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Implementing Precision Agriculture: An Analysis of Smart Farming Technology Adoption on Commercial Farms in Zimbabwe

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| Abstract

The adoption of precision agriculture technologies is considered important for improving productivity and sustainability in modern farming. Commercial agriculture in Zimbabwe faces challenges such as resource constraints and climate variability, but the uptake and effects of smart farming technologies in this setting are poorly understood. This study analysed the implementation of smart farming technologies on commercial farms in Zimbabwe. It aimed to identify the key technologies adopted, assess the drivers and barriers to adoption, and evaluate the perceived impacts on farm operations. A mixed-methods approach was used. A structured questionnaire was administered to a stratified random sample of 150 commercial farm managers. This was supplemented by 25 in-depth interviews with farm owners and technology providers, and direct field observations on a subset of farms. Quantitative data were analysed using descriptive and inferential statistics, while qualitative data underwent thematic analysis. Adoption rates for basic guidance technologies were relatively high, while more advanced variable-rate application systems saw limited uptake. Key barriers identified were high initial investment costs, lack of technical support, and unreliable connectivity. Adopters reported perceived improvements in input efficiency and yield mapping capabilities. The implementation of precision agriculture in Zimbabwe's commercial sector is nascent and uneven,

dominated by foundational guidance technologies. Although perceived benefits exist, significant economic and infrastructural barriers hinder the adoption of more advanced systems. To foster wider adoption, policymakers and technology developers should focus on developing tailored financing models, enhancing local technical training and support networks, and investing in rural digital infrastructure. Future research should explore the long-term economic returns on investment for adopters. Precision agriculture, smart farming, technology adoption, commercial farms, Zimbabwe, agricultural engineering This study provides a foundational analysis of smart farming technology adoption within Zimbabwe's commercial agriculture, offering empirical evidence on current uptake levels, critical barriers, and perceived impacts to inform policy and practice.
