

Approaches, determinants, constraints, and strategic pathways for farm innovation adoption: a systematic review

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Farm innovation adoption is essential for improving agricultural productivity, sustainability, and resilience under growing population pressure, climate variability, and resource constraints. However, adoption remains uneven across farming systems and regions. The present article gives a systematic review of 110 studies, conducted following the PRISMA 2020 guidelines, to synthesise evidence on adoption patterns, analytical approaches, determinants, constraints, and strategic pathways influencing farm innovation adoption across crops, livestock, fisheries, and allied sectors. The review indicates that research is largely concentrated on adoption levels and behaviour assessments, with comparatively fewer studies examining diffusion processes, impact evaluations, experimental interventions, policy analysis, and theory development. Adoption is influenced by human and economic capacity, behavioural attributes, institutional and extension support, technology characteristics, social networks, and market conditions. Key constraints include gaps in knowledge and skills, weak extension systems, financial and labour limitations, infrastructure and market inefficiencies, risk perceptions, and institutional barriers. The findings underscore the need for integrated, systems-oriented research and policy approaches to strengthen adoption, improve extension effectiveness, and promote sustainable agricultural livelihoods.

Keywords: Adoption, behaviour, diffusion, systematic review, technology transfer

Although sustained global economic growth is estimated at around 2.8% annually, it may reduce economic poverty in developing countries; yet, concerns related to malnutrition and food insecurity are likely to persist even by 2050 (refs 7,8). In this context, agriculture remains central to achieving food and nutritional security^{9,10}. While the relative contribution of agriculture to gross domestic product may decline over time, its role in reducing poverty and hunger will remain critical^{11,12}. Enhancing agricultural productivity through the effective adoption of farm innovations is therefore not only a technical necessity but also a socio-economic imperative¹³⁻¹⁹. Over the past few decades, a wide range of innovations spanning improved crop varieties, climate-smart practices, mechanisation, digital tools, aquaculture technologies, and livestock management practices have been developed to address these challenges.

Since agriculture is inherently more complex than many other economic sectors, where production outcomes are shaped by a wide array of interacting factors such as agro-ecological variability, socio-economic conditions, institutional frameworks, market dynamics, and farmer behaviour, the mere availability of innovations does not guarantee their effective uptake by farmers^{20,21}. Empirical evidence across regions consistently indicates significant variability in adoption levels, with many technologies remaining partially adopted or underutilised²². This persistent adoption gap underscores the importance of understanding not only what innovations are promoted, but also how they diffuse and why farmers decide to adopt, modify, or reject them under diverse socio-economic and agro-ecological conditions²³. Enabling the adoption of