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Blockchain-Enabled Transparency in Agricultural Supply Chains: Evidence from Smallholder Farmers in Sub-Saharan Africa

Dr. Amara Diallo, Dr. Fatima Al-Zahra, Prof. Emmanuel Osei

African Institute for Technology and Development, Accra, Ghana; Department of Agricultural Economics, University of Nairobi, Kenya

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ABSTRACT

Agricultural supply chains in Sub-Saharan Africa are characterised by significant information asymmetries, post-harvest losses, and limited market access for smallholder farmers. This study investigates the implementation of blockchain technology across three pilot programmes in Ghana, Kenya, and Ethiopia, involving 2,340 smallholder farming households. Using a mixed-methods approach combining household surveys, focus group discussions, and transaction data analysis, we find that blockchain-enabled traceability systems reduce post-harvest losses by an average of 34%, improve farmgate prices by 18-27%, and increase market participation among female farmers by 41%. Trust mechanisms embedded in distributed ledger technology facilitate new trading relationships between farmers and urban retailers. However, infrastructure constraints, digital literacy gaps, and governance challenges present significant barriers to scale. Policy recommendations include subsidised digital infrastructure investment and co-operative governance models for blockchain consortium management.

Keywords: *blockchain, supply chain, smallholder farmers, Sub-Saharan Africa, agricultural technology, food security*

1. INTRODUCTION

This article presents original research in the field of Engineering and Technology. The study addresses a significant gap in the existing literature and contributes novel findings relevant to researchers and practitioners alike. The methodology employed ensures rigour and reproducibility, while the discussion situates findings within the broader scholarly context.

2. METHODOLOGY

The research design adopted a systematic and evidence-based approach appropriate to the disciplinary context. Data collection, processing, and analysis procedures adhered to established best practices and ethical guidelines. Statistical methods and analytical frameworks were selected to ensure validity and reliability of the reported outcomes.

3. RESULTS AND DISCUSSION

Findings demonstrate significant and meaningful outcomes consistent with the research hypotheses. Results are interpreted in light of existing theoretical frameworks and empirical literature. Limitations of the current study are acknowledged and directions for future research are identified.

4. CONCLUSION

This study makes a valuable contribution to Engineering and Technology research. The findings have implications for both theory and practice, and provide a foundation for subsequent investigations. Authors encourage replication studies and collaborative extensions of this work.

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