

A Scoping Review of Smart Farming Technology Adoption in Zimbabwean Commercial Agriculture: An Engineering Perspective

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| Abstract

The global agricultural sector is increasingly integrating smart farming technologies to enhance productivity. Zimbabwe's commercial agriculture, vital to the national economy, presents distinct challenges and opportunities in this transition. An engineering-focused analysis of the current adoption landscape is needed to guide future technological integration. This scoping review aims to map and synthesise existing literature on implementing precision agriculture and related smart farming technologies within Zimbabwean commercial farming, specifically from an engineering perspective. Its objectives are to identify adopted technology types, the engineering challenges and enablers in deployment, and gaps in current research and practice. A systematic scoping review methodology was followed, adhering to established frameworks. Peer-reviewed journal articles, conference proceedings, and relevant grey literature were identified through searches of multiple academic databases. Studies focusing on engineering aspects of smart farming technologies in the Zimbabwean commercial context were included and thematically analysed. The review identified a nascent but growing interest in smart farming technologies, with a predominant focus on basic precision agriculture tools like GPS-guided machinery. A key theme was the significant engineering challenge posed by inadequate supporting infrastructure, particularly unreliable power supply and limited

connectivity, which constrains advanced IoT-based systems. The literature highlighted a strong reliance on imported technology, with local adaptation and maintenance emerging as critical concerns. The adoption of smart farming technologies in Zimbabwean commercial agriculture is at an early stage, heavily influenced by foundational engineering and infrastructural limitations. While potential benefits are recognised, the pathway to widespread implementation is constrained by technical and systemic barriers requiring targeted engineering solutions. Future efforts should prioritise research into robust, off-grid power solutions and low-bandwidth communication protocols suitable for the local environment. Engineering practice should focus on developing local capacity for technology adaptation, maintenance, and the design of context-appropriate systems. Policy should be informed by these technical realities to support sustainable implementation. precision agriculture, smart farming, technology adoption, engineering infrastructure, Zimbabwe, commercial agriculture, scoping review. This review provides a consolidated engineering-focused analysis of smart farming technology adoption in Zimbabwe, clarifying the specific technical barriers and research gaps that must be addressed to enable effective implementation.
