A Systematic Review of Digital Body Condition Score Validation in East African Dairy Systems: Ultrasonic Backfat Correlation for Extension Services in Rwanda

J, e, a, n, d, e, D, i, e, u, U, w, i, m, a, n, a, ,, C, l, a, u, d, i, n, e, M, u, t, e, s, i, ,, J, e, a, n, P, a, u, l, N, i, y, o, n, z, i, m, a, ,, M, a, r, i, e, A, i, m, e, e, U, w, a, s, e

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Abstract

Body condition scoring (BCS) is a key management practice for dairy cattle, affecting health, fertility, and milk yield. In East African smallholder systems, conventional visual and tactile BCS methods are often subjective. Digital BCS tools may improve standardisation, but require validation against objective measures like ultrasonic backfat thickness to be credible for extension services. This systematic review critically evaluated evidence for the validation of digital BCS applications against ultrasonic backfat measurements in dairy cattle. The objective was to assess their applicability for use by extension officers in East Africa, with specific focus on Rwanda. A systematic search of peer-reviewed literature was performed using multiple electronic databases. Pre-defined inclusion criteria encompassed studies on dairy cattle involving digital BCS tools validated with ultrasound backfat. Study screening, selection, and data extraction were conducted independently by two reviewers. The quality of evidence was appraised using appropriate critical appraisal tools. The search identified a limited number of directly relevant studies. A consistent theme was a reported positive correlation between digital BCS values and ultrasonic backfat measurements, although the correlation strength varied. A critical gap was the complete absence of validation studies conducted under field conditions in East Africa or studies that included extension officers as end-users. While existing evidence indicates a

correlation between digital BCS and backfat, a substantial evidence gap exists concerning the validated performance of these tools in East African smallholder systems. Their accuracy and utility for extension officers in Rwanda are not yet established. Primary research is required to validate specific digital BCS tools against ultrasound under Rwandan field conditions. Future validation studies must actively involve extension officers to assess practicality and inter-observer reliability. Development should account for local constraints, such as smartphone availability and connectivity. body condition score, dairy cattle, digital tool, validation, ultrasound, backfat thickness, extension services, Rwanda, East Africa, systematic review This review consolidates available evidence on digital BCS validation and explicitly identifies the lack of field-based research relevant to East African extension systems, thereby directing future research priorities.