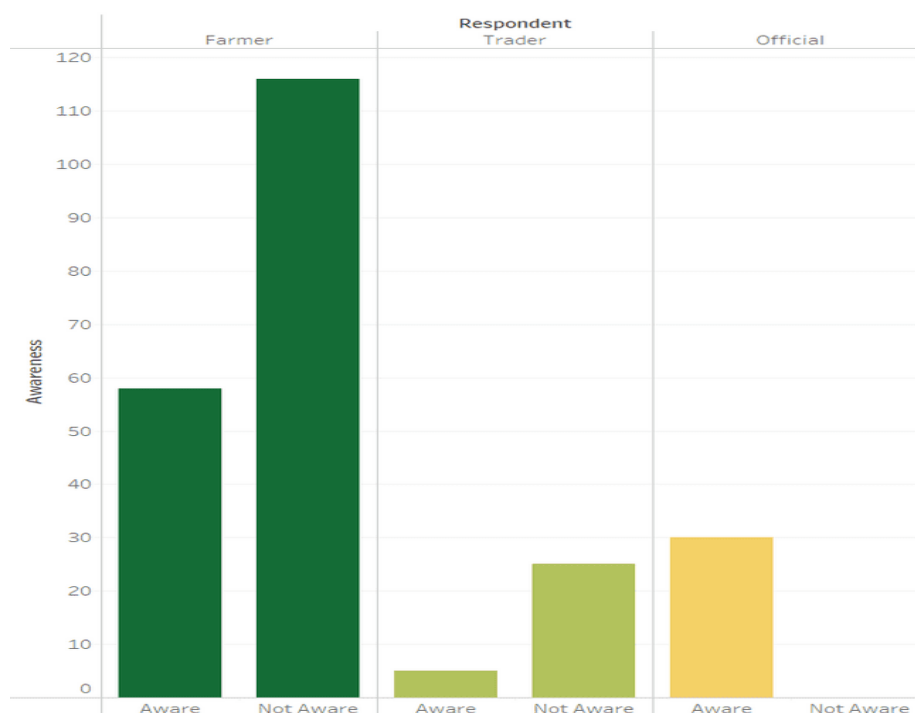
Figure 6: The Chi-square test representation for the type of respondent and their awareness of the e-NAM portal

Given their role in administering and promoting agricultural policies, it is expected that officials would have comprehensive knowledge of the e-NAM portal. Their universal awareness underscores the importance of their role in disseminating information and encouraging adoption among other stakeholder groups. Among the 30 trader respondents, 25 (83.3%) are not aware of the e-NAM portal, while only 5 (16.7%) are aware. This low level of awareness among traders, who are also essential participants in the agricultural market, highlights a significant gap that needs to be addressed. Traders' lack of awareness may hinder the portal's effectiveness in creating a more integrated and transparent market system.

The significant association between respondent type and awareness of the e-NAM portal has important implications for policy and practice. The high level of awareness among officials suggests that the issue is not one of information availability, but rather one of information dissemination and engagement with the target audiences, particularly farmers and traders. Outreach programs should be intensified to increase farmers' awareness of the e-NAM portal. This could include targeted training sessions, workshops, and the use of local language media to ensure that the benefits and functionalities of the portal are communicated effectively. Similar efforts are needed to raise awareness among traders. Additionally, engaging trader associations and

using digital platforms that traders commonly use could improve their understanding and use of the e-NAM portal.

Ordered Logistic Regression

The table defines the dependent and independent variables involved in the study. The dependent variable is the rating of how helpful the e-NAM portal is in a respondent's job, measured on a scale from 1 to 5, with 1 being the lowest rating and 5 being the highest. The expected sign for this variable is positive, indicating that higher ratings would suggest a more favorable view of the portal's usefulness.

Table 2: The definition and description of variables

Variables	Description and source	Expected sign
Dependent variables		
e-NAM helpful in job	rating 1, 2, 3, 4, 5 (1 being the lowest and 5 being the highest rating)	+
Independent variables		
Knowledge to use e-NAM portal	rating 1, 2, 3, 4, 5 (1 being the lowest and 5 being the highest rating)	+/-
Technological compatibility	rating 1, 2, 3, 4, 5 (1 being the lowest and 5 being the highest rating)	+/-
Can get help if necessary	rating 1, 2, 3, 4, 5 (1 being the lowest and 5 being the highest rating)	+

The independent variables are:

Knowledge to use the e-NAM portal: This variable also ranges from 1 to 5, where a higher score indicates greater knowledge. The expected sign is either positive or negative, implying that while greater knowledge could enhance the perception of the portal's usefulness, it might also reveal complexities that reduce its perceived helpfulness.

Technological compatibility: This measures the ease with which respondents can use the technology required by the e-NAM portal. Again, it is rated from 1 to 5, with the expected sign being positive or negative, suggesting that compatibility could either facilitate or hinder the portal's perceived utility.

Ability to get help if necessary: Rated from 1 to 5, this variable reflects the ease of obtaining assistance when needed. The expected sign is positive, indicating that better access to help should increase the perceived usefulness of the e-NAM portal.

Table 3: The result for the ordered logit regression for the usefulness of e-NAM for the respondents

Dependent variable_ e-NAM helpful in job		
Independent variables	**Parameter estimate**	**P value**
Knowledge to use e-NAM portal	-1.17	0.000***
Technological compatibility	3.01	0.000***
Can get help if necessary	18.01	0.991

The results of the analysis, as shown in the table, provide parameter estimates and p-values for each independent variable's relationship with the dependent variable, "e-NAM helpful in job." These statistics reveal important insights into the factors that influence how respondents perceive the usefulness of the e-NAM portal in their professional roles.

Knowledge to use the e-NAM portal: The parameter estimate for this variable is -1.17, with a p-value of 0.000. This result is statistically significant, indicating that knowledge of how to use the e-NAM portal has a strong and negative impact on its perceived usefulness in jobs. The negative coefficient suggests that as users become more knowledgeable about the portal, they may find it less helpful, possibly due to the discovery of limitations or complexities that were not apparent initially.

Technological compatibility: This variable has a parameter estimate of 3.01 and a p-value of 0.000, making it statistically significant. The positive coefficient indicates that greater technological compatibility significantly enhances the perceived usefulness of the e-NAM portal. Respondents who find the technology easy to integrate into their existing systems are likely to rate the portal as more helpful in their work,

underscoring the importance of user-friendly technology in the adoption of digital platforms.

Ability to get help if necessary: The parameter estimate for this variable is an exceptionally high 18.01, but the p-value is 0.991, rendering this result statistically insignificant. This suggests that while respondents may believe they can get help when needed, this factor does not significantly influence their perception of the e-NAM portal's usefulness. The insignificance of this variable could imply that the availability of help is either taken for granted or does not play a critical role in how the portal is perceived, possibly because other factors like technological compatibility are more influential.

Constraints and Future Considerations:

Despite the benefits, there are several constraints to e-NAM's adoption. A significant number of smallholder farmers remain outside the purview of the structural changes introduced by e-NAM due to a lack of awareness about the incentives and benefits offered through the platform. This highlights the need for revisiting the implementation process and potentially incorporating additional features to address the specific needs of smallholder farmers. Particularly, farmers from northern regions have reported benefiting from better price realization after e-NAM's implementation, suggesting regional disparities in the platform's impact. To extend e-NAM's benefits more broadly, targeted interventions are required to include underserved farmer populations and enhance their participation.

In summary, e-NAM has the potential to significantly benefit farmers and other stakeholders through improved market access, financial gains, and operational efficiencies. However, the platform's success hinges on overcoming adoption barriers and ensuring widespread benefits. The analysis indicates that while technological compatibility significantly influences the perceived usefulness of the e-NAM portal, increasing user knowledge may lead to less favorable perceptions. Furthermore, while the availability of help is a positive feature, it does not significantly impact user perceptions in this context. To enhance e-NAM's effectiveness and adoption, a multifaceted approach is needed, focusing on improving technological compatibility, addressing issues related to user knowledge, and bridging the awareness gap. This approach should include targeted training, educational programs, incentives, and

support for digital literacy. Policymakers and administrators must ensure that these strategies are implemented to help all stakeholders fully benefit from e-NAM, ultimately achieving a more efficient and transparent agricultural market system in Goa's APMC mandis.

Chapter 3: Demography and Participation Patterns of Smallholders in Goa's e-NAM

Goa -Population, language, geography

Goa, with its capital at Panaji, spans an area of 3,702 square kilometers. The state's population stands at 1,458,545, comprising 739,140 males and 719,405 females. Between 1991 and 2000, the population growth was 14.8%, slightly lower than the 16.08% growth recorded between 1981 and 1990. In 2011, Goa's sex ratio, which indicates the number of females per thousand males, was 973, an improvement from 967 in 1991. The population density per square kilometer increased from 316 in 1991 to 364 in 2001, with North Goa exhibiting a higher density of 437 compared to South Goa's 300. The national average density during this period was 324. Goa boasts an impressive literacy rate of 80%, with 83.3% of males and 76.4% of females being literate. The religious composition of the state is predominantly Hindu at 64.68%, followed by Christians at 29.86%, and a minority of Muslims at 5.25%. Additionally, approximately 0.15 to 0.2 million of Goa's population of 1,343,998 are immigrants from various parts of India who have made Goa their home.

The principal languages spoken in Goa are Konkani, Marathi, and English. Portuguese, the language of colonial rulers until the state's liberation in 1961, has seen a significant decline in use. Despite being the official language and medium of study during Portuguese rule, it remained the language of the elite and failed to resonate with the majority of Goans. After the Portuguese left, the language quickly fell out of favor and usage, though a small segment of the pre-liberation generation still uses it. Goa's rich history, marked by diverse influences from various regions, ethnicities, and religions, has contributed to its status as a multilingual state.

Goa's natural resources are plentiful. The state has a forest cover of over 1,424 square kilometers, accounting for nearly one-third of its total area. These forests are economically significant, providing valuable products such as bamboo, Maratha barks, chillar barks, and bhirand. Coconut trees are ubiquitous throughout Goa, except in the upper regions, and the state's vegetation also includes cashew, mango, jackfruit, and pineapples. The state's mineral wealth is substantial, with major resources including iron ore, manganese, ferro-manganese, bauxite, and silica sand. The iron and

manganese mining industries form the backbone of Goa's economy. Additionally, Goa is traversed by several major rivers, such as the Mandovi, Zuari, Terekhol, Chapora, and Betul, with other notable rivers including the Tiracol, Chapora, Sal, and Talpona.

Climate & Rainfall: Goa receives rainfall from the southwest monsoons, averaging 2,800 mm annually, primarily from June to September. Occasional thundershowers occur in May and October. The climate is warm and humid, with summer temperatures ranging from 24°C to 36°C and winter temperatures between 21°C and 30°C.

Humidity and Altitude: The average relative humidity in Goa is 75.90%. Land elevation in Goa ranges from sea level to 1,022 meters, with the highest point being the Wagheri Hills in Sattari taluka. The Ghat section of NH-4 rises to 650 meters MSL near Anmod.

Soils: Goa's soils are predominantly lateritic (81%), sandy loam to silt-loam in texture, well-drained, and highly acidic (pH 5.5 to 6.5). They have moderate organic carbon content and are poor in potash. About 11% of the soils along the seacoast and estuaries are sandy-to-sandy loams, including the Ker lands and beach fronts. The remaining 8% are alluvial, found in the Khazans and adjoining areas with high water tables and susceptibility to saline water inundation.

Land Types: Goa's diverse topography gives rise to various land types, each supporting different forms of agriculture and contributing to the state's agricultural richness.

Khazan Land: These low-lying areas are often situated below sea level along estuaries. Characterized by their unique hydrology, Khazan lands are protected by embankments and sluice gates that regulate the inflow and outflow of saline water. This management allows for the cultivation of monsoon paddy, which is well-adapted to these waterlogged conditions. Following the monsoon season, these lands are used for growing Rabi vegetables such as brinjal, spinach, and various gourds. Additionally, pisciculture is practiced in some areas by regulating water flow, contributing to the local fish supply.

Ker Land: This flat land, located at low elevations above sea level, features a high-water table that makes it suitable for multiple cropping through irrigation. The well-drained, sandy to sandy loam soils in Ker lands support the cultivation of Rabi paddy

and a variety of vegetables and pulses. Crops like tomatoes, cucumbers, beans, and pulses such as cowpea and mung bean thrive here. The availability of irrigation makes these lands highly productive, contributing significantly to Goa's agricultural output.

Morod Land: Upland or terraced fields, referred to as Morod land, are ideal for horticultural and plantation crops or a single rain-fed crop of rice. These lands are typically less reliant on irrigation and are used to grow crops like cashew, coconut, and various fruits. The well-drained soils and elevation make Morod lands suitable for plantation crops that require good aeration and minimal waterlogging.

Important Crops of Goa: Goa's agriculture is rich and varied, encompassing a wide range of fruits, field crops, vegetables, flowers, spices, and tubers.

Fruits:

Mango: Mangoes are a significant fruit crop in Goa, with varieties like Mankurad and Alphonso being particularly prized for their sweetness and flavor. Mango orchards are common, and the fruit is consumed fresh, as well as processed into juices, pickles, and jams.

Cashew: Cashew cultivation is widespread, with the nut being a major cash crop. Goa is known for its high-quality cashew nuts and feni, a traditional alcoholic beverage made from cashew apples.

Coconut: Coconut palms are a ubiquitous sight in Goa, providing coconuts used for their water, milk, and oil. Coconut products are essential in Goan cuisine and industry.

Banana: Bananas are grown in many regions, providing a staple fruit that is consumed fresh and used in various culinary preparations.

Pineapple: Pineapple cultivation is prevalent, and the fruit is enjoyed fresh or processed into juices and preserves.

Jackfruit: Jackfruit trees are common in Goa, producing large, nutritious fruits used in both savory and sweet dishes.

Arecanut: Arecanut is another important crop, used primarily for chewing along with betel leaves.

Field Crops:

Paddy: Paddy fields dominate the agricultural landscape, with rice being a staple food. Both Kharif and Rabi paddy crops are grown, depending on the season.

Ragi: Also known as finger millet, ragi is a nutritious cereal crop that is gaining popularity for its health benefits.

Sugarcane: Sugarcane cultivation supports local sugar production and provides raw material for the production of jaggery and other by-products.

Groundnut: Groundnuts are cultivated for their edible seeds and oil, playing an important role in local agriculture.

Cowpea: Cowpea is a versatile pulse crop used in various traditional dishes and valued for its high protein content.

Vegetables:

Brinjal: Also known as eggplant, brinjal is a versatile vegetable used in a variety of Goan dishes.

Bhendi: Okra, or lady's finger, is a popular vegetable grown extensively in Goa.

Chillies: Chillies are widely grown and used to add spice to Goan cuisine.

Cucumber: Cucumbers are cultivated for their refreshing taste and are used in salads and pickles.

Pumpkin: Pumpkins are grown for their edible flesh and seeds, featuring in numerous recipes.

Gourds: Various gourds like bottle gourd, bitter gourd, and ridge gourd are commonly grown and consumed.

Musk Melons: These melons are enjoyed for their sweet, juicy flesh.

Red Amaranthus: This leafy vegetable is rich in nutrients and commonly used in local cuisine.

Radish: Radishes are grown for their crisp, spicy roots and are used in salads and pickles.

Knol-Khol: Also known as kohlrabi, this vegetable is valued for its edible stem and leaves.

Cabbage: Cabbages are grown and used in a variety of dishes, from salads to curries.

Bottle Gourd: This versatile gourd is used in soups, stews, and sweet dishes.

Long Beans: Long beans are a popular vegetable in Goan cuisine, often used in stir-fries and curries.

Cluster Beans: Cluster beans are valued for their tender pods and are used in various dishes.

Flowers:

Jasmine: Jasmine flowers are cultivated for their fragrance and used in garlands and perfumes.

Crossandra: Known for its bright orange flowers, crossandra is popular in gardens and floral decorations.

Dahlia: Dahlias are grown for their vibrant, showy blooms.

Hibiscus: Hibiscus flowers are used for ornamental purposes and in traditional medicines.

Marigold: Marigolds are widely grown for their bright flowers, used in decorations and religious ceremonies.

Orchids: Orchids are cultivated for their exotic and intricate flowers.

Gerbera: Gerberas are popular cut flowers, known for their large, colorful blooms.

Anthuriums: Anthuriums are valued for their striking, heart-shaped flowers.

Gladiolus: Gladiolus flowers are grown for their tall spikes of blooms, used in floral arrangements.

Spices:

Black Pepper: Black pepper is a significant spice crop, grown for its pungent berries used in cooking and seasoning.

Nutmeg: Nutmeg trees produce seeds and mace, both of which are used as spices.

Kokum: Kokum, a specialty of Goa, is highly valued for its unique sweet-tart flavor and deep red color, making it a key ingredient in traditional Goan cuisine, particularly in curries and beverages like sol kadhi. The fruit is also known for its medicinal properties, including aiding digestion and acting as a natural coolant, further enhancing its significance in the local diet and culture.

Turmeric: Turmeric is grown for its rhizomes, used as a spice and in traditional medicine.

Cinnamon: Cinnamon bark is harvested and used as a spice for its sweet, warm flavor.

Tubers:

Colocasia: Also known as taro, colocasia is grown for its starchy corms and edible leaves.

Yam: Yams are cultivated for their large, starchy tubers, used in various dishes.

Elephant Foot Yam: This tuber is valued for its large, edible corm.

Dioscorea: Dioscorea yams are grown for their nutritious tubers.

Sweet Potato: Sweet potatoes are cultivated for their sweet, nutritious roots, used in both savory and sweet dishes.

This diverse range of crops highlights the agricultural richness of Goa and the state's ability to support a wide variety of agricultural activities.

Working of the Agricultural Produce Market Committee (APMC) yards in the state of Goa

Figure 7: The Goa Agricultural Produce and Livestock Marketing Board, Ponda yard

The infrastructure of agricultural mandis in Goa is limited, with only eight regulated markets across the state. Within this network, significant disparities exist. For example, mandis in Margao and Ponda are comparatively better equipped, featuring covered auction platforms, weighing bridges, proper storage facilities, and even some digital transaction systems. These better-equipped markets also benefit from structured layouts with designated zones for traders and transport support, which helps streamline the handling of agricultural produce. In contrast, mandis in other regions face serious infrastructural challenges. Many lack adequate storage facilities, compelling farmers to sell their produce quickly and often at less favorable prices. Poor road connectivity, a shortage of trained manpower, and less organized management contribute to an overall fragmented and inefficient market system compared to the relatively advanced setups in Margao and Ponda.

Goa's Agricultural Produce Market Committee (APMC), now known as the Goa State Agricultural Marketing Board (GSAMB), plays a crucial role in ensuring fair prices for farmers and preventing their exploitation. It provides essential facilities, including spacious auction platforms, storage godowns, office buildings, and infrastructure for grading and quality control. GSAMB has established multiple market yards, including a main yard in Margao and sub-market yards in Ponda, Sanquelim, Mapusa, Curchorem, Valpoi, Canacona, and Pernem. These market yards are equipped with spacious auction platforms for conducting auctions of agricultural produce, small and big stalls for traders and vendors, storage godowns, administrative offices, and facilities such as fumigation chambers for treating betelnut and betelnut grading machines. Additionally, farmers visiting the market have access to accommodations in the form of a farmers' rest house, and there is a canteen facility that provides food and refreshments. The market yards are secured with compound walls and have basic amenities such as electricity, water, sanitary arrangements, asphalt roads for smooth vehicle movement, and wells to ensure a reliable water supply. Financial transactions are facilitated through an on-site banking institution.

GSAMB regulates trading practices to prevent farmer exploitation, ensuring fair prices and facilitating timely payments. It also provides facilities for grading, standardization, and quality certification of agricultural produce and offers market-led extension services to farmers. As part of modernization efforts, GSAMB has introduced e-auction and e-trading to facilitate price discovery. Additionally, it has integrated with the e-National Agricultural Market (e-NAM) to enable system automation, transaction processing, and real-time data access. The main GSAMB office is located in Margao, where major commodities such as coconut, arecanut, and black pepper are traded. Among all the market yards, Ponda is the largest, dealing with a wide range of commodities, including coconut, arecanut, cashew, and banana. The Ponda yard is also equipped with the state's largest warehouse, ripening chambers for bananas, and cold storage for fruits and vegetables. The Mapusa yard primarily handles coconut, fruits, and vegetables, while the Curchorem yard focuses on arecanut and coconut. The Canacona yard deals in cashew, coconut, copra, arecanut, and kokum, a seasonal product. Smaller yards in Valpoi and Sanquelim mainly trade cashew, coconut, and arecanut. GSAMB imposes a one percent marketing fee based on the traded price of commodities. Price updates for the previous day (Average Daily Modal Price or ADMP) are published on the Agmarknet website and the e-NAM

platform by 11:30 a.m. each day, except for Fridays, when data is updated the following Monday. Additionally, subsidies are provided on select commodities, including coconut, cashew, and arecanut, to support farmers engaged in their cultivation and trade. The major sample collected for the study comes from the Margao and Ponda mandis (65%), with the remaining sourced from other mandis across the state.

(Lowest Quality)   (Below Average Quality)

(Above Average Quality)   (Highest Quality)

Figure 8: Different qualities of Arecanut/ betel nut, from lowest quality to the highest

This chapter focuses specifically on smallholders, who are primarily farmers. The data collected from farmers will provide the necessary inputs to analyze their participation patterns in e-NAM. The adoption of the e-NAM portal has significantly impacted the agricultural market by providing crucial price information for various agricultural products, which has minimized the gap between farmers and traders. The platform offers a transparent bidding system that operates in real time, promoting competition among producers and traders while drastically reducing or even eliminating transaction costs. The development of agriculture has become increasingly tied to internet usage, particularly among farmers, though they tend to lag behind the urban population in terms of adoption. Given that India's economy is predominantly agriculture-based, the role of Information and Communication Technology (ICT) is essential for ensuring accelerated and efficient growth in the sector (Kumar et al., 2023). e-NAM also addresses the time delays associated with traditional selling methods, further highlighting the need for comprehensive studies on the adoption and implementation of e-NAM in the agricultural market. It emphasizes the importance of ICT in revolutionizing agricultural practices, stressing the role of e-NAM in bridging information gaps, improving market transparency, and facilitating efficient trade for farmers and traders alike (Rohtash et al., 2023).

Table 4: The definition and description of variables for the logistic regression for awareness

Variables	Description and source	Expected sign
Dependent variables		
Awareness about e-NAM	dummy, 0=not aware, 1= aware	+
Independent variables		
Age of household	dummy, 1=less than 35, 2= 35 to 50, 3=greater than 50	+/-
Education of household	dummy, 1=no schooling, 2= primary, 3=secondary, 4=higher secondary, 5=graduation, 6=post-graduation	+/-

This logistic regression model explores the relationship between age, formal education, and awareness of the e-NAM portal/app in APMC markets. The significant findings in this model indicate that both age and education play crucial roles in determining whether an individual is aware of the e-NAM portal.

Age: The odds ratio for age is 0.269, with a highly significant p-value of 0.000. This result suggests that as age increases, the likelihood of being aware of the e-NAM portal also increases. Specifically, individuals aged 35–50 and those over 50 are more likely to be aware of the e-NAM portal compared to individuals under 35. This could be attributed to older individuals having more experience and exposure to agricultural markets and technologies, making them more likely to know about the portal.

Education: The odds ratio for education is 0.173, also with a highly significant p-value of 0.000. This indicates that individuals with higher levels of formal education are significantly more likely to be aware of the e-NAM portal. The odds of awareness increase as one moves from no schooling to post-graduate education. Educated individuals may have better access to information and a greater ability to navigate and understand digital platforms, contributing to their higher awareness of the portal.

Table 5: Factors affecting the awareness of farmers about e-NAM

Dependent variable_ Awareness about e-NAM (Yes or No)		
Independent variables	**Parameter estimate**	**P value**
Age	0.268***	0.000
Education	0.172***	0.000

Note: Number of observations is 174

Both age and education are strong predictors of awareness about the e-NAM portal, with older and more educated individuals being more likely to know about it. This suggests that efforts to increase awareness of the e-NAM portal should focus particularly on younger and less educated populations to ensure broader dissemination and utilization of the portal.

Table 6: The definition and description of variables for logistic regression

Variables	Description and source	Expected sign
Dependent variables		
Registered member of e-NAM	*dummy, 0=no, 1=yes*	+
Independent variables		
Age of household	*dummy, 1=less than 35, 2= 35 to 50, 3=greater than 50*	+/-
Education of household	*dummy, 1=no schooling, 2=primary, 3=secondary, 4=higher secondary, 5=graduation, 6=post-graduation*	+/-

This logistic regression model examines the impact of age and formal education on whether an individual is a registered member of the e-NAM portal. The findings provide insights into how these demographic factors influence registration behaviour.

Age: The odds ratio for age is 1.872, but the p-value is 0.261, which is not statistically significant. This result suggests that age does not have a significant effect on whether an individual is a registered member of the e-NAM portal. In other words, individuals across different age groups are equally likely or unlikely to be registered, indicating that age is not a key determinant of registration behaviour. The lack of significance might be due to other factors, such as accessibility or personal preferences, which were not captured by age alone.

Education: The odds ratio for education is 0.490, with a p-value of 0.043, indicating statistical significance. This suggests that higher levels of formal education are associated with a greater likelihood of being a registered member of the e-NAM portal. Specifically, individuals with higher education levels are more likely to register, likely because they possess the skills necessary to understand and engage with the digital platform. The decreasing odds with increasing education levels may reflect that those

with basic to moderate education are more motivated to register, possibly seeking benefits from the portal that align with their agricultural activities.

Table 7: Factors affecting the registration of farmers for e-NAM

Dependent variable_ Registered member of e-NAM (Yes or No)		
Independent variables	**Parameter estimate**	**P value**
Age	1.872	0.261
Education	0.490*	0.043

Note: Number of observations is 174

Education is a significant predictor of registration on the e-NAM portal, while age is not. This indicates that initiatives to boost registration should particularly target individuals with lower educational attainment to encourage broader participation. Strategies could include providing educational resources or support to help these individuals understand the benefits of registration.

Chapter 4: Economic Impact of e-NAM on Farmer Price and Viability

Introduction

The e-NAM (Electronic National Agriculture Market) portal has emerged as a transformative tool in the agricultural sector, providing farmers with vital information about the prices of various agricultural produce. By offering a transparent and real-time bidding mechanism, e-NAM has significantly minimized the gap between farmers and traders. This enhanced transparency fosters increased competition, which in turn helps in reducing or even eliminating transaction costs. Such advancements are crucial, given that the development of agriculture is closely linked with the adoption of modern technologies, including the internet. Although farmers are slightly behind the urban population in adopting these technologies, the role of ICT is indispensable for the accelerated and efficient growth of an agriculture-based economy. e-NAM also addresses the time lags associated with traditional selling procedures, further enhancing its value.

Despite the clear advantages, a notable proportion of farmers continue to favor traditional market methods, particularly transactions through local commission agents and traders. This preference for conventional practices underscores the necessity for the government to implement focused efforts to promote awareness about the benefits of e-NAM. Educating farmers and other stakeholders about the advantages of using this platform is essential for its widespread adoption. Studies have demonstrated that participation in e-NAM can lead to significant economic benefits for farmers. For example, research indicates that vegetable farmers who engage in e-NAM transactions experience notable improvements in their monthly income and per capita annual expenditure compared to their counterparts who do not use the platform (Dey et al., 2023). These findings highlight the positive impact of e-NAM on farmer price and viability, reinforcing the need for increased adoption and support for this digital marketplace.

Figure 9: Workers segregating Arecanuts at the Goa Agricultural Produce and Livestock Marketing Board, Ponda yard

The economic impact analysis is centered on farmers and their pricing before and after e-NAM adoption. Therefore, the data collected from farmers is the most relevant for this chapter.

Analysis of Paired t-Test Results:

This analysis utilizes a two-sample t-test to compare the prices received by farmers before and after the adoption of the e-NAM portal. The variables of interest include the first one, which indicates whether a farmer makes a visit to the Agricultural Produce Market Committee (APMC) Mandi (1 = Yes, 0 = No), and the second one, which indicates whether the farmer is a registered member of the e-NAM portal (1 = Yes, 0 = No). The paired t-test is designed to assess whether there is a statistically significant difference in the prices received by farmers who visit APMC Mandi and

those who do not, with the assumption that being a registered member of the e-NAM portal might influence this relationship.

Table 8: t-test for the visit to APMC mandis

Group	Observations	Mean (Proportion of Registered e-NAM Members)	Std. Error	Std. Dev.	95% Confidence Interval
No visit to APMC Mandi	91	0.9011	0.0315	0.3002	0.8386, 0.9636
Visit to APMC Mandi	83	1.000	0.000	0.000	1.0000, 1.0000
`	174	0.9483	0.0168	0.2221	0.9150, 0.9815

Note: Number of Observations is 174

Table 9: t-test result for the visit to APMC mandis

Difference Between Means (Diff)	Standard Error of Diff	95% Confidence Interval	t-value	Degrees of Freedom (df)	p-value (two-tailed)
-0.0989	0.0330	[-0.1640, -0.0338]	-3.0008	172	0.0031

Note: Number of Observations is 174

The p-value for a two-tailed test ($Pr(|T| > |t|) = 0.0031$) is less than the conventional significance level of 0.05, indicating that there is a statistically significant difference in the proportion of registered e-NAM members between farmers who visit APMC Mandi and those who do not. The analysis indicates that farmers who visit APMC

Mandi (Group 1) are all registered members of the e-NAM portal (mean = 1.0000). In contrast, a smaller proportion of farmers who do not visit APMC Mandi (Group 0) are registered members (mean = 0.9011). The difference between the two groups is statistically significant, as evidenced by the t-test results.

This finding suggests that visiting APMC Mandi is strongly associated with being a registered member of the e-NAM portal. The perfect registration rate among farmers who visit APMC Mandi may reflect greater exposure to market information and resources, including e-NAM, which is often promoted within the physical market space. Conversely, farmers who do not visit the Mandi may have less direct access to such information, resulting in lower registration rates. The paired t-test results demonstrate a significant association between visiting APMC Mandi and being a registered member of the e-NAM portal. This underscores the importance of physical market interactions in promoting the adoption of digital platforms like e-NAM. To enhance e-NAM registration among farmers who do not visit the Mandi, targeted outreach and awareness campaigns are recommended, especially for those in remote or less-connected areas.

Figure 10: Ripening chambers at the Goa Agricultural Produce and Livestock Marketing Board, Ponda yard

Cost-Benefit Analysis

The cost-benefit analysis evaluates the perceived financial viability of the e-NAM portal among respondents, including farmers, traders, and officials from Goa. The analysis uses the variables:

Resources are available(V1): Measures the resources available to use the e-NAM portal/app, rated from 1 (lowest) to 5 (highest).

e-NAM gives rational returns(V2): Assesses whether respondents believe that e-NAM helps in obtaining a rational return on products, with responses coded as Yes(1), No(2), or Not aware(3).

Table 10: Summary of variables for net benefit calculation

Variable	Mean	Std. Dev.	Minimum	Maximum
Resources are available	3.55	1.92	1	5
e-NAM gives rational returns	0.94	0.22	1	3

Note: Number of Observations is 174

The net benefit is computed as the difference between the responses of the stakeholders on returns and resources, reflecting the difference between perceived benefits and resources or costs.

Net Benefit = Responses of V2 (e-NAM gives rational returns) − Responses of V1 (Resources available

Table 11: Summary of Net Benefit Calculation

Variable	Mean	Std. Dev.	Minimum	Maximum
Net Benefit	-0.55	1.92	-2	2

Note: Number of Observations is 174

The analysis of net benefits derived from using the e-NAM portal reveals a mean value of -0.551724. This negative mean indicates that, on average, respondents perceive the net benefit of using e-NAM as unfavorable. The result suggests that the costs or resource requirements associated with e-NAM outweigh the perceived benefits. The standard deviation of 1.927943 indicates significant variability in perceptions among respondents. The range of net benefits, from -2 to 2, shows considerable divergence in opinions. This variability is particularly notable given the different levels of familiarity with e-NAM among the respondent groups.

ANOVA

The ANOVA test seeks to explore the relationship between various demographic and behavioral factors and their influence on the dependent variable, specifically the respondents' age category. The independent variables include formal education, type of phone owned, registered membership with e-NAM, and behavioural knowledge about operating a smartphone for online activities. The test is designed to assess the significance of these factors and their collective impact on the age variable, providing

insights into how different aspects of technological and educational familiarity intersect with age demographics among e-NAM users.

Table 12: ANOVA results

Variables	Partial SS	df	Mean Square	F	Prob>F
Education Level	7.43	4	1.85	6.88	0.000
Type of Phone Owned	14.32	1	14.32	53.00	0.000
Registered with e-NAM	2.44	1	2.44	9.06	0.000
Knowledge of Smartphone Operation	1.81	1	1.81	6.73	0.010
Explained SS	31.17	7	4.45	16.48	0.000
Residual SS	44.85	166	0.27		
Total	76.02	173	0.43		

Note: Number of Observations is 174

The tests R-squared value is 0.4100, indicating that approximately 41% of the variance in the age variable is explained by the independent variables included in the model. This is a reasonably strong explanatory power for a social and behavioral model, suggesting that these factors are influential in understanding the age-related differences among respondents concerning e-NAM adoption and usage. The F-statistic of 16.48 is highly significant with a p-value of 0.0000, demonstrating that the test, as a whole, provides a significant explanation of the variance in the age variable.

Education Level: The education level of respondents has a significant impact on the age category, with a p-value of 0.0000. Higher education levels are likely associated with younger age groups, reflecting the increasing emphasis on education in younger generations. Education plays a crucial role in enabling users to engage with e-NAM, particularly among younger farmers and traders who are more likely to have higher formal education.

Type of Phone Owned: The type of phone owned by respondents is the most significant variable in this model, with a p-value of 0.0000 and a high partial SS of 14.321606. This result highlights the crucial role that smartphone ownership plays in influencing the age category. Younger respondents are more likely to own smartphones, which facilitate easier access to e-NAM and other online activities, thereby promoting greater engagement with the platform.

Registered with e-NAM: The status of being a registered member of e-NAM is also significant, with a p-value of 0.0030. The significance of this variable suggests that registration with e-NAM is more prevalent among certain age groups, likely those who are more familiar with or interested in the technological benefits of the platform. This could reflect a generational divide where younger farmers and traders are more proactive in registering and utilizing e-NAM services.

Knowledge of Smartphone Operation: The ability to operate a smartphone for online activities has a significant effect on the age variable, with a p-value of 0.0103. This suggests that younger respondents, who are generally more adept at using smartphones for online purposes, are more likely to engage with e-NAM. This is consistent with broader trends of digital literacy being more common among younger age groups.

The behavioral elements reflected in this test highlight the critical role of technological adoption and education in shaping the demographics of e-NAM users. Younger respondents are more likely to be technologically savvy, owning smartphones and using them effectively for online activities, which in turn correlates with higher levels of engagement with e-NAM. Education also plays a significant role, as higher levels of education tend to correlate with younger age groups who are better equipped to leverage the benefits of e-NAM. The significance of these variables suggests that efforts to increase e-NAM adoption should focus on enhancing digital literacy and smartphone access, particularly among older and less educated farmers and traders. Additionally, promoting the benefits of e-NAM registration across all age groups could help bridge the generational gap in platform usage. The ANOVA results provide a comprehensive understanding of the factors influencing age-related differences among e-NAM users.

Conclusion

The significant results for education, phone ownership, e-NAM registration, and smartphone usage emphasize the importance of these factors in determining the likelihood of engaging with the platform. The findings suggest that targeted interventions aimed at improving digital literacy and access to technology, particularly among older and less educated groups, could enhance the overall adoption and effective use of e-NAM in Goa. Farmers and traders, who are less familiar with e-NAM, are likely contributing to the negative perception, as they may not fully appreciate the system's benefits. In contrast, officials, who are more knowledgeable about e-NAM, likely have a more positive view. The negative mean could thus be attributed to the lack of awareness and understanding among the majority of farmers and traders. To improve the overall perception of e-NAM, targeted education and outreach programs should be implemented to enhance familiarity and understanding among farmers and traders. Addressing specific concerns and providing clear demonstrations of e-NAM's benefits could potentially shift the average net benefit to a more favorable position, thereby improving the financial viability of the system for all stakeholders.

Chapter 5: Strategies for Enhancing e-NAM Adoption in Goa

To enhance e-NAM adoption in Goa, this chapter outlines strategies focusing on infrastructure development, software upgrades, farmer education, comprehensive strategies, and research for continuous improvement.

1. Infrastructure Development and Integration

To support the large-scale adoption of e-NAM in Goa, it is crucial that all e-NAM mandis either own or be linked with WDRA (Warehousing Development and Regulatory Authority) accredited warehouses and cold storages. These facilities should be aligned with the major commodities transacted in each mandi, ensuring that the physical infrastructure supports the trading activities. Additionally, the development of appropriate technologies and a comprehensive strategy is necessary to integrate essential services such as banking, grading and assaying, warehousing, and weighment. This integration would help in evolving a true national market for agricultural produce, enabling seamless trade across different mandis.

2. Enhancing Software Capabilities for Automated Trading

The current e-NAM software must be upgraded to extend beyond mere trade transactions. To enable inter-mandi trade and facilitate the unification of markets, the software should offer a complete solution covering both internal and external management aspects. This enhancement would allow the market system to be fully automated, ensuring that all trade activities, from the individual market level to the national market level, are streamlined and efficient. Furthermore, establishing mechanisms to address inter-mandi disputes is essential for maintaining smooth operations across the platform.

3. Education and Training for Farmers

Educating farmers on the benefits and functionalities of e-NAM is crucial for its widespread adoption in Goa. Farmers with higher levels of education are more likely to access and comprehend market data, such as current prices, demand trends, and supply requirements, available on the e-NAM platform. To maximize the platform's potential, tailored training programs should be implemented to help farmers, especially organic farmers, understand how to register, list their produce, participate

in online auctions, and effectively negotiate prices. These training sessions should be adapted to varying levels of technological literacy and should emphasize the advantages of e-NAM in terms of market access, price transparency, and the reduction of intermediaries.

4. Comprehensive Strategy and Incentive Structures

The successful implementation of e-NAM in Goa requires a comprehensive strategy that includes incentives for users and the involvement of banks. It is important to bring banks on board and ensure they understand the full scope of mandi trade requirements. This strategy should address the various barriers to e-NAM adoption, such as restrictions imposed by different acts, fiscal aspects, and the need for integrated logistics services. Without a holistic approach, the impact of e-NAM will be limited, and its potential as a national-level market platform may not be fully realized.

5. Research and Continuous Improvement

Ongoing research is needed to understand the main barriers to e-NAM adoption and to identify effective strategies for its successful implementation. Studies could explore whether higher awareness of e-NAM leads to changes in marketing strategies, crop choices, income levels, or market access for smallholder farmers. Such research would provide valuable insights for continuously improving the platform and ensuring it meets the needs of all stakeholders involved.

Figure 11: Goa Bagayatdar bazar outlet at Madgaon APMC, Arlem, Goa

This chapter requires insights from all stakeholders to develop effective strategies for enhancing e-NAM adoption. The combined data collected of farmers, traders, and officials will provide a holistic view of perceptions and suggestions from farmers, traders, and officials.

Chi-Square test

This analysis focuses on identifying factors that influence the adoption of e-NAM (Electronic National Agriculture Market) in Goa. We selected variables that reflect user perceptions and experiences with e-NAM, which are crucial for understanding and enhancing its adoption. The variables include:

1. Perception of e-NAM Process Length: This variable examines whether e-NAM is perceived as more time-consuming compared to the open auction system. Lengthiness can be a significant deterrent to adoption if users find the process cumbersome.

2. Perception of e-NAM Process Ease: We assess if users find e-NAM easier to use compared to traditional methods. Ease of use is a critical factor influencing technology adoption.

3. Perceived Risk in Adopting e-NAM: This variable explores whether stakeholders perceive significant risks associated with adopting e-NAM. High perceived risk can hinder adoption as users may fear negative consequences.

4. Need for Specific Training: We analyze if respondents believe that specific training is necessary for effectively using e-NAM. Adequate training is essential for overcoming initial barriers and ensuring efficient use.

5. Awareness Programs About e-NAM: This variable investigates the effectiveness of awareness programs in educating stakeholders about e-NAM. Proper awareness is vital for reducing resistance and promoting adoption.

These variables were selected due to their direct relevance to barriers and facilitators of e-NAM adoption, providing insights into areas where targeted interventions can improve the adoption process.

Table 13: Description of variables for e-NAM chi-square test

Variables	Response	Farmers	Official	Trader	Total	Chi-Square Statistic
Perception of e-NAM Process Length	Yes	0	0	0	0	234
	No	0	30	0	30	
	Not Aware	174	0	30	204	
	Total	174	30	30	234	
Perception of e-NAM Process Ease	Yes	0	30	0	30	234
	No	-	-	-	-	
	Not Aware	174	0	30	204	
	Total	174	30	30	234	
Perceived Risk in Adopting e-NAM	Yes	48	8	16	72	107.33
	No	10	22	3	35	
	Not Aware	116	0	11	127	
	Total	174	30	30	234	
Need for Specific Training	Yes	174	30	22	226	56.32
	No	-	-	-	-	
	Not Aware	0	0	8	8	
	Total	174	30	30	234	
Awareness Programs About e-NAM	No	116	0	25	141	55.14
	Yes	58	30	5	93	
	Total	174	30	30	234	

Note: Number of observations is 234

1. Perception of e-NAM Process Length:

The chi-square test reveals that all respondents perceived e-NAM as lengthier in 30 cases, with only 30 respondents (all Officials) viewing it as not aware. The test statistic for lengthier process was 234.0000 (p-value = 0.000), indicating a significant association between the perception of e-NAM's lengthiness and profession. This suggests that lengthiness is a substantial barrier to adoption, particularly impacting the acceptance of e-NAM among Farmers and Traders who did not perceive it as a notable issue.

2. Perception of e-NAM Process Ease:

Similarly, the chi-square test ease of e-NAM process shows that 30 Officials perceived e-NAM as easier, while no Farmers or Traders shared this view. The majority of respondents (204) were not aware of the ease of e-NAM, leading to a chi-square statistic of 234.0000 (p-value = 0.000). This suggests that the ease of use is perceived differently across professions, with a notable gap in awareness, potentially affecting overall adoption.

3. Perceived Risk in Adopting e-NAM:

The analysis indicates that 72 respondents (48 Farmers, 8 Officials, 16 Traders) perceive a significant risk in adopting e-NAM. In contrast, 35 respondents (10 Farmers, 22 Officials, 3 Traders) view it as having no risk, and 127 respondents (116 Farmers, 0 Officials, 11 Traders) are not aware of the risks. With a chi-square statistic of 107.3318 (p-value = 0.000), the significant perceived risk varies across professions, highlighting the need for targeted risk mitigation strategies.

4. Need for Specific Training:

The chi-square test results show that 226 respondents (174 Farmers, 30 Officials, 22 Traders) believe specific training is necessary. Only 8 respondents (all Traders) are not aware of the need for training. The chi-square statistic for the need for training was 56.3257 (p-value = 0.000), indicating a strong agreement on the need for training across all professions. This underscores the importance of developing comprehensive training programs to enhance e-NAM adoption.

5. Awareness Programs About e-NAM:

The chi-square test results show a notable variation in awareness of e-NAM programs across different professions. Specifically, 141 respondents (116 Farmers, 25 Traders) reported not being aware of any awareness programs. In contrast, 93 respondents (58 Farmers, 30 Officials, 5 Traders) acknowledged the presence of such programs. The chi-square statistic for this variable is 55.1407 (p-value = 0.000), indicating a significant association between awareness of programs and the respondents' profession. The results suggest that while some awareness programs are in place, a substantial portion of Farmers and Traders remains unaware of them. This disparity underscores the need for more effective and widespread awareness campaigns. Enhancing communication and outreach efforts could bridge this gap, ensuring that all stakeholders are well-informed about e-NAM and its benefits, which is crucial for increasing adoption and addressing any resistance.

The strong agreement on the need for specific training and the lesser acknowledgment of awareness programs suggest that enhancing training and awareness efforts could address some of the barriers to adoption. Tailored training programs and improved awareness campaigns are essential for overcoming initial resistance and ensuring effective use of e-NAM. By focusing on these areas, stakeholders can develop strategies to address the identified challenges, improve user experiences, and promote wider adoption of e-NAM in Goa.

Table 14: Summary statistics of the variables

Variable	Mean	Standard Deviation	Minimum	Maximum
Awareness about e-NAM	0.33	0.47	0	1
Registered member	0.94	0.22	0	1
Have resources to use e-NAM portal/app	3.55	1.92	1	5
Knowledge to use e-NAM portal/app	3.55	1.92	1	5

Note: Number of observations is 234

SWOT Analysis of e-NAM Portal Adoption

The following summarizes the strengths, weaknesses, opportunities, and threats (SWOT) based on data from variables related to the e-NAM portal: awareness, registration, resource availability, and knowledge. The analysis is derived from the summary statistics of these variables for a sample of 174 respondents.

Strengths:

High Registration Rate: The mean value for registration (0.9483) indicates a high rate of registration among respondents. This suggests that once users are aware of the e-NAM portal, they are likely to register, reflecting a strong acceptance and initial adoption of the platform.

Perceived Resources and Knowledge: Both resources and knowledge have means of 3.55, indicating that respondents generally feel they have adequate resources and knowledge to use the e-NAM portal. This suggests that the current user base is relatively well-equipped to utilize the platform effectively.

Weaknesses:

Low Awareness: The mean value for awareness is 0.3333, which shows that only about 33% of respondents are aware of the e-NAM portal. This indicates a significant gap in awareness, which could hinder broader adoption and utilization of the platform.

Resource and Knowledge Discrepancies: While the mean values for resources and knowledge suggest that respondents feel they have the resources and knowledge to use e-NAM, the standard deviations (1.93) indicate considerable variation in perceptions. This variability suggests that while some respondents feel well-equipped, others may face challenges.

Opportunities:

Increasing Awareness: The low awareness rate presents an opportunity to enhance outreach and educational efforts. Targeted campaigns could improve understanding and drive higher registration rates.

Leveraging Existing Resources: Given that a significant portion of users feel they have the necessary resources and knowledge, there is an opportunity to build on these strengths to improve the user experience and provide additional training or support where needed.

Threats:

Limited Awareness Impact: The relatively low level of awareness poses a threat to achieving widespread adoption. Without increased efforts to inform potential users, the benefits of the e-NAM portal may not be fully realized.

Inconsistent Resource and Knowledge Levels: The variability in perceived resources and knowledge could lead to uneven adoption and usage, potentially affecting the platform's overall effectiveness and user satisfaction.

In conclusion, while the e-NAM portal shows promise in terms of registration and user readiness, addressing the gaps in awareness and variability in resource and knowledge perceptions will be crucial for maximizing its impact and adoption.

Figure 12: Facilities at the cold storage at Ponda yard

Stakeholder Analysis

The stakeholder analysis reveals distinct patterns among the respondents in terms of their type, awareness, registration, and perceptions of the e-NAM portal. Of the 234 respondents, farmers constitute the majority at 74.36%, while officials and traders each make up 12.82%. This distribution underscores the significant representation of farmers in the study. Awareness of the e-NAM portal is relatively low, with only 39.74% of respondents being aware of it, while 60.26% are not. This suggests a substantial need for increased awareness efforts. Despite the low awareness, e-NAM registration is high, with 83.33% of registered users, reflecting that once aware, a large proportion choose to register. However, there are 12.82% of responses missing or not available, which could influence the completeness of registration data. Regarding perceived resources and knowledge, the majority of respondents rate their resources (69.66%) and knowledge (60.26%) as high, indicating confidence in using the e-NAM portal. Yet, the variability in perceptions, with a significant portion rating these aspects lower, points to potential areas for improvement. Overall, the data highlights a need for better outreach and support to enhance awareness and address variability in user perceptions.

Figure 13: APMC market yard, Mapusa Goa

Chapter 6: Challenges in Scaling e-NAM Adoption in Goa and Proposed Solutions

Introduction

The Indian agricultural sector has been the backbone of the nation's economy, yet it remains marred by inefficiencies that hinder its growth. Recognizing these challenges, the Government of India has taken proactive measures to reform agricultural markets, with the National Agriculture Market Scheme (e-NAM) being one of the most ambitious initiatives. The e-NAM aims to create a unified national market for agricultural commodities by integrating physical Mandis through an online trading platform. However, the adoption of e-NAM in states like Goa has encountered several obstacles that need to be addressed to realize its full potential.

Stakeholder Involvement and Challenges

e-NAM involves a diverse array of stakeholders, including farmers, traders, commission agents, and government officials. Each of these groups plays a crucial role in the platform's success. Farmers, being the primary beneficiaries, are expected to gain from better price discovery and wider market access. However, their ability to operate within the e-NAM system is often compromised by several factors. One of the significant challenges is the low level of digital literacy among farmers in rural areas. Although the penetration of smartphones and the internet has increased in India, many farmers still struggle with using digital platforms effectively. The e-NAM app, which is central to the platform's functionality, has seen limited adoption. A cursory glance at the download statistics from Google Playstore and Apple's Appstore reveals that the numbers are far from satisfactory. This indicates that a substantial portion of the farmer community is either unaware of the app or finds it too complex to use.

Moreover, even among those who have adopted the platform, there is a reliance on intermediaries such as commission agents to carry out transactions. This dependency undermines one of e-NAM's primary objectives: to empower farmers to trade directly and independently. The resistance to change among farmers is not just a matter of digital literacy but also cultural and systemic. Traditional methods of selling produce at local Mandis, where prices are negotiated face-to-face, are deeply ingrained in the agricultural community. Traders and commission agents, who are also key

stakeholders in e-NAM, face their own set of challenges. Traders, for instance, are wary of the tax implications that come with conducting business through digital platforms. The transparency that e-NAM brings to transactions, while beneficial in many ways, also means that traders can no longer avoid taxation. This has led to a reluctance among traders to fully embrace the platform.

Commission agents, on the other hand, are concerned about their role in the e-NAM system. Traditionally, these agents have played a vital role in facilitating transactions between farmers and buyers. However, e-NAM's direct trading model threatens to marginalize their role, leading to resistance from this group. This fear of being phased out of the system is a significant barrier to the widespread adoption of e-NAM. Furthermore, the platform's effectiveness is hampered by the lack of uniformity in its implementation across different regions. While some states have fully integrated their APMCs (Agricultural Produce Market Committees) into the e-NAM system, others, like Goa, are still struggling with partial integration. This inconsistency creates confusion among stakeholders and reduces the overall efficiency of the platform.

Figure 14: Segregation of Arecanut by workers at Curchorem yard, Goa

Technological and Infrastructural Constraints

The success of e-NAM hinges on the uniformity and reliability of operations across different markets. One of the key operations is the price discovery mechanism, which is essential for ensuring that farmers receive fair prices for their produce. However, the methods currently used for price discovery, such as sealed/closed bid or open auction methods, vary widely across different markets. This lack of standardization undermines the transparency and fairness that e-NAM is supposed to bring to agricultural trading. The reliance on traditional methods for assessing produce quality is another significant hurdle. Many farmers and traders prefer to physically inspect agricultural commodities before finalizing a deal, rather than relying on electronic assessment reports. This scepticism towards digital assessments is rooted in the belief that physical examination is more accurate and trustworthy. As a result, the e-NAM platform, which relies heavily on electronic assessments, is often bypassed in favour of traditional practices.

In addition to these operational challenges, the lack of adequate infrastructure in rural areas further impedes the adoption of e-NAM. Reliable internet connectivity is still a luxury in many parts of rural India, including Goa. Without consistent and high-speed internet access, farmers and other stakeholders find it difficult to use the e-NAM platform effectively. This digital divide between urban and rural areas is a major obstacle to the widespread adoption of e-NAM. Moreover, the platform's technological limitations are a concern. The current version of e-NAM is primarily an online trading platform, but it lacks advanced features that could make it more user-friendly and efficient. For instance, integrating Artificial Intelligence (AI) and the Internet of Things (IoT) into e-NAM could provide stakeholders with real-time information and analytics, helping them make more informed decisions. Such technological advancements could significantly enhance the platform's appeal and usability.

Understanding the challenges faced by all stakeholders is crucial for proposing solutions. The combined data collected of farmers, traders, and officials allows for a comprehensive exploration of difficulties encountered by all of these stakeholders alike.

Table 15: Summary statistics of the variables

Variable	Mean	Standard Deviation	Minimum	Maximum
e-NAM lengthier than open auction	2.87	0.33	1	3
e-NAM easier than open auction	2.74	0.67	1	3
Difficulty understanding language on portal	2.52	0.61	1	3
e-NAM software considered fast	2.74	0.67	1	3
e-NAM difficult for illiterate	1.49	0.86	1	3
Perceived risk in adoption of e-NAM	2.23	0.89	1	3
e-NAM usage requires specific training	1.06	0.36	1	3

Note: Number of observations is 234

Figure 15: Graph representing the variables for Gap analysis
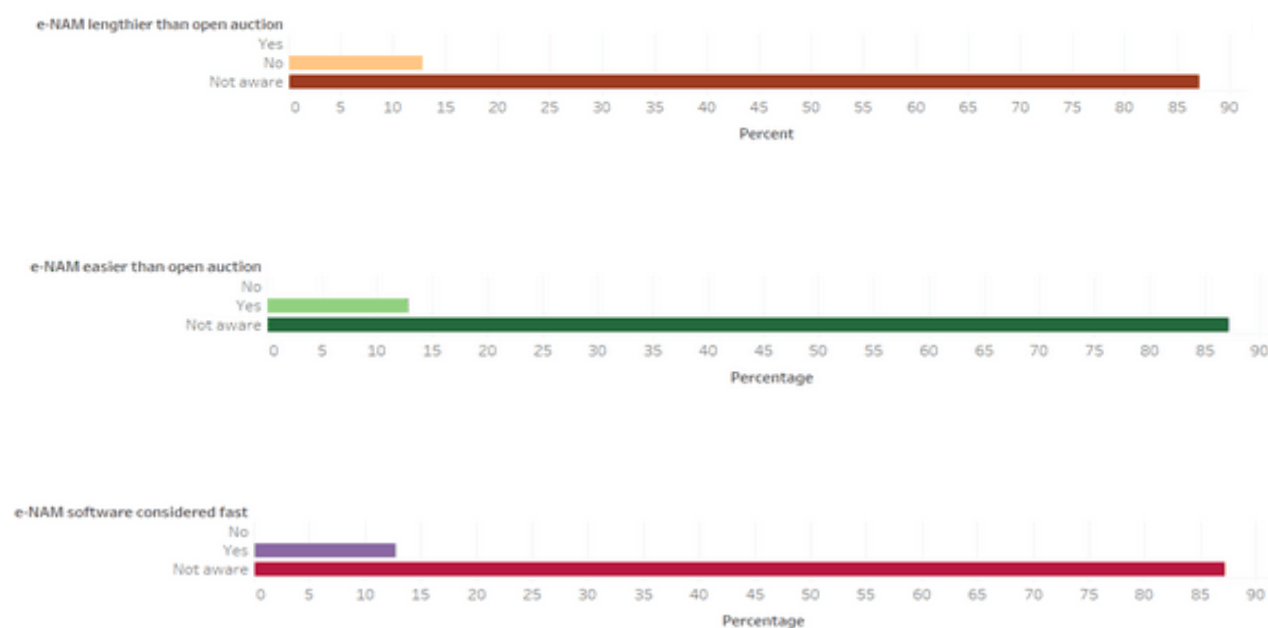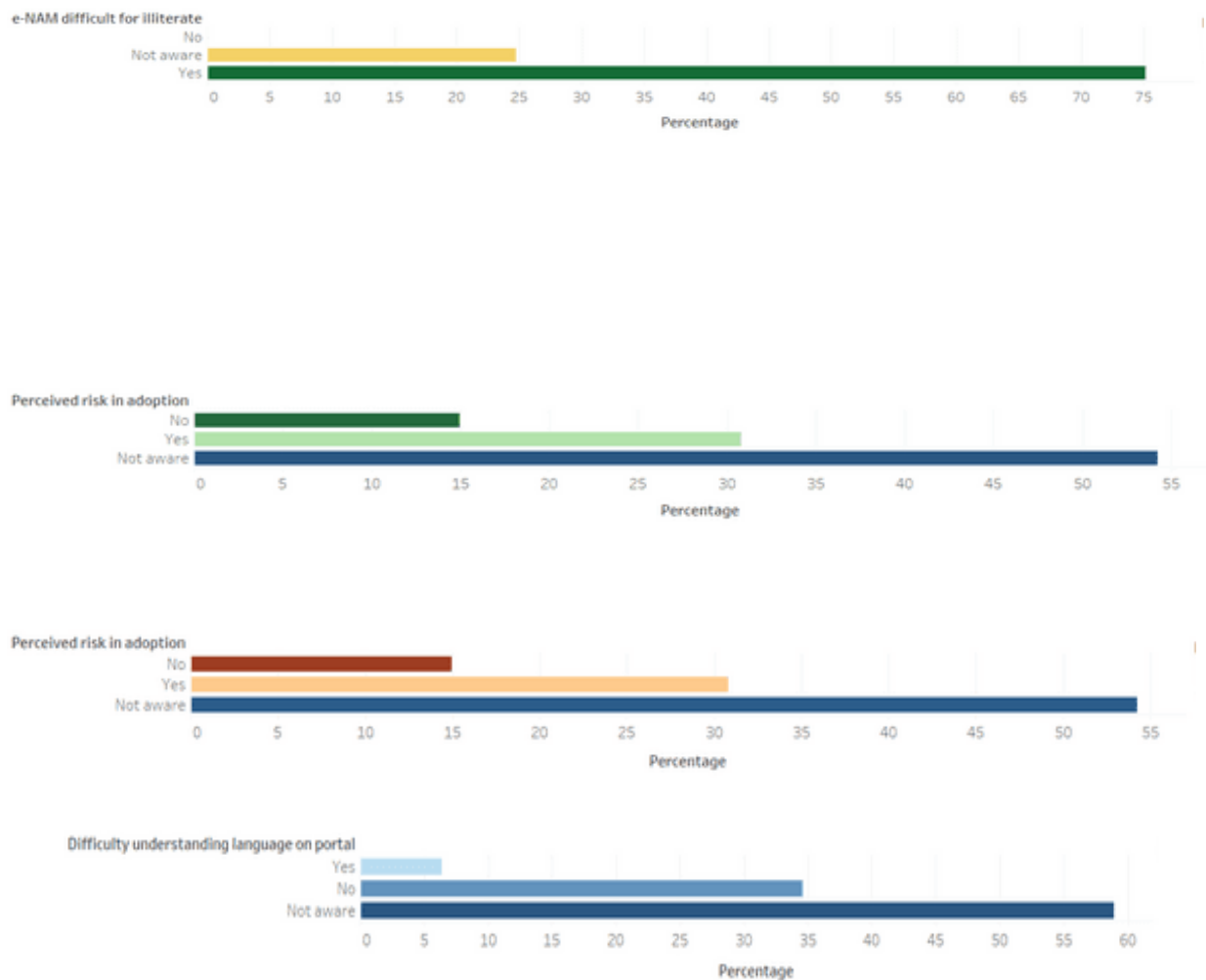
Figure 16: Graph representing the variables for Gap analysis

Gap analysis

The gap analysis aims to identify discrepancies between current practices and desired outcomes regarding the e-NAM process. The results reveal several insights into user perceptions:

e-NAM Process Lengthier: The mean score of 2.87 indicates that respondents generally perceive the e-NAM process as lengthier than the open auction system, suggesting a gap in efficiency.

e-NAM Process Easier: With a mean of 2.74, respondents are split on whether e-NAM is easier compared to the open auction process, highlighting a need for simplification.

Difficulty Understanding Language: A mean score of 2.53 indicates moderate difficulty in understanding the language used in e-NAM, suggesting improvements in communication or language support might be necessary.

e-NAM Software Fast: The mean of 2.74 reflects mixed opinions on whether the e-NAM software is considered fast, pointing to potential software performance issues.

e-NAM Difficult for Illiterate: A mean of 1.50 shows a consensus that e-NAM is not considered difficult for illiterate users, which is a positive finding.

Perceived Risk in Adopting e-NAM: The mean score of 2.24 suggests that there is some perceived risk in adopting e-NAM, indicating a need for addressing concerns to boost confidence.

Requires Specific Training: A mean of 1.07 implies that most respondents believe specific training is not required, suggesting that training needs may not be as critical as other concerns.

Overall, these results highlight areas where the e-NAM system might need improvements in efficiency, ease of use, software performance, and risk mitigation to align better with desired outcomes.

Policy and Institutional Support

For e-NAM to succeed, strong policy and institutional support from the Government of India is essential. This includes addressing the challenges faced by different stakeholders and providing targeted solutions. A key priority is improving digital literacy among farmers through localized training programs that teach essential digital skills and practical platform usage. Alongside this, expanding rural internet connectivity is crucial to ensuring all farmers can access e-NAM without technological barriers.

Providing financial incentives will further drive adoption. Traders can benefit from tax breaks for conducting transactions on e-NAM, while farmers should receive subsidies to help acquire smartphones and digital tools. Ensuring uniform implementation across APMCs by standardizing price discovery and quality assessment processes will create a consistent experience for all users. Additionally, integrating banking, warehousing, and logistics services into e-NAM will streamline trading, reducing inefficiencies and improving market access.

A well-defined policy framework should guide e-NAM's continuous improvement. This includes mechanisms for dispute resolution, stakeholder feedback, and ongoing monitoring to ensure the platform remains effective and adaptable to user needs.

Proposed Solutions

To enhance e-NAM adoption in Goa, several key interventions are recommended. Expanding digital literacy programs in collaboration with state governments and NGOs will help farmers confidently use e-NAM. These programs should include practical demonstrations and step-by-step guidance on smartphone usage and online transactions. Additionally, improving internet infrastructure through partnerships with telecom companies will ensure reliable connectivity in rural areas.

Regular stakeholder engagement through training sessions and workshops is essential to build trust and familiarity with e-NAM. These sessions should cater to different groups—farmers, traders, and commission agents—addressing their specific concerns and streamlining onboarding processes. Establishing help centers and hotlines can further support users facing technical difficulties.

Integrating AI and IoT technologies into e-NAM can provide real-time market insights, automate price predictions, and improve efficiency. The government should partner with technology firms to test and implement these innovations through pilot projects before nationwide expansion.

Policy reforms should introduce targeted incentives such as tax benefits for traders and financial assistance for farmers investing in digital tools. Ensuring uniform implementation across states will create a level playing field and reduce regional disparities in e-NAM adoption.

Finally, the long-term success of e-NAM depends on the modernization of agricultural marketing as a whole. Reforming traditional mandi practices, upgrading infrastructure, and integrating support services such as storage and logistics will ensure that e-NAM serves as a comprehensive, efficient, and farmer-friendly platform.

Conclusion

The adoption of e-NAM in Goa, as in other parts of India, presents both significant opportunities and challenges. While the platform has the potential to transform agricultural trading by providing better price discovery, wider market access, and greater transparency, several barriers must be overcome to achieve these benefits. By enhancing digital literacy, improving infrastructure, engaging stakeholders, integrating advanced technologies, and implementing supportive policies, the GoI can ensure the successful adoption of e-NAM and drive the development of the agricultural sector in Goa and beyond. The success of e-NAM will ultimately depend on the willingness of all stakeholders to embrace change and work together towards a more efficient, transparent, and inclusive agricultural marketing system. With the right interventions, e-NAM can become a powerful tool for improving the livelihoods of farmers and driving the growth of the agricultural sector in India.

Chapter 7: Inter-State e-NAM Connectivity and the Role of Negotiable Warehouse Receipts in Goa

Introduction

The introduction of the Agricultural Produce Marketing Committee (APMC) Act in 2003 marked a significant milestone in the agricultural sector of India, setting the stage for a series of market reforms aimed at improving the efficiency, transparency, and accessibility of agricultural markets. Among these reforms, the Warehouse Receipts Act of 2006 emerged as a pivotal development, providing a legal framework for the issuance and use of negotiable warehouse receipts (NWRs) (Singh et al., 2020). These reforms laid the groundwork for the establishment of a national electronic trading platform—e-NAM (National Agriculture Market)—which sought to unify disparate agricultural markets across India under a single, integrated digital platform. The e-NAM platform was designed to facilitate transparent sales, accurate price discovery, and efficient trading of agricultural produce. Initially focused on regulated markets, the platform has since expanded to include kisan mandis (farmer markets), warehouses, and private markets (Ranjith Kumar et al., 2020). However, the implementation of e-NAM has encountered significant challenges, particularly in states like Goa, where the integration of local markets with the national platform has been inadequate. This chapter explores the challenges associated with inter-state e-NAM connectivity, particularly in Goa, and examines the role of NWRs in enhancing market access and efficiency. This chapter involves assessing connectivity and the use of warehouse receipts, which may involve insights from all stakeholder groups. The combined data collected of farmers, traders, and officials will provide a broader perspective on inter-state connectivity and the role of warehouse receipts.

Inter-State e-NAM Connectivity and Warehouse-based Trading

One of the primary objectives of e-NAM is to create a unified national market by linking all agricultural markets across different states. This involves integrating local mandis with the e-NAM platform and ensuring seamless connectivity between these markets. The success of e-NAM relies heavily on the effective implementation of warehouse-based trading, which allows farmers to store their produce in accredited warehouses and trade using negotiable warehouse receipts. In August 2019, a

significant step was taken by the governments of Andhra Pradesh and Telangana, where WDRA-registered CWC warehouses were declared as markets. This allowed farmers to sell their products directly through e-NAM from the warehouse, eliminating the need to transport their produce to physical mandis (Reddy et al., 2019). This move was aimed at reducing logistics costs, minimizing post-harvest losses, and providing farmers with greater flexibility in choosing the timing of their sales. The warehouse-based trading module, officially launched in April 2020, introduced two key features: the warehouse-based trading module and the FPO-based trading module. The former facilitates trading from the premises of warehouses using negotiable warehouse receipts available in electronic form (e-NWR), while the latter allows farmers to access the e-NAM platform from Farmer Producer Organizations (FPO) collection centers (Singh et al., 2020). These modules were primarily designed to decongest mandis, ensure the continuity of the supply chain, and enable farmers to participate in the market more effectively.

Benefits of Warehouse-based Trading

Warehouse-based trading offers several advantages to farmers, traders, and the overall agricultural market. By enabling farmers to store their produce in accredited warehouses, the system provides them with the flexibility to wait for favorable market conditions before selling their produce. This is particularly beneficial in scenarios where market prices are low immediately after harvest, as farmers can avoid distress sales by holding onto their produce until prices improve. Moreover, accredited warehouses are required to follow strict scientific storage practices, ensuring that the quality of the produce is maintained during storage. These warehouses also provide third-party assaying facilities, which guarantee that the produce meets universally accepted quality standards. This quality assurance is crucial for traders, who can be confident in the quality, storage, and delivery of the produce they purchase through e-NAM. The presence of well-maintained warehouses with robust record-keeping systems further enhances the credibility of the platform and encourages wider participation from traders across the country.

Figure 17: Godown facility for traders at the APMC, Canacona yard

Another significant advantage of warehouse-based trading is the separation of physical commodity movement from trading activities. By decoupling these processes, the system reduces logistics and transport costs, making it more economical for traders to participate in the market. This, in turn, increases trade volumes and economies of scale, ultimately benefiting both farmers and traders. The government has also recognized the potential of warehouse-based trading to enhance market access for farmers. To this end, accredited warehouses have been given the status of mandis and linked with the e-NAM platform. This move aims to help farmers access better markets and realize higher returns on their produce. Trading through warehouse-linked e-NAM platforms ensures that farmers receive fair prices, as the quality and storage conditions of their produce are guaranteed by the warehouse. Furthermore, the warehouse itself can handle logistics, further reducing the burden on farmers.

Challenges in Goa's e-NAM Connectivity

Despite the success of e-NAM in several states, the implementation of this platform in Goa has faced significant challenges. One of the most critical issues is the lack of integration between local markets and the e-NAM platform. The selected mandis in Goa are currently devoid of essential facilities such as electronic bidding, integration of weighment systems with the e-NAM portal, and electronic gate pass systems. This lack of infrastructure hinders the smooth functioning of the e-NAM platform in the state and limits the participation of farmers and traders.

Moreover, the absence of warehouse integration across Goa's markets is a significant barrier to the effective implementation of e-NAM. Without warehouse integration, farmers in Goa are unable to take full advantage of the benefits offered by warehouse-based trading. For instance, there is no provision for electronic displays or the generation of exit passes in Goa's markets, which further complicates the trading process. This lack of infrastructure not only hinders the achievement of e-NAM's objectives but also contributes to the congestion of market yards, as farmers are forced to transport their produce to physical mandis rather than storing it in warehouses.

The challenges faced by Goa in integrating with the e-NAM platform highlight the need for targeted interventions to address these issues. To fully realize the potential of e-NAM in Goa, it is crucial to develop the necessary infrastructure, including the integration of warehouses with the e-NAM platform and the provision of essential facilities such as electronic bidding systems and weighment integration. Without these improvements, the benefits of e-NAM will remain out of reach for many farmers in Goa.

Role of Negotiable Warehouse Receipts in Goa

Negotiable Warehouse Receipts (NWRs) are a critical component of modern agricultural markets, providing farmers with a range of financial and operational benefits. NWRs allow farmers to store their produce in accredited warehouses and use the receipts as collateral to obtain loans from banks. This provides farmers with much-needed financial flexibility, enabling them to avoid distress sales and sell their produce when market conditions are favorable. In Goa, however, the lack of warehouse integration with the e-NAM platform has limited the effectiveness of NWRs. Without the ability to store their produce in accredited warehouses and trade using NWRs,

farmers in Goa are unable to fully benefit from this system. This is a significant disadvantage, as NWRs offer a range of benefits that can enhance the income and livelihoods of farmers.

For example, NWRs provide farmers with the flexibility to store their produce in warehouses during periods of low market prices or adverse climatic conditions. This is particularly important for perishable commodities such as vegetables, where market prices can be volatile, and the quality of the produce can deteriorate rapidly. By storing their produce in a warehouse, farmers can wait for more favorable market conditions before selling their produce, thereby avoiding distress sales and maximizing their returns. Furthermore, NWRs allow farmers to access credit from banks by pledging their warehouse receipts as collateral. This provides farmers with much-needed liquidity, enabling them to invest in their farming operations or meet their financial obligations. In this way, NWRs play a crucial role in enhancing the financial stability and resilience of farmers, particularly in times of market volatility.

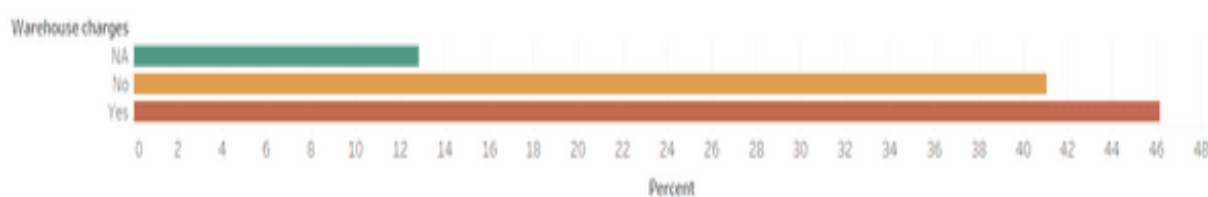Figure 18: Graph representing the variables for Network analysis
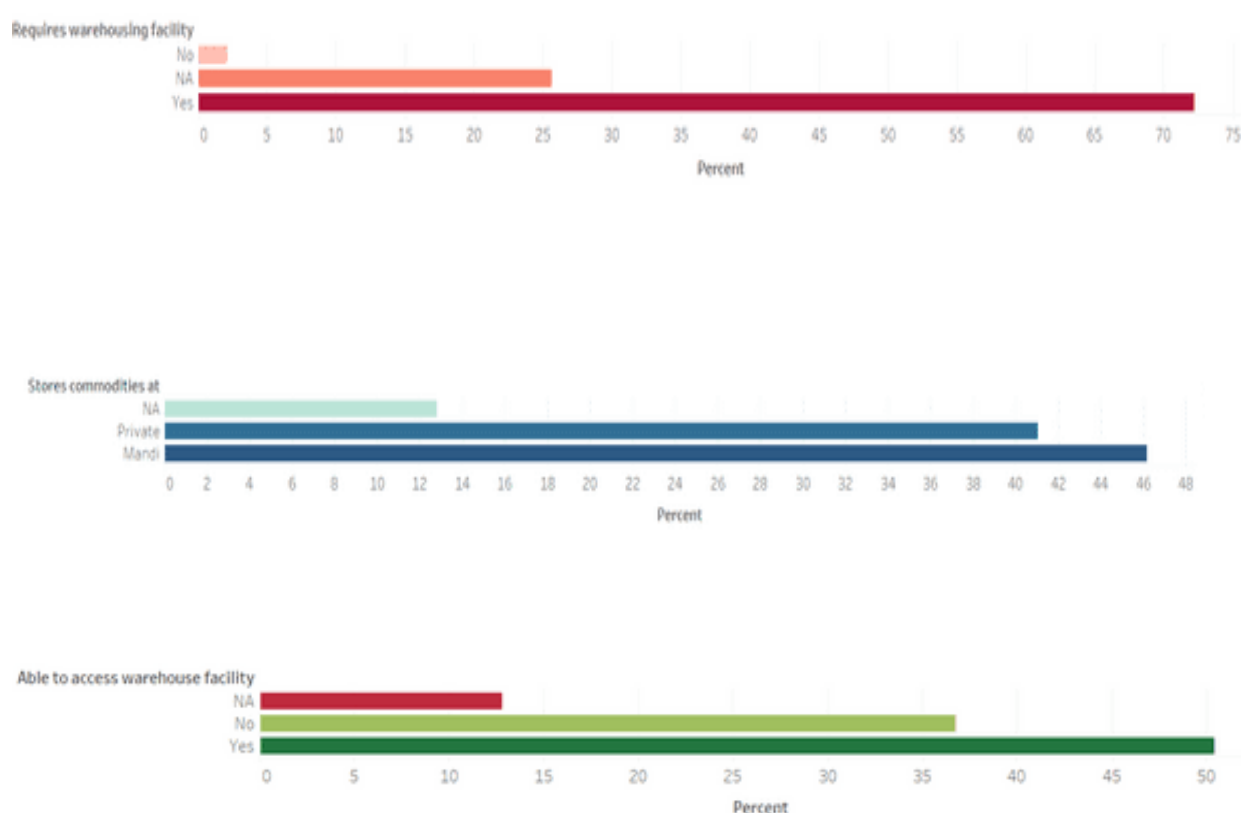
Figure 19: Graph representing the variables for Network analysis

However, the lack of infrastructure in Goa has hindered the effective implementation of NWRs in the state. Without the necessary facilities to issue and trade NWRs, farmers in Goa are unable to fully benefit from this system. This highlights the need for targeted interventions to develop the necessary infrastructure and integrate local markets with the e-NAM platform.

Network Analysis

The network analysis assesses connectivity and warehousing needs across states. The high mean of 0.97 for the variable crop requires warehousing indicates that nearly all respondents require warehousing for their crops. With location of the warehouse showing a mean of 0.45, warehouse facilities are equally split between private and mandi warehouses. The mean of 0.51 for the level of easiness to the access of warehouse reveals a balanced view on whether accessing these facilities is easy or not. The mean of 0.45 for the charges for warehouse suggests that there are charges associated with warehouse usage. These results highlight a widespread need for warehousing with mixed experiences regarding access and cost.

Table 16: Summary Statistics for variables

Variable	Mean	Standard Deviation	Minimum	Maximum
Crop Requires Warehousing	0.97	0.17	0	1
Warehouse Location	0.45	0.50	0	1
Easy Access to Warehouse	0.51	0.50	0	1
Charges for Warehouse	0.45	0.50	0	1

Note: Number of observations is 174

Feasibility Study

The feasibility study evaluates the practicality of implementing NWRs. With the variable crop requires warehousing showing a mean of 0.97, almost all respondents need warehousing, underscoring a critical requirement for NWRs. The mean of 0.45 for location of the warehouse indicates that storage is divided between private and mandi options, affecting how NWRs could be integrated. Access to warehousing, with a mean of 0.51 for the level of easiness to the access of warehouse, suggests that ease of access varies, which could influence NWR implementation. The mean of 0.45 for the charges for warehouse points to associated charges, highlighting a potential barrier to adoption. Overall, the data suggests significant demand but mixed feasibility considerations.

Recommendations for Enhancing e-NAM Connectivity and NWRs in Goa

To address the challenges faced by Goa in implementing e-NAM and NWRs, several recommendations can be made:

Infrastructure Development: It is imperative to develop the necessary infrastructure to support the implementation of e-NAM in Goa. This includes the integration of local mandis with the e-NAM platform, the provision of electronic bidding systems, and the integration of weighment systems with the e-NAM portal. Additionally, it is essential to establish accredited warehouses with the necessary facilities to issue and trade NWRs.

Private Sector Participation: The government should encourage private sector participation in the development and maintenance of e-NAM infrastructure in Goa. This could include inviting private players to establish warehouses at strategic locations, developing electronic bidding systems, and providing logistics services. By involving the private sector, the government can leverage additional resources and expertise to enhance the implementation of e-NAM in the state.

Capacity Building: Capacity-building programs should be implemented to educate farmers, traders, and other stakeholders about the benefits of e-NAM and NWRs. This could include training programs on how to use the e-NAM platform, the advantages of warehouse-based trading, and the process of obtaining loans using NWRs as collateral.

By increasing awareness and understanding of these systems, the government can encourage greater participation in the e-NAM platform.

Stakeholder Engagement: Engaging with key stakeholders, including farmers, traders, commission agents, and warehouse operators, is crucial for the successful implementation of e-NAM in Goa. The government should work closely with these stakeholders to address their concerns and ensure that the e-NAM platform meets their needs. This could include regular consultations, feedback mechanisms, and the establishment of a stakeholder advisory group to guide the implementation of e-NAM in the state.

Monitoring and Evaluation: The government should establish a robust monitoring and evaluation framework to assess the implementation of e-NAM and NWRs in Goa. This could include regular audits of the e-NAM platform, the accreditation of warehouses, and the issuance of NWRs. By closely monitoring the implementation process, the government can identify and address any issues that arise, ensuring the success of e-NAM in Goa.

Conclusion

The successful implementation of e-NAM and the effective use of NWRs are critical for enhancing market access, improving price discovery, and increasing the income of farmers in India. While significant progress has been made in several states, the challenges faced by Goa highlight the need for targeted interventions to develop the necessary infrastructure and integrate local markets with the national platform. By addressing these challenges, the government can ensure that farmers in Goa, like their counterparts in other states, can fully benefit from the advantages of e-NAM and NWRs. This, in turn, will contribute to the overall goal of creating a unified national market for agricultural produce, benefiting farmers, traders, and consumers alike.

Chapter 8: Conclusions and Policy Insights

Concluding Remarks

e-NAM is aimed to unify India's agricultural markets through digital integration. In order to establish a single national market for agricultural products, the National Agriculture Market (eNAM), a pan-India electronic trade web, links the current APMC mandis. Despite its success in several states, Goa's implementation of e-NAM faces notable challenges. This report explores these challenges and the role of negotiable warehouse receipts (NWRs) in enhancing market efficiency. The National Agriculture Market (e-NAM) is an online trading platform designed to integrate existing Agricultural Produce Market Committees (APMCs) across India, creating a unified market for agricultural commodities. Managed by the Small Farmers Agribusiness Consortium (SFAC) under the Ministry of Agriculture and Farmers' Welfare, e-NAM seeks to streamline marketing processes, enhance transparency, and enable real-time price discovery by linking markets across the country (Dey et al., 2023). This platform benefits multiple stakeholders, including APMCs, farmers, traders, and Farmer Producer Organizations (FPOs), by simplifying trade procedures, ensuring fair pricing through electronic auctions, and facilitating prompt online payments. The key stakeholders in agricultural marketing include farmers, traders, Agricultural Produce Market Committees (APMCs), assaying bodies, Farmer Producer Organizations (FPOs), banks, logistics operators, warehouses, and mandi boards. Agricultural marketing has evolved significantly over time, transitioning from traditional barter and local village markets to advanced systems incorporating ICT, digital marketing, and global virtual platforms. With production often concentrated in one area while consumption occurs year-round in various locations, effective agricultural marketing has become essential. It plays a crucial role in ensuring that both consumers and farmers achieve better pricing and efficiency throughout the supply chain.

The study evaluates the implementation and benefits of e-NAM for farmers and stakeholders in Goa's APMC mandis. It aims to understand smallholder participation, measure the benefits in terms of pricing and viability, and identify necessary interventions for broader adoption. Additionally, it addresses challenges in connecting e-NAM across states and assesses the potential of Negotiable Warehouse Receipts

(NWRs) in Goa. The findings will be summarized with strategic policy recommendations to enhance e-NAM's effectiveness and adoption in the state.

We examined the adoption and benefits of the e-NAM (Electronic National Agriculture Market) platform within Goa's Agricultural Produce Market Committees (APMCs). e-NAM aims to streamline agricultural marketing by connecting farmers, traders, and officials, thereby enhancing market efficiency and transparency. e-NAM offers several advantages to farmers, including higher price realization due to broader market access, the convenience of online payments, time savings from reduced travel and paperwork, improved quality assessment facilities, and increased transparency in transactions. This underscores e-NAM's potential to provide tangible financial benefits and expanded market opportunities.

Adoption and Operational Challenges

The effectiveness of e-NAM adoption is influenced by various factors, including regional market dynamics and crop types. Effective adoption requires targeted training programs tailored to farmers' specific needs, such as content relevance, methodology, language, and location. Studies highlight that increased awareness and capacity building are essential for successful e-NAM implementation. Farmers in different regions report varying levels of benefit, with those in northern areas seeing better price realization. This suggests that regional disparities affect the platform's impact and points to the need for tailored interventions. A Chi-Square test was used to evaluate the relationship between stakeholder awareness of e-NAM and its effectiveness. Data from 174 farmers, 30 officials, and 30 traders were analysed. The test revealed significant differences in awareness: 66.7% of farmers and 83.3% of traders were not aware of the e-NAM portal, whereas all officials were aware. The Pearson Chi-Square statistic of 55.1407 (p-value = 0.000) indicates a statistically significant association between stakeholder type and awareness of the e-NAM portal. This suggests that information dissemination and engagement vary significantly across different stakeholder groups. The low awareness levels among farmers and traders indicate a need for improved information dissemination strategies. Officials' full awareness highlights their crucial role in promoting e-NAM. Targeted outreach, including local language media and digital platforms, is necessary to increase awareness among farmers and traders. The analysis suggests that while technological compatibility positively influences perceived usefulness, increased user knowledge

may not always enhance perception, possibly due to complexities discovered during use. The availability of help, though a positive feature, does not significantly impact user perceptions in this context. Despite the benefits, e-NAM faces adoption constraints, particularly among smallholder farmers who remain unaware of the platform's incentives. Regional disparities also affect the platform's impact. Future strategies should focus on bridging awareness gaps, enhancing digital literacy, and addressing specific needs of underserved farmer populations. Policymakers must ensure comprehensive implementation strategies to extend e-NAM's benefits broadly.

The analysis reveals significant insights into how smallholders interact with e-NAM. Awareness and registration behaviours are strongly influenced by educational attainment and, to a lesser extent, age. Key findings include:

Awareness of e-NAM: The logistic regression model indicates that both age and education are crucial determinants of awareness about e-NAM. Older individuals and those with higher education levels are more likely to be aware of the portal. This suggests that experience and educational background play a role in understanding and accessing digital agricultural platforms.

Registration on e-NAM: When it comes to actual registration on the e-NAM platform, education proves to be a significant factor. Individuals with higher levels of formal education are more likely to register on e-NAM. In contrast, age does not show a significant effect on registration, indicating that factors other than age might influence an individual's decision to register.

Policy Implications: The findings highlight a need for targeted interventions to improve e-NAM adoption among less educated and younger farmers. Strategies should focus on bridging the educational gap and enhancing digital literacy to facilitate broader engagement with the platform.

Educational Initiatives: Given the strong link between education and both awareness and registration, educational programs that inform and train farmers about e-NAM could enhance participation rates. These programs should be accessible and tailored to the needs of different demographic groups.

Technology Accessibility: Ensuring that technological tools and resources are available and user-friendly is critical. This includes providing support and assistance to farmers

with lower educational backgrounds to navigate and utilize the e-NAM portal effectively.

Focused Outreach: Outreach efforts should be directed towards younger and less educated farmers to increase their awareness and registration on e-NAM. Customized communication strategies and hands-on support could improve their engagement with the platform.

Economic Impact of e-NAM on Farmer Price and Viability

The e-NAM (Electronic National Agriculture Market) portal represents a significant advancement in agricultural markets by providing farmers with real-time price information and facilitating transparent transactions. The integration of Goa's Agricultural Produce Market Committee (APMC) mandis with the e-NAM platform has enhanced market access for farmers, facilitating better price discovery and reducing the need for intermediaries. This has helped bridge the gap between farmers and traders, promoting competition and reducing transaction costs. This digital initiative has also attracted more traders to participate in the state's agricultural markets, increasing competition and potentially leading to improved prices for farmers. Despite these benefits, many farmers continue to prefer traditional market practices, primarily due to a lack of awareness and understanding of e-NAM's advantages. The paired t-test analysis assesses the impact of e-NAM registration on price outcomes by comparing farmers who visit Agricultural Produce Market Committees (APMCs) with those who do not. Results show a significant difference in registration rates: farmers who visit APMCs are all registered with e-NAM, whereas a lower proportion of non-visitors are registered. The statistically significant p-value (0.0031) indicates that visiting APMC Mandis is associated with higher e-NAM registration. This association suggests that physical market interactions play a crucial role in promoting digital platform adoption, as farmers exposed to e-NAM within APMCs are more likely to register and utilize the portal.

Cost-Benefit Analysis

The cost-benefit analysis evaluates the perceived financial viability of e-NAM among farmers, traders, and officials. The analysis reveals a negative mean net benefit of -0.55, indicating that, on average, respondents view the costs of using e-NAM as outweighing the benefits. This negative perception is driven by significant variability

in individual opinions and the differing levels of familiarity with e-NAM across respondent groups. Despite the potential advantages of e-NAM, such as reduced transaction costs and improved market access, the negative net benefit suggests that further efforts are needed to demonstrate the tangible benefits and address concerns related to resource requirements. ANOVA results reveal significant relationships between age, education level, smartphone ownership, and e-NAM usage. The analysis indicates that younger, more educated respondents with smartphones are more likely to engage with e-NAM. Specifically:

Higher education is associated with younger age groups and greater engagement with e-NAM. Smartphone ownership significantly influences e-NAM usage, with younger individuals more likely to own and use smartphones. Registration rates are higher among certain age groups, reflecting a generational divide in technological adoption. Younger respondents, who are more adept at using smartphones, are more engaged with e-NAM.

These findings underscore the importance of technological literacy and access in influencing e-NAM adoption. Enhancing digital literacy and improving access to smartphones, particularly among older and less educated farmers and traders, are crucial for increasing e-NAM usage. The economic impact analysis highlights that while e-NAM has the potential to improve market efficiency and farmer viability, its benefits are not fully realized due to limited adoption and negative perceptions among some stakeholders. Targeted educational programs and outreach initiatives are essential to raise awareness and demonstrate the benefits of e-NAM. Addressing concerns related to resource requirements and providing practical demonstrations of e-NAM's advantages could help shift perceptions and enhance the platform's overall financial viability and effectiveness.

Strategies for Enhancing e-NAM Adoption in Goa

To advance e-NAM adoption in Goa, there are several strategies focusing on infrastructure, software, education, comprehensive planning, and research. The successful scaling of e-NAM in Goa depends on aligning mandis with WDRA-accredited warehouses and cold storage. The infrastructure must support major commodities and integrate essential services such as banking, grading, and

warehousing. This integration is crucial for creating a cohesive national market that facilitates seamless trade. Upgrading the e-NAM software is vital to extend beyond basic transactions. The system should manage both internal and external trade aspects, automate processes, and address inter-mandi disputes. These improvements will streamline operations and enhance market integration. Educating farmers on e-NAM's functionalities is critical. Tailored training programs should be developed to help farmers, especially those with limited tech skills, learn how to register, list produce, participate in auctions, and negotiate prices. Effective training will improve market access and transparency. A holistic strategy is required, including incentives for users and engagement with banks. Addressing barriers such as regulatory restrictions and integrating logistics services is necessary to fully realize e-NAM's potential as a national market platform. Ongoing research is needed to identify barriers and effective strategies for e-NAM adoption. Understanding how e-NAM influences marketing strategies, crop choices, and market access will help refine the platform to better serve stakeholders.

The National Agriculture Market Scheme (e-NAM) seeks to modernize agricultural trading by creating a unified digital marketplace. However, the adoption of e-NAM in Goa is hindered by several challenges. Stakeholders, including farmers, traders, and commission agents, face significant obstacles. Farmers, who are supposed to benefit from improved market access and better price discovery, struggle with digital literacy. Despite the growth in smartphone and internet usage, many farmers find the e-NAM app complex and have limited engagement with the platform. This low adoption rate suggests that digital literacy programs are crucial. Additionally, the dependency on intermediaries like commission agents persists, undermining e-NAM's goal of enabling direct transactions between farmers and buyers. Traders exhibit reluctance due to concerns about increased tax liabilities and transparency requirements. The shift to digital platforms exposes traders to more scrutiny, which deters full adoption. Commission agents fear that e-NAM's direct trading model threatens their traditional role, contributing to resistance within this group. Technological and infrastructural constraints also impede e-NAM's effectiveness. The platform suffers from a lack of standardized price discovery methods and skepticism towards digital assessments, with many stakeholders preferring traditional practices. Rural areas, including Goa, face connectivity issues, which further restrict the platform's usability. The existing version of e-NAM lacks advanced features, and integrating technologies like AI and

IoT could significantly enhance its functionality and appeal. The gap analysis reveals that users perceive e-NAM as less efficient and more cumbersome compared to traditional methods. Issues such as language difficulties, software performance, and perceived risks in adopting e-NAM highlight areas needing improvement. Notably, training requirements are perceived as minimal, but enhancing overall efficiency and addressing concerns could boost adoption rates.

e-NAM's primary goal is to integrate local mandis into a national platform, facilitating seamless connectivity and efficient trading. Warehouse-based trading, introduced in April 2020, allows farmers to store produce in accredited warehouses and trade using electronic negotiable warehouse receipts (e-NWRs). This system aims to reduce logistics costs, minimize post-harvest losses, and provide greater market flexibility. In Andhra Pradesh and Telangana, this model has streamlined trading and improved market access. However, Goa's e-NAM implementation has struggled with inadequate infrastructure. Local mandis lack essential facilities such as electronic bidding systems, weighment integration, and electronic gate passes, which hinder effective operation. The absence of integrated warehouses further complicates the situation, as farmers cannot fully utilize warehouse-based trading benefits. This inadequacy limits farmers' ability to store produce and access market opportunities, contributing to market congestion and inefficiencies.

Negotiable Warehouse Receipts (NWRs) are designed to provide financial and operational benefits by allowing farmers to use stored produce as collateral for loans. This system supports financial flexibility, enabling farmers to avoid distress sales and sell produce when market conditions are favorable. Accredited warehouses ensure quality and maintain proper records, enhancing market trust. In Goa, the lack of warehouse integration with e-NAM prevents farmers from leveraging these benefits, limiting their financial stability and market participation. The network analysis reveals a high need for warehousing across states, with mixed experiences regarding access and costs. Most respondents require warehousing, but access varies, and associated charges present a barrier. The feasibility study underscores the critical need for warehousing and highlights mixed feasibility considerations, stressing the importance of addressing infrastructure and cost issues. To overcome these challenges, several targeted recommendations are proposed. Developing infrastructure to support e-NAM and NWRs, encouraging private sector participation, implementing capacity-building

programs, and engaging stakeholders are essential steps. A robust monitoring and evaluation framework will ensure effective implementation and address emerging issues.

Policy Focus and Solutions

1. Targeted Training Programs: Develop and implement tailored training initiatives to enhance farmers' technological literacy and ensure content relevance. These programs should consider language preferences and effective delivery methods to maximize e-NAM adoption and utilization.

2. Expanded Outreach Efforts: Launch awareness campaigns through local media and digital platforms to engage farmers and traders. Community-based initiatives should be prioritized to ensure widespread participation and effective communication.

3. Addressing Regional Disparities: Customize e-NAM implementation to bridge regional gaps. Provide additional support and incentives to farmers in underrepresented areas to promote equitable access and adoption.

4. Enhancing Technological Compatibility: Upgrade the e-NAM platform to integrate seamlessly with existing agricultural systems, improving usability and functionality for stakeholders.

5. Comprehensive Digital Literacy Programs: Implement structured training programs for farmers, with a focus on smartphone usage and online platforms. Prioritize high-speed internet expansion in rural areas to facilitate smooth digital engagement.

6. Improving Access to Technology: Facilitate farmers' access to digital tools, such as smartphones and internet services, through subsidies or partnerships with technology providers to ensure wider participation in e-NAM.

7. Educational Support for Farmers: Develop targeted learning resources for less-educated farmers to enhance their understanding of e-NAM processes and digital trading.

8. Enhancing Accessibility: Ensure e-NAM resources and support services are user-friendly and accessible, particularly for those with lower literacy levels. Provide easy-to-use interfaces and dedicated assistance.

9. Strategic Awareness Campaigns: Highlight success stories and conduct hands-on training sessions to improve farmers' and traders' understanding of e-NAM's benefits, especially in remote areas.

10. Resource Optimization: Address concerns regarding e-NAM's resource demands by demonstrating cost-benefit advantages and providing practical support tools to streamline usage.

11. Infrastructure Development: Invest in WDRA-accredited facilities, electronic trading infrastructure, and logistics to support seamless e-NAM operations across mandis.

12. Software Enhancements: Upgrade e-NAM's software to enable inter-mandi trade, automate critical processes, and resolve disputes efficiently.

13. Stakeholder Engagement: Conduct workshops and consultations with farmers, traders, and other key players to gather feedback and align infrastructure development with user needs.

14. Integration of Advanced Technologies: Leverage AI and IoT to enhance e-NAM's decision-making capabilities, provide real-time data insights, and improve overall efficiency.

15. Policy Reforms and Incentives: Introduce subsidies for farmers and tax benefits for traders to encourage e-NAM adoption and ensure uniform implementation across regions.

16. Private Sector Participation: Promote private investments in e-NAM infrastructure, including warehouse development and logistics services, to supplement government initiatives.

17. Capacity Building: Train farmers, traders, and stakeholders on e-NAM and NWR functionalities to increase participation and improve market efficiency.

18. National Warehouse Receipt (NWR) Integration: Upgrade local mandis with electronic trading and weighment systems while establishing accredited warehouses with NWR capabilities to facilitate seamless market transactions.

References

Arora, V. (2013). Agricultural Policies in India: Retrospect and Prospect. Agricultural Economics Research Review, 135-157.

Acharya SS, Agarwal NL. Agricultural Marketing in India (Fifth). New Delhi: Oxford and IBH Publishing Company Pvt. Ltd; 2011.

Agholor, A. I., Ogujiuba, K., & Shongwe, I. N. (2023). Determinants of small farmers access to agricultural markets in South Africa. Agricultural Science & Technology (1313-8820), 15(1).

Agresti, A., & Kateri, M. (2017). Ordinal probability effect measures for group comparisons in multinomial cumulative link models. Biometrics, 73(1), 214-219.

Amarender Reddy, 'Electronic National Agricultural Markets: The Way Forward, Current Science, VOL. 115, NO. 5, 10 September 2018.

Banerjee, T., Mishra, M., Debnath, N. C., & Choudhury, P. (2019). Implementing e-commerce model for agricultural produce: A research roadmap. Periodicals of Engineering and Natural Sciences, 7(1), 302-310.

Chand R. E-Platform for National Agricultural Market. Economic and Political Weekly. 2016;51(28):15-18.

Coulter, J., & Onumah, G. (2002). The role of warehouse receipt systems in enhanced commodity marketing and rural livelihoods in Africa. Food policy, 27(4), 319-337.

Dayton CM. Logit regression analysis. Stat. 1992; 474-574.

Department of Agriculture & Farmers Welfare Ministry of Agriculture & Farmers Welfare Government of India. 2021;1.

Dey Kushankur 2016, 'National Agricultural Market: Rationale, Roll-out and Ramifications' Economic and Political Weekly, Vol 51, Issue no 19.

Dey, S., & Singh, P. K. (2023). Role of market participation on smallholder vegetable farmers' wellbeing: Evidence from matching approach in Eastern India. Agribusiness, 39(4), 1217-1237.

FAO (2005) Towards an India Common Market: Removal of Restrictions on Internal Trade in Agriculture Commodities, Food & Agricultural Organisation of the United Nations (FAO).

Fernandez, D., Liu, I., & Costilla, R. (2019). A method for ordinal outcomes: The ordered stereotype model. International journal of methods in psychiatric research, 28(4), e1801.

Ghosh L, Sahoo JP, Nahak SK, Samal KC. National agricultural market (e-NAM) for rebooting Indian faremer's economy. Agriculture Letter. 2021; 3(4): 55-62.

Glendenning, C. J., Babu, S., & Asenso-Okyere, K. (2010). Review of agricultural extension in India. Are farmers information needs being met, 55.

Gupta S, Badal PS. E-national Agricultural Market (e-NAM) in India: A Review. BHU Management Review. 2018; 6(1):48-57.

Kalamkar SS, Ahir K, Bhaiya SR. Status of Implementation of Electronic National Agriculture Market (eNAM) in selected APMCs of Gujarat. Progress. 2019; 112.

Kaushik M, Mathur B. Data Analysis of Students Marks with Descriptive Statistics. International Journal on Recent and Innovation Trends in Computing and Communication. 2014;2(5):1188-1191.

Khan N, Khan MM. Marketing of agricultural crops in rural Indian economy: A case Study. Marketing. 2012;3(2).

Krishnamurthy, M (2014), 'The Political Economy of Agricultural Markets': Insights from Within and Across Regions", IDFC Rural Development Network, India Rural Development Report, New Delhi: Orient Blackswan, Chapter 4.

Kumar N, Kumar A, Tyagi S. e-NAM: Connecting farmers and traders. Rashtriya Krishi. 2016; 11: 61-62.

Kumar, S. A., Pant, S. C., & Chandra, K. R. (2019). Performance of eNAM in Rajasthan–A CASE STUDY. CCS National Institute of Agricultural Marketing.

Kushankur Dey (2016) Rationale, Roll-out and Ramifications National Agricultural Market, Economic & Political Weekly, Vol. 51, Issue No. 19, 07 May, 2016.

Ma, J., Gao, H., Cheng, C., Fang, Z., Zhou, Q., & Zhou, H. (2023). What influences the behavior of farmers' participation in agricultural nonpoint source pollution control? —Evidence from a farmer survey in Huai'an, China. Agricultural Water Management, 281, 108248.

MANAGE (2018), e-NAM: A Beginning in the right direction - A Case study of Telangana

Meena GL, Burark SS, Singh H, Sharm L. Electronic-National Agricultural Market (e NAM): Initiative towards Doubling the Farmer's Income in India. Intl. Archive of Applied Sci. and Tech. 2019; 10(2): 162-171.

NABARD (2018), Status of Marketing Infrastructure under Status of Marketing Infrastructure under- A Quick Study. 27

Nair D, Mehta S. e-NAM: An impact study on doubling farmers income 4th international conference on new horizons in science, Engineering and management, and Humanities. 2020;662.

Narayana Gowda K "Agricultural Extension Systems in India" University of Agricultural Sciences, Bangalore

NIAM (2015) Unified Common Market: A concept Note, National Institute of Agricultural Marketing.

NIAM (2016) Linking Farmers to Electronic Markets (E-NAM): Current Scenario and A Way Forward, http://ccsniam.gov.in/images/pdfs/E-NAM-Status-&-Way-Forward.pdf.

Nitesh. Economic study of national agriculture market (e-NAM) in Bikaner district of Rajasthan. M.Sc. Thesis, Swami Keshwanand Rajasthan Agricultural University, Bikaner, India; 2018.

Pani SK, Jena D. Agricultural marketing in India: A review on challenges and prospects. Journal of Critical Reviews. 2020; 7: 4169-4174.

Pavithra, S., Gracy, C. P., Saxena, R., & Patil, G. G. (2018). Innovations in agricultural marketing: a case study of e-tendering system in Karnataka, India. Agricultural Economics Research Review, 31(1), 53-64.

Rajendran G, Karthikesan P. Agricultural marketing in India-an overview. Asia Pacific Journal of Research. 2014; 1(XVII).

Ramesh Chand (2016), e-Platform for National Agricultural Market, Economic & Political Weekly EPW July 9, 2016 vol II no 28.

Ramesh Chand (2017), Doubling Farmers' Income, Rationale, Strategy, Prospects, and Action Plan, NITI Policy Paper No. 1/2017 Kumar, S., Pant, S. C., & Chandra, R. K. (2019) Performance of e-NAM in Rajasthan-A Case Study.

Reddy, A. A., & Mehjabeen. (2019). Electronic national agricultural markets, impacts, problems and way forward. IIM Kozhikode Society & Management Review, 8(2), 143-155.

Reddy, A. A. (2018). Electronic national agricultural markets. Current Science, 115(5), 826 837.

Rehman SU, Selvaraj M, Ibrahim MS. Indian Agricultural Marketing- A Review, Asian Journal of Agriculture and Rural Development. 2012;2(1):69-75.

Roshini S, Sonali SB, Mahapatra U. E-nam in Agricultural Marketing- An Overview. International Journal of Current Research. 2018;10(2):65276-65278.

Sahoo, A. K., & Krishna, D. K. (2020). Prospects of Direct marketing through Agricultural Market Reform in India. Division of Agriculture Extension, New Delhi, 1(2020).

Samantaray, S. K., Farhan, M., Singh, P., & Kakkar, A. (2023). Impact of e-NAM on organic agriculture farmers' economic growth: a SmartPLS approach. Organic Agriculture, 1-18.

Sekhar, C. S. C., & Bhatt, Y. (2019). Electronic national agricultural market (e-NAM): a review of performance and prospects in Haryana.

Singh DP, Patil C, Meena SS. Impact of online agriculture marketing policy- e-NAM on prices and arrivals of agricultural commodities in Punjab, India. International Journal of Current Microbiology and Applied Science. 2021;10(2):2319-7706.

Singh S (2012), "Institutional and Policy Aspects of Punjab Agriculture: A Smallholder Perspective," Economic and Political Weekly ,47 (4)

Singh, N. K., & ALAGAWADI, M. (2021). Electronic-National Agriculture Market (e-NAM): A Paradigm Shift in Agricultural Marketing.

Singh, S., & Paty, B. K. (2019). Insights into Implementation of National Agricultural Market scheme in Telangana. Journal of Agricultural Extension Management, 19(2), 63-76.

Sukhpal Singh, Shruti Bhogal (2015) "Commission Agent System Significance in Contemporary Agricultural Economy of Punjab", Economic & Political Weekly, November 7, 2015 vol l, no 45.

Trevor Kit Fong et al., (1999), Success and Failure Factors for Implementing Effective Agricultural Electronic Markets. Claire J. Glendenning et al (2010), "Review of Agricultural Extension in India", International Food Policy Research Institute (IFPRI)

Vadivelu A, Kiran BR. Problems and prospects of agricultural marketing in India: An overview. International Journal of Agricultural and Food Science. 2013; 3(3):108-118.

Varshney, D., Roy, D., & Meenakshi, J. V. (2023). Impact of COVID-19 on agricultural markets: assessing the roles of commodity characteristics, disease caseload, and market reforms. In Contextualizing the COVID Pandemic in India: A Development Perspective (pp. 249-271). Singapore: Springer Nature Singapore.

Venkatesh, P., Singh, D. R., Sangeetha, V., Balasubramanian, M., & Jha, G. K. (2021). The changing structure of agricultural marketing in India: a state-level analysis of e-NAM. Agricultural Economics Research Review, 34(conf), 97-109.

Yadav H, Shalendra, ODISHA- Linking Farmers to Electronic Markets (ENAM) Current Scenario and a Way Forward. 2017.

Yadav JP, Sharma A. National agriculture market: the game changer for Indian farming community. Journal Article. 2017;5810-5815.

Appendix

Project Questionnaire

1. Profession: ☐ Farmer ☐ Commission Agent (Trader) ☐ Associated with Farmer Producer Organization (FPO) ☐ Mandi Secretary/official

2. Age ☐ <35 ☐ 35 – 50 ☐ >50

3. Gender ☐ Male ☐ Female

4. Marital Status ☐ Single ☐ Married

5. Total number of Family Members/households:

6. People engaged in Farming activities:

7. District: ☐ South ☐ North

8. Belongs to which Mandi: ☐ Canacona ☐ Curchorem ☐ Mapusa ☐ Margao ☐ Ponda ☐ Sanquelim ☐ Valpoi

9. Do you make a visit to APMC Mandi? ☐ Yes ☐ No

10. What type of agricultural product do you deal with: ☐ Cashew ☐ Copra ☐ Coconut ☐ Arecanut/Supari ☐ Paddy ☐ Others (Mention):

11. Formal Education: ☐ No schooling ☐ Primary education ☐ Secondary ☐ Higher Secondary ☐ Graduation ☐ Post Graduation

12. Languages Known:

   Speak: ☐ English ☐ Hindi ☐ Konkani ☐ Marathi ☐ Tamil ☐ Telugu ☐ Kannada

13. Read & Write: ☐ English ☐ Hindi ☐ Konkani ☐ Marathi ☐ Tamil ☐ Telugu ☐ Kannada ☐ Others (mention):

14. How do they know the best prices? ☐ Newspaper ☐ Acquaintances ☐ Mandi ☐ Bagayatdar ☐ Traders ☐ Phone ☐ Others (mention):

15. Phone you own: ☐ Smartphone ☐ Featurephone ☐ Telephone ☐ No phone

16. Do you know to operate a smartphone for online activities: ☐ Yes ☐ No

17. Nearest possibility available to use internet: ☐ Family ☐ Relatives ☐ Internet cafe ☐ Govt. supported centres set up in Goa)

18. Are you aware about the e-NAM portal/App in APMC market? ☐ Yes ☐ No

19. Registered member? ☐ Yes ☐ No

20. Please choose your usage frequency for the following:

	Never	Sometimes in a month	Sometimes in a week	Once a day	May times per day
e-NAM portal					
e-NAM app					

21. How do you rate the e-NAM portal / App? (1 being the lowest and 5 being highest) :

□1 □2 □3 □4 □5

22. Easiness to use & user interface: □1 □2 □3 □4 □5

23. Helpful in your job (farmer/trader/official): □ 1 □ 2 □ 3 □ 4 □ 5

24. I have the resources to use the e-NAM portal / App □ 1 □ 2 □ 3 □ 4 □ 5

25. I have the knowledge necessary to use the e-NAM portal / App □1 □2 □3 □ 4 □5

26. The e-NAM portal / App is compatible with other technologies that I use □ 1 □ 2 □ 3 □ 4 □ 5

27. I can get help from others when I have difficulties using the e-NAM portal / App □ 1 □ 2 □ 3 □ 4 □ 5

28. Area (in hectare) □ <1 □ 1-2 □ 2-4 □ 4-10

29. Years of farming □ <5 □ 5-10 □ 10 – 15 □ > 15

30. Seasons: □ Kharif □ Rabi □ All seasons

31. Irrigation methods: □ Wells □ Ponds □ Canals □ Storage tanks □ Others

32. Distance to nearest market: □ <2 km □ 2-5 □ 5-8 □ >8

33. Credit amount taken: □ Yes □ No

34. Rate of Interest (in %): □ 7-8 □ 8-9 □ 10-12 □ >12

35. Is there a specific time in a year you take loan? □ Yes □ No Specify:

36. Loan taken from Banks or Private lenders? □ Public bank □ Pvt. bank □ Co-operative bank □ Pvt. lenders

37. Does your crop require warehousing facility? □ Yes □ No

38. If you require warehouse, where do you store it? (Privately/ In the Mandi warehouses)

39. Are you able to access these warehouse facilities easily? □ Yes □ No

40. Are there any charges for warehouses? □ Yes □ No

41. Is the e-NAM process perceived as lengthier than open auction system? □ Yes □ No □ Not aware

42. Is the e-NAM process perceived as easier than the open auction process? □ Yes □ No □ Not aware

43. Is the bid price lower in e-NAM compared to open auction bidding price? ☐ Yes ☐ No ☐ Not aware

44. Are there fewer bidders participating in e-NAM? ☐ Yes ☐ No ☐ Not aware

45. Do participants face difficulties understanding the language on the projection screen during e-NAM? ☐ Yes ☐ No ☐ Not aware

46. Is the software used in e-NAM considered fast? ☐ Yes ☐ No ☐ Not aware

47. Do you actively share information about e-NAM among other farmers? ☐ Yes ☐ No

48. Do you believe that selling products through e-NAM helps farmers in getting a rational return? ☐ Yes ☐ No ☐ Not aware

49. Is the e-NAM process considered difficult for illiterate people? ☐ Yes ☐ No ☐ Not aware

50. Is there perceived risk in adopting e-NAM? ☐ Yes ☐ No ☐ Not aware

51. Does the e-NAM process require specific training? ☐ Yes ☐ No ☐ Not aware

52. Do you believe that the e-NAM scheme is more beneficial for farmers than open auction bidding? ☐ Yes ☐ No ☐ Not aware

53. Does agricultural product weighing through e-NAM take more time than open auction bidding? ☐ Yes ☐ No ☐ Not aware

54. Any awareness programmes conducted for you about e-NAM? ☐ Yes ☐ No ☐ Not aware

List of Abbreviations

ADMP	Average Daily Modal Price
AGMARKNET	Agricultural Marketing Information Network
APLM	Agricultural Produce and Livestock Market
APMC	Agricultural Produce Market Committee
BHIM UPI	Bharat Interface for Money Unified Payments Interface
DMI	Directorate of Marketing & Inspection
e-NAM	Electronic National Agriculture Market
e-NWRs	Electronic Negotiable Warehouse Receipts
FPO	Farmer Producer Organizations
GAPLAMB	Goa Agricultural Produce and Livestock Marketing Board
GoI	Government of India
ICT	Information and Communication Technology
MIS	Management Information System
NEFT	National Electronic Funds Transfer
NWR	Negotiable Warehouse Receipts
RMC	Regulated Market Committee
RTGS	Real Time Gross Settlement
SFAC	Small Farmers' Agribusiness Consortium
WDRA	Warehousing Development and Regulatory Authority

Manual sorting of arecanut, Ponda APMC yard

List of commodities at the Canacona sub-yard

De-husking process of the coconuts at the Margao APMC yard

Goa Agricultural Produce and Livestock Marketing Board, Curchorem sub-yard

Farmers selling their produce on roadside. Most of them doesn't visit APMCs, but sometimes sell their products at the Horticulture cooperation outlets.

राष्ट्रीय कृषि और ग्रामीण विकास बैंक, मुंबई

NATIONAL BANK FOR AGRICULTURE AND RURAL DEVELOPMENT