Operational Efficiency of E-Tendering in Banana Marketing: A Comparative Study of Manual and Digital Tender Systems in Agricultural Producers' Cooperative Marketing Societies

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Abstract*—Agricultural Producers' Cooperative Marketing Societies (APCMS) play a significant role in the marketing of agricultural commodities by providing organized marketing services and improving farmers' access to competitive markets. However, the conventional manual tender system is often associated with lengthy processing time, excessive paperwork, operational delays, and limited transparency, reducing marketing efficiency for highly perishable commodities such as banana. This study evaluates the operational efficiency of the e-tender system in comparison with the traditional manual tender system in banana marketing at the Gobichettipalayam Agricultural Producers' Cooperative Marketing Society, Tamil Nadu. A descriptive and comparative research design was adopted using primary data collected through direct observation of 100 banana tender lots during April–May 2026. Operational efficiency was assessed using mean processing time, time saved, percentage reduction in processing time, and staff requirement. The findings revealed that the e-tender system substantially improved the efficiency of all operational activities. The average total processing time decreased from 54.42 minutes under the manual system to 18.84 minutes under the e-tender system, representing a 65.4% reduction. Registration recorded the highest efficiency gain (81.4%), while manpower requirements declined by 50%, demonstrating improved labour utilization and reduced operational costs. The study concludes that e-tendering enhances transparency, minimizes paperwork, accelerates transaction processing, and improves service delivery in cooperative banana marketing. The findings support the wider adoption of e-tendering across Agricultural Producers' Cooperative Marketing Societies and emphasize the need for investment in digital infrastructure, capacity building, and standardized digital operating procedures to strengthen cooperative agricultural marketing in Tamil Nadu.

***Index Terms*—Banana Marketing, Agricultural Producers' Cooperative Marketing Society (APCMS), E-Tendering, Digital Transformation, Operational Efficiency**

I. Introduction

Agriculture plays a vital role in India's economy by contributing to food security, employment, and rural livelihoods. Among horticultural crops, banana is one of the most important fruit crops due to its year-round availability, high nutritional value, export potential, and significant contribution to farmers' income. Tamil Nadu is a leading banana-producing state, where banana cultivation and marketing provide livelihoods to thousands of farmers and other stakeholders (Food and Agriculture Organization [FAO], 2022; Ministry of Agriculture & Farmers Welfare [MoAFW], 2022).

As a highly perishable commodity, banana requires an efficient marketing system to minimize post-harvest losses, improve price realization, and ensure timely disposal of produce. Agricultural Producers' Cooperative Marketing Societies (APCMS) play a significant role in this process by providing services such as procurement, grading, storage, auctioning, market information, and payment facilitation. These societies also promote value addition and strengthen farmers' bargaining power through cooperative marketing (Tamil Nadu Cooperative Marketing Federation [TANFED], 2023).

Traditionally, many APCMS have relied on manual tender systems, which involve extensive paperwork, longer processing time, operational delays, limited transparency, and higher administrative costs. To overcome these challenges, APCMS in Tamil Nadu have introduced digital technologies, particularly e-tendering, to improve efficiency, transparency, and service delivery. Digitalization enables faster registration, electronic bid submission, digital record management, and online payment processing, thereby reducing transaction time and enhancing operational performance (FAO, 2023; Ministry of Cooperation, 2023).

Although previous studies have examined agricultural marketing and digital agriculture, limited empirical research has evaluated the operational efficiency of e-tendering in banana marketing through APCMS. Therefore, this study compares the manual tender system and the e-tender system to assess improvements in processing time, manpower utilization, and overall operational efficiency, providing evidence for strengthening digital transformation in cooperative marketing (World Bank, 2019; Organisation for Economic Co-operation and Development [OECD], 2019).

II. Literature Review

Recent studies have emphasized that digital transformation is reshaping agricultural marketing systems by improving operational efficiency, transparency, and farmers' access to markets. Balkrishna et al. (2024) reported that e-governance initiatives in Indian agriculture, including the Digital Agriculture Mission and AgriStack, have strengthened service delivery, enhanced transparency, and improved access to agricultural information. The study further noted that successful implementation depends on adequate digital infrastructure, institutional support, and digital literacy among stakeholders.

Yuan and Sun (2024) observed that digital transformation in smallholder agriculture significantly improves agricultural productivity, reduces transaction costs, and enhances market access. Their review highlighted that digital technologies such as online marketing platforms, electronic transactions, and digital information systems contribute to more efficient agricultural marketing. However, the authors emphasized that investment in digital infrastructure and capacity building is essential for the sustainable adoption of digital technologies.

Similarly, Arulmanikandan et al. (2024) found that digital agricultural practices, including mobile applications, electronic payment systems, digital advisory services, and online marketing platforms, have enhanced farmers' access to timely market information and improved marketing efficiency. These technologies reduce paperwork, improve communication between stakeholders, and support faster decision-making throughout the agricultural value chain.

Furthermore, Patil et al. (2025) highlighted the growing role of digital technologies in strengthening collective agricultural institutions and improving farmers' participation in agricultural markets. Their systematic review concluded that digital platforms enhance transparency, improve institutional efficiency, and strengthen farmers' bargaining power, thereby contributing to sustainable agricultural marketing and rural development.

Although recent studies have demonstrated the benefits of digital agriculture, e-governance, and digital marketing systems, limited empirical research has specifically examined the operational efficiency of e-tendering in Agricultural Producers' Cooperative Marketing Societies (APCMS), particularly in banana marketing. Therefore, the present study addresses this research gap by comparing the manual tender system with the e-tender system and evaluating the impact of digitalization on processing time, manpower utilization, and overall operational efficiency in cooperative agricultural marketing.

Data and Methodology

The study adopts a descriptive and comparative research design to evaluate the operational efficiency of the existing manual tender system and the e-tender system implemented in Agricultural Producers' Cooperative Marketing Societies (APCMS) engaged in banana marketing. The study compares the average processing time required for major operational activities under both systems and assesses the efficiency gains achieved through digitalization.

Study Area

The study is conducted in the Gobichettipalayam Agricultural Producers' Cooperative Marketing Society (APCMS) engaged in banana marketing in Tamil Nadu.

Data Collection

Primary data were collected through direct observation of **banana tender lots** conducted under the manual and e-tender systems during April–May 2026. The processing time for each activity was recorded using structured observation schedules and verified with APCMS officials.

Method of Analysis

The operational efficiency of the manual and e-tender systems is evaluated using descriptive statistical techniques. The following measures are computed:

- Mean Processing Time (minutes)
- Time Saved (minutes)
- Percentage Reduction (%)
- Staff Requirement
- Percentage Reduction in Staff

The percentage reduction is calculated as:

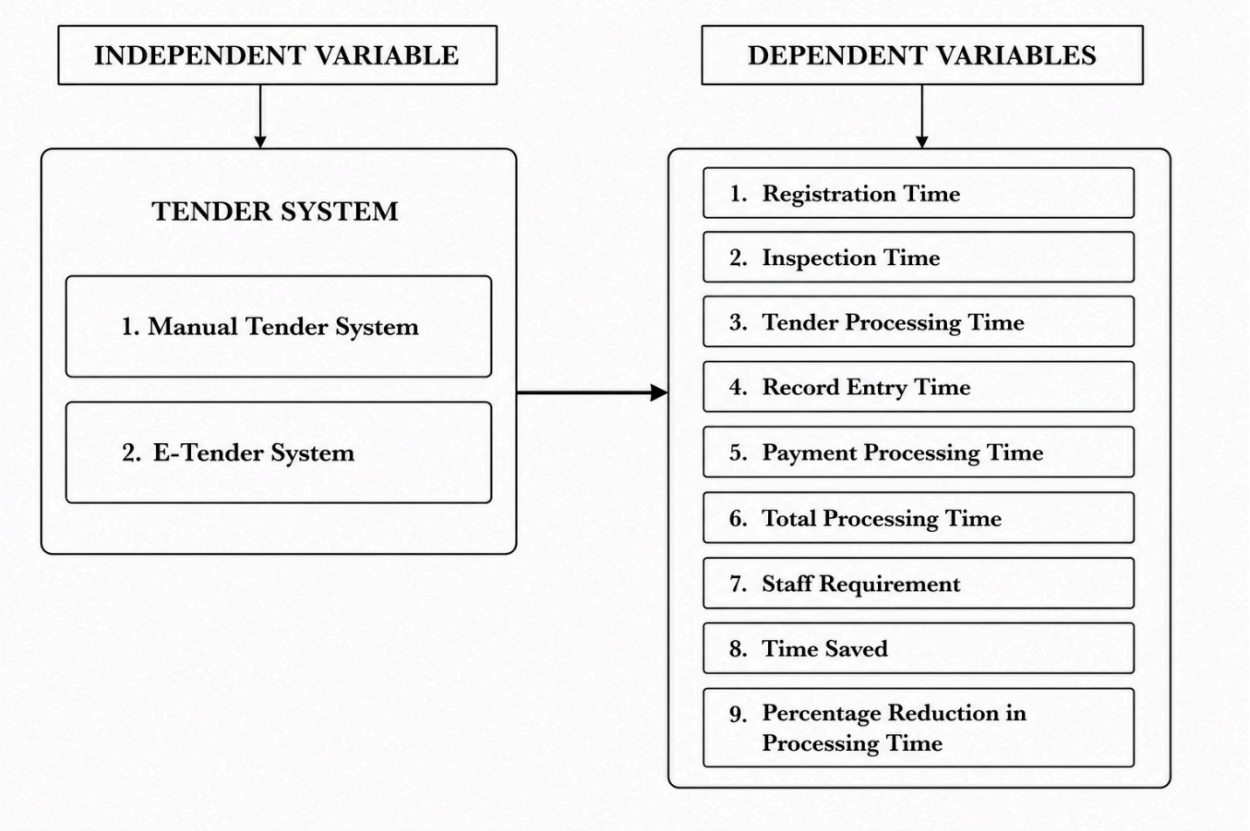
Percentage Reduction (%) = [(Manual Mean − E-Tender Mean) / Manual Mean] × 100

The findings are presented using tables, clustered bar charts, and comparative analysis.

Research Objectives

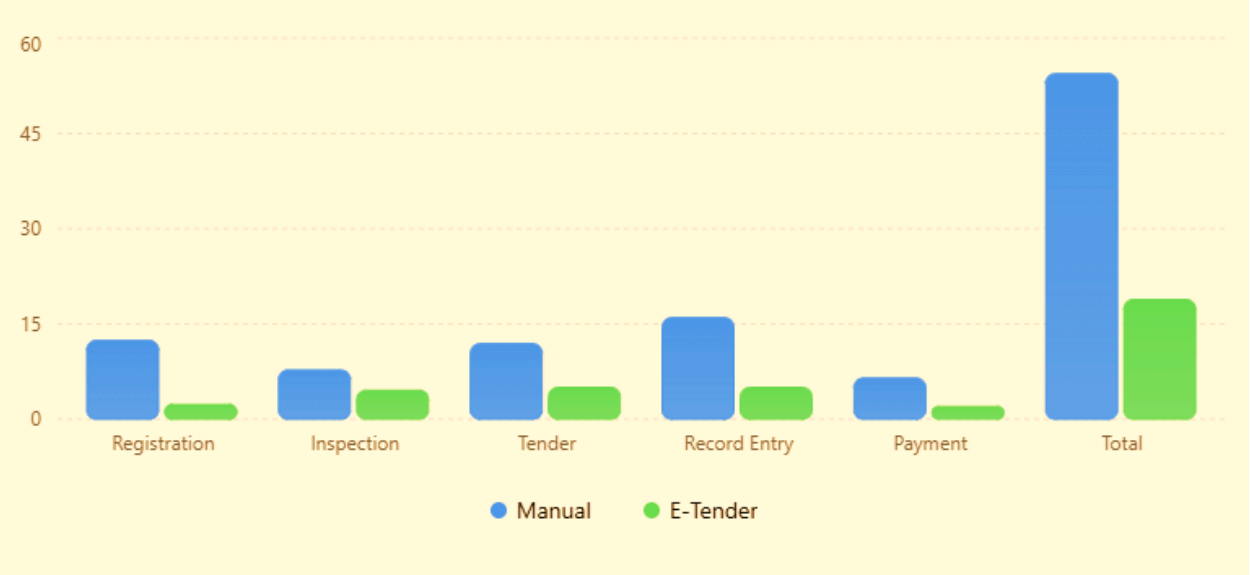
1. To compare the average processing time between the manual tender system and the e-tender system in banana marketing.
2. To estimate the time saved through the implementation of the e-tender system.
3. To examine the reduction in manpower requirements after digitalization.
4. To assess the overall effectiveness of digital transformation in improving banana marketing operations in APCMS.

Variables



III. Result and Discussion

Activity	Manual Mean	E-Tender Mean	Time Saved	% Reduction
Registration	12.38	2.30	10.08	81.4%
Inspection	7.72	4.54	3.18	41.2%
Tender	11.88	5.00	6.88	57.9%
Record Entry	15.98	5.00	10.98	68.7%
Payment	6.46	2.00	4.46	69.0%
Total	**54.42**	**18.84**	**35.58**	**65.4%**
Staff	**30**	**15**	**15**	**50.0%**



Registration achieved the highest efficiency gain (81.4%), suggesting that digital registration eliminates manual documentation and reduces waiting time for farmers. This finding demonstrates that registration is the operational stage benefiting most from digitalization.

The average registration time was reduced from **12.38 minutes** in the manual system to **2.30 minutes** in the e-tender system. This indicates that digital registration significantly improves processing speed and minimizes delays at the initial stage.

Inspection time decreased from **7.72 minutes** to **4.54 minutes**, showing that the e-tender process improves the efficiency of inspection activities and reduces the time required for quality verification.

The tender process required **11.88 minutes** under the manual system compared to **5.00 minutes** under the e-tender system. This demonstrates that electronic tendering considerably accelerates bid processing and tender finalization.

Manual record entry averaged **15.98 minutes**, whereas electronic record entry required only **5.00 minutes**. The digital system substantially reduces paperwork and improves the accuracy and speed of data recording.

Payment processing time declined from **6.46 minutes** to **2.00 minutes** after adopting the e-tender system, indicating faster financial transactions and improved service delivery.

The total average processing time was reduced from **54.42 minutes** to **18.84 minutes**, saving **35.58 minutes per lot**. This represents a **65.4% reduction** in processing time, demonstrating that the e-tender system is considerably more efficient than the manual tender system.

The manual system required **30 staff members**, whereas the e-tender system required only **15 staff members**. This **50% reduction in manpower** indicates that digitalization enhances labour efficiency and reduces operational costs while maintaining the tender process.

IV. Policy Implications

The findings of the study provide several policy implications for strengthening digital transformation in Agricultural Producers' Cooperative Marketing Societies.

1. The Government of Tamil Nadu, TANFED, and Agricultural Producers' Cooperative Marketing Societies should collaborate to scale up e-tendering infrastructure, strengthen digital capacity, and establish uniform operational standards to accelerate the digital transformation of cooperative agricultural marketing
2. Adequate investment should be made in digital infrastructure, including reliable internet connectivity, computer systems, power backup, and secure digital platforms, to support uninterrupted e-tender operations.
3. Regular capacity-building programmes should be organized for society staff, farmers, and traders to improve digital literacy and enhance their ability to use e-tendering systems effectively.
4. Standard Operating Procedures (SOPs) should be developed for digital tender operations to ensure uniform implementation, transparency, accountability, and efficient record management across cooperative marketing societies.
5. Digital payment systems should be fully integrated with e-tender platforms to facilitate faster payment settlement, reduce transaction delays, and improve financial transparency.
6. Continuous monitoring and periodic performance evaluation should be undertaken to assess the effectiveness of e-tender implementation, identify operational challenges, and support continuous system improvement.
7. The successful implementation of e-tendering in banana marketing may be extended to other agricultural commodities marketed through APCMS, thereby promoting digital transformation and improving the overall efficiency of cooperative agricultural marketing in Tamil Nadu.

V. Limitations of the Study

The study is limited to one Agricultural Producers' Cooperative Marketing Society engaged in banana marketing. Operational efficiency was assessed primarily using descriptive measures and direct observation. Stakeholder perceptions, including those of farmers, traders, and cooperative officials, were not examined. Consequently, the findings should be interpreted within the context of the selected case. Future

studies should include multiple cooperative marketing societies, larger samples, inferential statistical analyses, and stakeholder-based surveys to improve the robustness and generalizability of the findings.

VI. Conclusion

The study compared the operational efficiency of the manual tender system and the e-tender system in banana marketing at the Gobichettipalayam Agricultural Producers' Cooperative Marketing Society (APCMS). The findings revealed that the e-tender system substantially improved the efficiency of all major marketing activities, including registration, inspection, tender processing, record entry, and payment. The average total processing time was reduced from 54.42 minutes under the manual system to 18.84 minutes under the e-tender system, representing a 65.4 percent reduction in processing time. Registration recorded the highest improvement, while the digital system also reduced staff requirements by 50 percent, indicating better utilization of human resources and lower operational costs.

The results demonstrate that the adoption of e-tendering has enhanced transparency, minimized paperwork, accelerated transaction processing, and improved service delivery in cooperative banana marketing. Digitalization has streamlined marketing operations and strengthened the efficiency of cooperative institutions by reducing delays and improving administrative performance. Therefore, wider adoption of e-tendering can contribute to modernizing Agricultural Producers' Cooperative Marketing Societies and improving the competitiveness of banana marketing in Tamil Nadu. Future research may examine the long-term economic impact of e-tendering on farmers' income, marketing costs, and market participation across different agricultural commodities and cooperative marketing societies.

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