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Digitalisation in livestock farming: Impacts, trends, and barriers to adoption

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Abstract

The global livestock sector faces mounting pressure to increase production while reducing environmental impacts, improving animal welfare, and adapting to climate change. This study provides a comprehensive synthesis of how digitalisation can drive sustainable livestock production, based on a systematic literature review of 201 peer-reviewed publications (2010–2024). Digital technologies – particularly within the framework of Precision Livestock Farming (PLF) – integrate sensors, Internet of Things (IoT) systems, artificial intelligence (AI), and data analytics to enable real-time monitoring and decision-making at the individual animal level. These innovations enhance productivity and efficiency through early disease detection, optimised feeding, improved reproductive management, and automated monitoring of animal behaviour and environmental conditions. The findings highlight significant environmental benefits, including reduced greenhouse gas emissions through improved feed efficiency, fertility management, and animal health monitoring. Economic gains are also evident, with technologies contributing to increased productivity, reduced labour costs, and improved resource use efficiency, although these benefits often depend on effective implementation and long-term investment strategies. Social impacts are more nuanced: while digitalisation can improve working conditions and animal welfare, it may also reshape labour demand and exacerbate inequalities between large and small producers. Despite rapid technological advancements, adoption remains uneven. Developed countries lead in implementing advanced systems such as robotics, AI, and blockchain, whereas the Global South primarily relies on lower-cost mobile-based solutions. Key barriers include high upfront costs, limited infrastructure, low digital literacy, and insufficient access to training and extension services. The study underscores the need for targeted policies and investments to bridge this adoption gap. Critical strategies include strengthening rural digital infrastructure, enhancing capacity building and digital literacy, promoting affordable and locally adapted technologies, and fostering inclusive innovation systems that engage youth and women. In conclusion, digitalisation offers transformative potential to align livestock production with sustainability goals, including improved food security, climate resilience, and rural development. However, realising this potential requires coordinated efforts across technological, institutional, and socio-economic dimensions to ensure equitable and context-specific implementation, particularly in developing regions.

Keywords: Artificial intelligence, digital agriculture, Internet of Things (IoT), precision livestock farming, sustainability, technology adoption

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