



## Optimizing Extension Approaches to Facilitate Varied Adoption Trajectories in Agriculture

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### Abstract: -

This paper reviews a range of agricultural extension approaches and evaluates the evidence regarding their effectiveness in encouraging changes in farm practices. It explores how different methods influence the adoption process and identifies the key factors that contribute to successful outcomes. Agricultural researchers often encounter difficulties in ensuring that their findings translate into practical on-farm change. These challenges are intensified by the current research, development, and extension (RD&E) funding landscape, the complex nature of innovation adoption, and the increasing privatisation and commercialisation of advisory services. To address these issues, the study undertook a systematic review of extension strategies, including small group and peer learning, technology development initiatives, formal training programs, information dissemination, individual advisory or coaching services, digital extension (e-extension), co-innovation processes, best management practice frameworks, and social marketing approaches. In addition, the review presents two case studies from the Australian dairy industry that demonstrate how combinations of extension methods were applied to tackle feeding system challenges and the outcomes achieved. Overall, the review highlights the importance of researchers taking an active role in guiding farmers toward reliable information sources, collaborating with a diverse network of advisors, promoting field-based demonstrations, and participating in integrated and cooperative RD&E efforts to enhance the impact of their work.

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## Introduction:

Variation in adoption-related learning processes arises from differences among individuals and groups, farming systems, and technologies, as well as from the institutional context the social, cultural, political, and organisational frameworks that shape change and adoption. Agricultural extension methods are designed as interventions to encourage voluntary change and represent a key means of accounting for farmer diversity and contextual influences within adoption processes. Nevertheless, agricultural extension as a field of study along with its theories, terminology, and practices remains contested and strongly influenced by underlying values. Much of this debate stems from contrasting theories of change, such as diffusion-of-innovation models versus approaches centred on farmer empowerment, and from differing views on whether the broader socio-political context of intervention should be made explicit, including the influence of global value chains and commercial interests on extension objectives. Research on extension methods has often reflected these divisions, either concentrating on strategies to overcome demand- and supply-side adoption barriers or critiquing extension practices for insufficiently considering farmers' needs, innovative capacities, or institutional constraints. As a result, relatively few studies have compared

extension methods directly or examined delivery quality and mechanisms of impact while accounting for socio-political factors. This gap has contributed to a tendency to overlook how the characteristics and implementation of different methods influence adoption, creating an implicit assumption that method choice is inconsequential or that extension initiatives simply succeed or fail without regard to who delivers them, how they are delivered, or why they were selected. However, it is reasonable to expect that the skills and capacities of extension providers, along with the format and mode of delivery, shape the effectiveness of interventions and, ultimately, the adoption process. For this reason, a critical assessment of the evidence on the effectiveness of different extension approaches is essential to inform the design and delivery of adoption pathway support (Michie et al. 2011).

## Methodology

The success of agricultural extension approaches depends greatly on the specific context in which they are applied. As a result, most research examining extension methods and their implementation has relied on case study analyses. Comparative investigations are relatively limited, and many assessments are conducted after the fact, without having deliberately examined the rationale behind the selection or design of particular methods.

Given this situation, evaluating the performance of different extension strategies across diverse settings requires a meta-analytical perspective to systematically assess the strength of evidence and detect recurring trends among studies. In addition, qualitative analysis is essential to uncover the shared mechanisms and processes that explain why certain methods are effective in different contexts.

### **Framework for agricultural extension approaches**

Over the past 40 years, numerous scholars have proposed different ways of categorising agricultural extension approaches. The Food and Agriculture Organization (FAO) outlined eight major approaches, each reflecting particular contexts in which extension services are delivered. These include the general or technology-transfer model, the commodity-specialised approach, the training and visit system, participatory approaches, project-based approaches, farming systems approaches, cost-sharing models, and educational institution-based approaches. Bell (2015) later expanded this framework to incorporate Farmer Field Schools and the United States Land Grant model. Other researchers have organised extension methods according to where the initiative originates. For example, some distinguish between “push” (supply-driven or extension-centred), “pull”

(demand-driven or farmer- and market-oriented), and participatory approaches. Additional classifications focus on the primary client or communication channel, such as individual-based, group-based, educational, or mass media approaches. Some scholars emphasise governance and organisational structures governmental, private, or non-governmental systems or differentiate models by characteristics such as profit versus non-profit orientation, free versus cost-recovery services, multi-purpose versus single-purpose programs, and technology-driven versus needs-based approaches (Nagel 1997).

More recently, debates around the ethics, objectives, and methods of extension have encouraged analysis through theoretical perspectives that question whose interests are prioritised. These perspectives include producer-focused, interaction-focused, and system-focused approaches. In the Australian context, Coutts et al. (2017) proposed a typology centred on nine distinct mechanisms that stimulate learning and behavioural change. This framework was particularly relevant to the present review because it emphasises the processes that promote learning and change across the entire innovation system, regardless of the institutional setting or philosophical stance underlying extension efforts. Accordingly, this typology provided the basis for selecting and

comparing studies on extension methods and their effectiveness. Articles were selected for detailed examination based on how closely they aligned with the paper's objective: to assess the outcomes and impacts of specific extension methods and to understand the processes through which those outcomes were achieved. Studies were excluded if they broadly explored determinants of adoption without directly evaluating particular extension approaches, focused on early (pre-2005) versions of decision-support tools rather than internet-based systems, or were published as books or book chapters. Where searches returned a large number of results, additional filters such as LIMIT-TO: farm were applied to refine the dataset. To address the study's objectives, each of these articles was analysed by categorising the extension method(s) according to the established typology, documenting the type of evidence used to evaluate effectiveness, recording the adoption outcomes or changes linked to the methods, identifying interactions among different approaches, and summarising key success factors and other notable insights related to method implementation.

### **Best Management Practices (BMPs)**

Research on the uptake of best management practices (BMPs) indicates that well-prepared and clearly written BMP guidelines are valued by farmers. However,

written guides alone are generally insufficient to drive meaningful changes in farm management. More substantial outcomes are achieved when BMP materials are combined with other extension strategies. For example, participation in advisory groups has been shown to significantly increase the likelihood of farmers adopting environmental BMPs. Similarly, in the context of nutrient management planning, perceived social expectations and the belief that practices are easy to implement were found to strongly influence farmers' intentions to adopt BMPs. Trust also plays a critical role in adoption. Since farmers differ in the degree of confidence they place in various organisations, tailored strategies are needed to promote recommended management practices. Engaging multiple organisations capable of providing direct advice and maintaining contact with landholders has been suggested as an effective way to reach diverse farmer groups. Farmer participation in the development of BMPs has emerged as another key factor for success. In areas such as climate risk management and water quality improvement, involving farmers in drafting guidelines and deciding how information is communicated has strengthened trust and ensured that recommendations are practical, integrating both scientific knowledge and operational realities. Complementary

extension activities including farm visits and personalised on-site recommendations have been found to improve understanding and significantly enhance BMP implementation. Likewise, regular engagement with advisers, seminar participation, and involvement in demonstration projects or field-scale initiatives featuring model farmers and integrated whole-farm practices have supported greater adoption. More recently, the use of farm-level data for monitoring performance and tracking progress toward BMP goals has gained attention as an important element in programme design. This highlights the growing recognition that effective BMP adoption requires not only technical guidance but also participatory processes, trusted relationships, and tools that support ongoing learning and evaluation.

### **Social Marketing**

Social marketing strategies concentrate on the psychological and behavioural aspects of farm decision-making, often drawing on techniques such as social comparison to encourage change. These approaches are widely used in agri-environmental programs to promote desirable behaviours. Research has examined the effectiveness of both “nudges” non-financial and non-regulatory measures that influence behaviour without removing choice or altering economic incentives and “budges,” which limit or restrict available

options. Broader marketing tools, including incentives and demonstration activities, are also commonly applied within this framework (Heiman et al. 2020). Implementing these concepts in practice can be challenging. For example, a study of voluntary uptake of water-quality management practices found that both nudging and budging were necessary, although the appropriate combination varied among individuals. Regulatory measures sometimes fostered both cooperation and division, influencing whether farmers responded with acceptance or resistance (Barnes et al. 2013).

In the same study, strengthening social norms through group-based information sharing and visible demonstrations of individual practices was suggested as a way to clarify acceptable standards and reduce feelings of unfair targeting under environmental schemes.

Evidence regarding the impact of nudges is mixed. Some research has shown that nudging can reduce fertiliser use (Peth et al. 2018), yet social comparison mechanisms have, in some cases, discouraged behavioural change, suggesting that such strategies may be effective for certain farmer groups but counterproductive for others. A systematic review of environmentally oriented “green” nudges found that most studies reported positive effects among farmers. Similar findings have been reported where nudges rewarded participation or highlighted peers’

pro-environmental actions. Concerns have also been raised about the durability of these interventions. If nudges do not support deeper value formation or habit development, particularly in areas such as environmental management, their long-term influence may be limited. The varied outcomes associated with social comparison further point to the risk of unintended consequences when nudges are poorly designed and underline the broader methodological challenges involved in evaluating behavioural interventions under controlled conditions.

### Conclusion

Researchers and extension professionals collaborated to implement a blended extension strategy aimed at helping dairy farmers evaluate and adopt a new feed option under conditions of uncertainty and risk. A key element of the QDAF dairy team's approach was the integration of participatory technology development bringing together multiple stakeholders with structured peer learning focused on WGS silage across several production seasons. This strategy was grounded in co-innovation principles, drawing on the dairy team's established relationships within the broader farm services sector, including seed suppliers, contractors, animal nutritionists, and consultants. By mobilising these networks, the team created a platform that supported the integration of more

conventional extension activities such as group learning sessions, on-farm demonstration sites, targeted information dissemination, and digital extension tools. These activities also contributed to the continuous refinement of the underlying research. Although farmers were already interested in identifying alternative options for summer silage production, evidence from the case suggests that the coordinated, multi-actor network was central to building trust and facilitating collaboration. This environment enabled farmers to share experiences, conduct trials, and gradually implement the alternative feed source across many farms. Complementary extension methods further reinforced farmer engagement, supporting ongoing experimentation and wider adoption of WGS silage. Throughout the process, scientists remained actively involved, incorporating farmer feedback as it emerged and adjusting research findings and recommendations accordingly. This iterative engagement strengthened both the relevance of the research and the effectiveness of its application in practice.

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