Sustainable Supply Chain Digitalization: Leveraging AI and E-Learning to Empower Farmers and Consumers in Bangladesh

Dr. Mohammad Saiduzzaman *
Deputy Manager (Store Purchase), BJMC, Ministry of Textile & Jute, Dhaka, Bangladesh

Md. Mehedi Morshed
Chief Executive Officer, Cox's Bazar Municipality (Senior Assistant Secretary), Ministry of Local Government, Bangladesh

Dr. Zahiduzzaman Zahid
Islamic FinTech & Business Analytics Researcher, University of the Cumberlands, Kentucky, USA, and COO, FoneBox Inc, TX, USA

Abstract

Sustainable supply chain digitalization is critical for enhancing agricultural efficiency, reducing post-harvest losses, and empowering smallholder farmers in developing economies. However, existing literature lacks a holistic framework integrating artificial intelligence (AI) and e-learning to foster sustainable agricultural supply chains in resource-constrained settings like Bangladesh. This study bridges this gap by proposing a novel, theoretically grounded model that leverages AI-driven predictive analytics, blockchain-enabled traceability, and mobile-based e-learning platforms to enhance farmer decision-making, market access, and sustainability. Grounded in the Technology Acceptance Model (TAM) and Knowledge Spillover Theory, this research employs a mixed-methods approach, combining survey data from 450 farmers and interviews with 25 agri-business stakeholders across Bangladesh. Quantitative analysis using structural equation modeling (SEM) reveals that perceived usefulness ($\beta = 0.42$, $p < 0.01$) and e-learning accessibility ($\beta = 0.35$, $p < 0.05$) significantly influence AI adoption among farmers. Qualitative insights highlight the role of government subsidies (cited by 68% of respondents) and localized digital training (demanded by 72%) in overcoming adoption barriers. A case study of FAO's e-learning modules (DOI: 10.1016/j.techfore.2022.121876) demonstrates a 23% increase in crop yields post-training. The study advances theory by extending TAM to incorporate infrastructural and cultural moderators (e.g., mobile literacy, trust in AI). Practically, it proposes a scalable AI-as-a-service (AIaaS) model and policy recommendations for Bangladesh's Digital Agriculture Strategy (2025–2041). By addressing SDGs 2 (Zero Hunger), 9 (Industry Innovation), and 12 (Responsible Consumption), this research offers a replicable blueprint for digitalizing agrarian supply chains in low- and middle-income countries.

Keywords

Sustainable supply chain, AI in agriculture, e-learning, digital Bangladesh, smallholder farmers, technology adoption.