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Addressing sweet potato oversupply using data-driven tools for livelihoods improvement in malawi. a systematic review

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Abstract

Background:

Sweet potato is a key food and nutrition security crop in Malawi and across sub-Saharan Africa, especially biofortified orange-fleshed varieties that address vitamin A deficiency. However, productivity and market performance remain low due to limited access to quality planting materials, weak postharvest systems, and fragmented value chain governance. Emerging digital innovations such as machine learning (ML), hyperspectral imaging (HSI), and remote sensing present new opportunities to improve productivity, efficiency, and inclusivity across the sweet potato value chain.

Objective:

This systematic review synthesizes evidence on how data-driven and gender-responsive innovations can enhance productivity, equity, and sustainability within the sweet potato value chain in Malawi and comparable African contexts.

Methods:

Peer-reviewed studies were systematically reviewed following PRISMA guidelines. Twenty-six articles published between 2015 and 2025 were selected from Google Scholar and

ScienceDirect. Data extraction captured study characteristics, focus areas, and outcomes. Study quality and bias were assessed using the Newcastle–Ottawa Quality Assessment Scale.

Results:

Of the reviewed studies, 27 % focused on production, utilisation, and governance, revealing gaps in coordination, policy alignment, and value addition. About 43 % examined ML and HSI applications for yield prediction, quality grading, and spatial mapping, reporting 80–95 % accuracy in predicting physical and nutritional attributes. Only 17 % explicitly addressed gender and inclusion, showing persistent inequities in digital participation. A smaller subset (13 %) proposed frameworks combining AI, participatory governance, and policy tools for inclusive food systems. Collectively, the evidence highlights rapid advancement in digital agriculture but limited integration with gender, governance, and capacity-building dimensions.

Conclusion:

Data-driven tools hold transformative potential to enhance productivity, quality, and market systems in sweet potato value chains. To realise this potential, digital agriculture must be embedded in inclusive, gender-responsive, and context-specific frameworks that

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strengthen research–policy–practice linkages, data infrastructure, and institutional collaboration for resilient and equitable food systems.

Keywords: Data Science, Data-driven agriculture, Digital transformation , Malawi, sweet potato