



ISSN Print: 2664-844X
ISSN Online: 2664-8458
NAAS Rating (2026): 4.97
IJAFS 2026; 8(3): 390-394
www.agriculturaljournals.com
Received: 19-01-2026
Accepted: 22-02-2026

Nikita Bhagwat Khedekar
Final Year Student, Dr.
Sharadchandra Pawar College
of MBA (Agri), Baramati,
Maharashtra, India

Jaya Tiwari
Principal, Assistant Professor,
Division of Agril. Economics,
Dr. Sharadchandra Pawar
College of M.B.A. (Agri.),
Baramati, Maharashtra, India

Abhishek A Gadhave
Assistant Professor, Division of
Agribusiness Management, Dr.
Sharadchandra Pawar College
of MBA (Agri.), Baramati,
Maharashtra, India

Dr. PS Deokate
Assistant Professor, Division of
Agril. Economics, Dr.
Sharadchandra Pawar College
of MBA (Agri.), Baramati,
Maharashtra, India

PA Shitole
Assistant Professor, Division of
Statistics, Dr. Sharadchandra
Pawar College of M.B.A.
(Agri.), Baramati,
Maharashtra, India

Swati Bhagwat Khedekar
MBA (Agri Business
Management), Dr.
Sharadchandra Pawar College
of M.B.A. (Agri.), Baramati,
Maharashtra, India

Corresponding Author:
Nikita Bhagwat Khedekar
Final Year Student, Dr.
Sharadchandra Pawar College
of MBA (Agri), Baramati,
Maharashtra, India

Traceability in agricultural exports: Key factors, benefits, and challenges

Nikita Bhagwat Khedekar, Jaya Tiwari, Abhishek A Gadhave, PS Deokate, PA Shitole and Swati Bhagwat Khedekar

DOI: <https://www.doi.org/10.33545/2664844X.2026.v8.i3e.1272>

Abstract

Traceability systems have gained importance in agricultural exports due to growing concerns over food safety, product quality, and compliance with international standards. These systems help in tracking the journey of farm produce from its origin to the final destination. Despite their benefits, the adoption of such systems among Indian farmer-exporters remains inconsistent. This research aims to explore the core factors that influence the adoption of traceability systems and to assess the advantages and limitations faced by farmer-exporters engaged in export-oriented agriculture. The study adopted a descriptive approach and collected primary data using a structured questionnaire distributed among exporter farmers in Nashik District of Maharashtra. A sample of 90 respondents was analyzed using tools like frequency distribution, Chi-square test and Garrett ranking to interpret the collected data effectively. The results revealed that key factors of traceability adoption include Record Keeping, certification requirements, buyer demands, documentation processes, and access to digital tools, Transparency and Accountability. While traceability systems help exporters secure better prices, attract loyal buyers, and improve product trust, issues such as implementation costs, lack of technical knowledge, and procedural complexity, lack of awareness were noted as significant challenges. Traceability can enhance the global competitiveness of agricultural exports, but wider adoption requires awareness-building, support mechanisms, and simplified regulatory frameworks. Focused efforts are needed to make these systems more accessible, especially for small and medium-scale farmer-exporters.

Keywords: Traceability, agricultural exports, farmer-exporters, certification, supply chain

Introduction

Background of Agricultural Exports: Agriculture is a cornerstone of India's economy, playing a crucial role in both employment generation and national income. India stands among the top global exporters of various agricultural products, including grapes, spices, rice, and fresh vegetables. As global demand for safe and high-quality produce increases, agricultural exports are becoming increasingly important for boosting rural incomes and supporting economic development. However, one of the key challenges faced by Indian exporters, particularly small and medium-scale farmers, is adhering to international safety and quality regulations.

Importance of Traceability: Agricultural traceability refers to the system that allows the tracking of a product's journey through all stages of its production, handling, and distribution. In the export sector, such systems are essential for maintaining transparency, meeting global food safety requirements, and gaining the trust of international buyers. Traceability also plays a crucial role in ensuring product authenticity, enabling recall of defective goods, and protecting brand image. For exporters dealing in perishable goods, implementing a traceability system is not only a value addition but also a prerequisite for market entry.

Problem Statement: Though traceability is crucial for agri-export growth, its adoption among Indian farmer-exporters is still limited. Key challenges include low awareness, lack of technical support, and high costs. Additionally, there is still a gap in understanding the factors that drive adoption and the real impact on farmers' export outcomes.

Research Gap

Previous studies have mostly examined traceability from the viewpoints of processors, exporters, or food safety regulators. However, there is little research focused on the experiences of farmer-exporters, especially in key agricultural regions like Maharashtra. This lack of field-level data creates a gap in understanding how traceability systems function at the farmer level and what kind of support is needed to encourage broader adoption.

Objective of the Study

This study aims to

To identify the key factors of traceability and evaluate its benefits and challenges in the export of agricultural products.

Hypothesis

H0: There is no significant benefits of traceability in export of agricultural Products.

H1: There is significant benefits of traceability in export of agricultural Products.

Research Methodology

Type of Research: This study follows a quantitative research design to investigate the key factors of traceability systems in agricultural exports and to assess their benefits and challenges from the perspective of farmer-exporters. A quantitative approach was chosen to allow for the objective measurement and comparison of responses across a defined sample.

Method of Data Collection

Data for the study was obtained through a structured questionnaire survey. The questionnaire included both multiple-choice and ranking-based questions aimed at collecting information on farmer demographics, their knowledge and application of traceability systems, and their views on the benefits and challenges involved.

Sampling Method and Respondent Profile

The research was carried out in 2 Talukas of Nashik district, Maharashtra. From this district, 2 talukas were selected for the study Niphad and Dindori. Out of these talukas, different villages were selected for collection of required data. Vinchur, Umbarkheda, Varkheda, Jopul, Pimpalgaon,

Korhate, Ganjewadi, Sukene, Nandurdi, Talegaon vani, Kokangaon etc. A leading region for the export of crops such as grapes, onions, and pomegranates. The 90 farmer-exporters were selected through purposive sampling, targeting individuals actively engaged in export activities.

Tools and Techniques for Data Analysis

The data was analyzed using descriptive and statistical methods, including frequency analysis for general trends, Garrett ranking to prioritize Key factors of traceability Implementation, and Chi-square tests to Benefits of Traceability System to the farmers.

Results and Discussions

This chapter presents the empirical findings of the study on the implementation of agricultural traceability systems among farmer-exporters, with a focus on identifying key factors, important aspects, challenges, and benefits associated with adoption. The results are discussed in light of existing literature on agricultural traceability, which is widely recognized as a critical component in ensuring food safety, quality assurance, and market access in export-oriented agriculture (Bosona & Gebresenbet, 2013; Charlebois *et al.*, 2014) ^[5, 10]. For farmer-exporters, traceability systems serve not only as compliance tools for meeting international regulations but also as mechanisms for enhancing transparency, improving operational efficiency, and building buyer trust (Moe, 1998) ^[17]. In this study, factors such as record-keeping practices, buyer/exporter requirements, cost considerations, and use of digital tools were evaluated to determine their role in influencing adoption. Additionally, challenges like language barriers, lack of awareness, technical complexity, and cost constraints were examined to understand the limitations faced by small and medium-scale farmer-exporters.

The findings are structured into four main sections

- Key factors influencing traceability adoption
- Important operational aspects of traceability in export agriculture
- Challenges encountered during implementation
- Benefits derived from adoption

Key Factors of Traceability

Table 1: Key Factors for Implementing Traceability System

Sr. No.	Key Factors of Traceability	Frequency	Percentage (%)
1.	Record keeping of farm inputs (<i>e.g.</i> , seeds, pesticides, fertilizers)	87	25.66
2.	Use of digital tools and technical support	40	11.80
3.	Government rules and Certification or audit process	36	10.62
4.	Buyer or exporter demand	64	18.88
5.	Training and awareness programs	35	10.32
6.	Cost of traceability system	42	12.39
7.	Transparency and Accountability	35	10.32
	Total	339	100

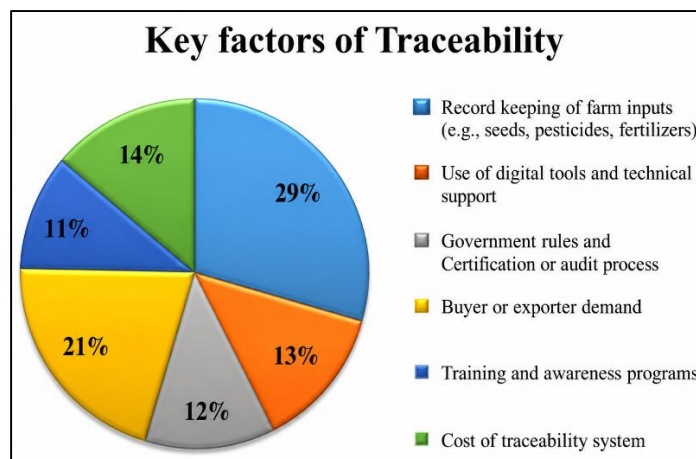


Fig 1: Key factors of Agricultural Traceability

In brief, the data shows that record keeping of farm inputs (25.66%) is the most important factor for traceability among farmer-exporters. Buyer/exporter demand (18.88%) also strongly influences adoption. Other factors like cost (12.39%), use of digital tools (11.80%), and government

certification processes (10.62%) play a moderate role. Training/awareness and transparency/accountability were less frequently cited (10.32% each), indicating a need for more support in these areas. Important aspects of traceability system in Export Agricultural Products.

Table 2: Important aspects of traceability system in Export Agricultural Products

Sr. No.	Aspect	Frequency	Percent Position	Garrett Score	Total Score	Garrett Mean score	Ranking
1.	Recording seed source	90	7.14	77	2574	28.60	I
2.	Recording chemical usage (pesticides, etc.)	90	21.43	66	2420	26.89	II
3.	Recording irrigation and crop schedule	90	35.71	55	1969	21.88	V
4.	Harvest and post-harvest details	90	50.00	44	2057	22.86	IV
5.	Packaging and transportation information	90	64.29	33	1936	21.51	VI
6.	Using mobile apps or tech tools	90	78.57	22	2079	23.10	III
7.	Training from experts	90	92.86	11	1837	20.41	VII

Among the key traceability practices, farmers with a Garrett mean score of 28.60, showing its top priority (Rank I), rated recording seed source highest. Chemical usage records came next at 26.89 (Rank II), followed by use of mobile apps/tech tools at 23.10 (Rank III). Post-harvest details scored 22.86 (Rank IV), while irrigation and crop schedules and packaging/transportation info scored 21.88 and 21.51

respectively, showing lower importance. Training from experts received the lowest score of 20.41 (Rank VII), indicating minimal emphasis on capacity building.

Challenges Faced by farmers in implementing traceability

Table 3: Challenges Faced by farmers in implementing traceability

Sr. No.	Challenges faced by farmers	Frequency	Percentage
1.	Language/localization issues	67	32.68
2.	Lack of Awareness	46	22.44
3.	Technical Complexity	31	15.12
4.	High Cost	26	12.68
5.	Lack of support	35	17.07
	Total	205	100

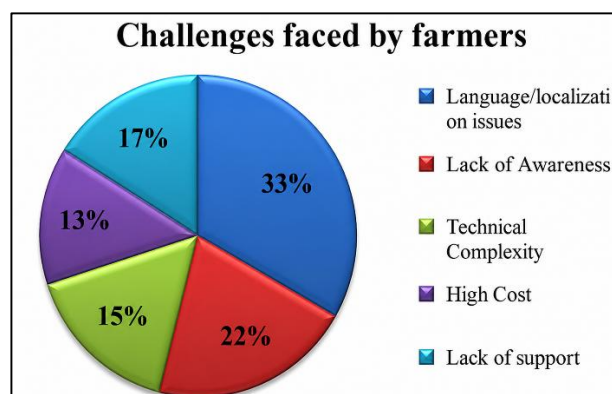


Fig 2: Challenges faced by farmers

The table outlines key challenges faced by farmers in adopting traceability systems. The most prominent issue was language and localization barriers (32.68%), indicating that many available systems are not well suited to regional languages or local farming contexts. A significant number of respondents (22.44%) also cited a lack of awareness, suggesting limited understanding of traceability and its potential advantages. Challenges such as technical complexity (15.12%) and insufficient support (17.07%)

reveal that many farmers struggle with the usability of these systems and often lack proper assistance during setup and use. Additionally, high implementation costs (12.68%) remain a concern, especially for smallholders. These results highlight the urgent need for affordable, easy-to-use, and locally adapted traceability solutions supported by training and outreach.

Benefits of Implementing Traceability System

Table 4: Benefits of Implementing Traceability System

Sr. No	Benefits of traceability system	$\chi^2 = \sum E(O-E)^2$ Calculated	Crit. χ^2 Value	Significance Level	H ₀ : Accept/Reject
1	Higher Price	123.44	9.49	$p < 0.05$	Reject
2	Regular Buyers	89.67	9.49	$p < 0.05$	Reject
3	Less Export Rejection	85.11	9.49	$p < 0.05$	Reject
4	Improved Practices & Planning	69.44	9.49	$p < 0.05$	Reject
5	Transparency & Traceable Identity	70.11	9.49	$p < 0.05$	Reject

H₀: There is no significant benefits of traceability in export of agricultural Products.

H₁: There is significant benefits of traceability in export of agricultural Products.

The Chi-square test results indicate that all five benefits of traceability systems are statistically significant, as their calculated values exceed the critical value of 9.49 at $p < 0.05$. The highest value was observed for higher price (123.44), followed by regular buyers (89.67) and less export rejection (85.11). Improved planning (69.44) and transparency (70.11) were also found significant. This shows that farmers clearly perceive these as major benefits of adopting traceability systems. Hence, the null hypothesis for each benefit is rejected.

Findings

Farmer-exporters identified record-keeping, buyer demand, and cost as the main factors influencing traceability adoption. Seed source tracking, chemical usage records, and tech tools were seen as the most important aspects. Key challenges included language barriers, low awareness, technical complexity, and lack of support. Despite this, farmers recognized traceability as beneficial for better pricing, buyer trust, fewer rejections, and transparency in exports.

Conclusion

The study concludes that traceability is increasingly recognized by farmer-exporters as a valuable tool for improving market access, price realization, and farming standards. Record keeping and compliance with buyer demands are central to successful traceability implementation. However, several barriers remain—especially in terms of language adaptability, digital literacy, cost, and limited awareness. Despite these challenges, the perceived benefits are strong enough to encourage adoption, particularly when adequate support systems are in place.

References

1. Anjum S, Khan A. Changing pattern in India's agricultural exports under WTO. *Economic Affairs*. 2017;62(2):253-262.
2. Aksoy AM, Beghin JC. Global agricultural trade and developing countries. Washington, DC: World Bank; 2005. p. 237-257.
3. Alfaro JA, Rábade LA. Traceability as a strategic tool to improve inventory management: A case study in the food industry. *Int J Prod Econ*. 2009;118(1):104-110.
4. Anwar YS, Perdana T, Rachmadi M, Noor TI. Product traceability and supply chain sustainability of black soybeans as raw materials for soy sauce in maintaining quality and safety. *Sustainability*. 2023;15(18):5-7.
5. Bosona T, Gebresenbet G. Food traceability as an integral part of logistics management in food and agricultural supply chain. *Food Control*. 2013;34(2):32-48.
6. Bala ML, Sudhakar K. An overview of export performance of agricultural products in India. *IOSR J Bus Manag*. 2017;19(2):1-5.
7. Beulens AJM, Broens DF, Folstar P, *et al*. Food safety and transparency in food chains and networks. *Food Control*. 2005;16(6):481-486.
8. Curto JP, Gaspar PD. Traceability in food supply chains: Review and SME-focused analysis-Part 1. *AIMS Agric Food*. 2021;6(2):679-707.
9. Chen S, Brahma S, Mackay J, Cao C, Aliakbarian B. The role of smart packaging system in food supply chain. *J Food Sci*. 2020;85(3):517-525.
10. Charlebois S, Sterling B, Haratifar S, Naing SK. Comparison of global food traceability regulations and requirements. *Compr Rev Food Sci Food Saf*. 2014;13(5):1104-1123.
11. Engelseth P. Food product traceability and supply network integration. *J Bus Ind Mark*. 2009;24(5):421-430.
12. Fernandez CM, Alves J, Gaspar PD, Lima TM, Silva PD. Innovative processes in smart packaging: A systematic review. *J Sci Food Agric*. 2023;103(3):986-1003.
13. Feng H, Wang X, Duan Y, Zhang J, Zhang X. Applying blockchain technology to improve agri-food traceability: A review of development methods, benefits and challenges. *J Clean Prod*. 2020;260:121031.
14. Song JM, Sung J, Park T. Applications of blockchain to improve supply chain traceability. *Procedia Comput Sci*. 2019;162:119-122.

15. Demestichas K, Peppes N, Alexakis T, Adamopoulou E. Blockchain in agriculture traceability systems: A review. *Appl Sci.* 2020;10(12):4113.
16. Zhang L, Zeng W, Jin Z, Su Y, Chen H. A research on traceability technology of agricultural products supply chain based on blockchain and IPFS. *Secur Commun Netw.* 2021;2021:1-12.
17. Moe T. Perspectives on traceability in food manufacture. *Trends Food Sci Technol.* 1998;9(5):211-214.
18. Mohandas K, Indhusree A, Kuruvila A. Exports of vegetables from India: An economic analysis. *J Trop Agric.* 2018;56(1):34-44.
19. Pappa IC, Iliopoulos C, Massouras T. What determines the acceptance and use of electronic traceability systems in agri-food supply chains? *J Rural Stud.* 2018;58.
20. Panghal A, Pan S, Vern P, Mor RS, Jagtap S. Blockchain technology for enhancing sustainable food systems: A consumer perspective. *Int J Food Sci Technol.* 2023;59(5):3461-3468.
21. Qian J, Ruiz-Garcia L, Fan B, *et al.* Food traceability systems from governmental, corporate, and consumer perspectives in the European Union and China: A comparative review. *Trends Food Sci Technol.* 2020;99:402-412.
22. Saak A. Traceability and reputation in supply chains. *Int J Prod Econ.* 2016;177:149-162.
23. Thakur M, Hurburgh CR. Framework for implementing traceability system in the bulk grain supply chain. *J Food Eng.* 2009;95(4):617-626.
24. Surasak T, Wattanavichean N, Preuksakarn C, Huang SC. Thai agriculture products traceability system using blockchain and internet of things. *Int J Adv Comput Sci Appl.* 2019;10(9).
25. World Bank. From competition at home to competition abroad: A case study of India's horticulture. Washington, DC: World Bank; 2007.
26. Walker GS. Food authentication and traceability: An Asian and Australian perspective. *Food Control.* 2017;72:168-172.
27. Yadav S, Choi TM, Luthra S, Kumar A, Garg D. Using Internet of Things (IoT) in agri-food supply chains: A research framework for social good with network clustering analysis. *IEEE Trans Eng Manag.* 2023;70(3):1215-1224