

A Design Thinking and Technology Acceptance Model (TAM)-Informed Scoping Review of the Use of Chatbots in Agriculture: Protocol

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ADMINISTRATIVE INFORMATION

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Amendments - This protocol was registered with the International Platform of Registered Systematic Review and Meta-Analysis Protocols (INPLASY) on 13 March 2026 and was last updated on 13 March 2026.

INTRODUCTION

Review question / Objective This scoping review is aimed at (1) identifying how farmers, ranchers, agricultural producers, agricultural extension agents, agricultural technology developers, and researchers are utilizing chatbots in the agricultural sector, and (2) identifying the gaps in design, implementation, and evaluation of agricultural chatbots based on the Design Thinking approach and the Technology Acceptance Model.

Background Artificial intelligence (AI) has become increasingly integrated across every sector of the economy and society, and agriculture is no exception. Given its substantial economic importance and its sensitivity to both social and environmental changes, the agricultural sector has been significantly influenced by these technological innovations. While AI applications in agriculture have demonstrated clear benefits in improving efficiency and productivity; particularly through better management of inputs, enhanced

data use, and more accurate yield predictions, there is comparatively little scientific evidence on how AI supports communication, training, and the dissemination of technical knowledge within agriculture (Sharma et al., 2022; Subbulakshmi et al., 2026).

In this context, chatbots and language models have emerged as promising tools for bridging the information gap between agricultural researchers and producers who confront daily operational challenges (Reddy et al., 2025). A chatbot, often described as a “conversational agent,” interacts with users through natural language and can be understood more broadly as a type of “conversational user interface” (Luo et al., 2022, p. 1). Existing research underscores the speed, accessibility, and convenience of chatbot responses, positioning them as valuable complements to traditional agricultural information systems (Luo et al., 2022).

Although chatbots have been extensively examined in formal education and commercial settings, their role in non-formal education; on which many agricultural practitioners depend,

remains underexplored. Previous reviews suggest that chatbots hold potential for addressing technical questions and offering informal support; however, chatbots in agricultural technical assistance are still largely characterized by isolated, poorly documented initiatives limited to the design phase (Reddy et al., 2025). Current studies vary widely in their focus, addressing domains such as crop management, agricultural training, and marketing (Luo et al., 2022). Similarly, existing evidence synthesis tend to concentrate on customer service (Mohamad Suhaili et al., 2021), education (Huang et al., 2022; Okonkwo & Adebijola, 2021; Wollny et al., 2021), or health-related applications (Abd-Alrazaq et al., 2020; Lim et al., 2022). To date, however, there has been no systematic evaluation of the implementation strategies or performance metrics used in agricultural and food-related contexts.

Because access to accurate scientific information is crucial for effective decision-making across agri-food production, processing, and distribution, it is important to understand how chatbots are being deployed, for what purposes, and under which conditions. These knowledge gaps provide the rationale for undertaking this scoping review.

Rationale Achieving effective dissemination of agricultural technical information through chatbots requires their strategic integration with traditional communication channels and alignment with the realities of current production environments. Although there is strong enthusiasm for these digital tools within the broader movement toward agricultural digitalization and transformation, a clear and consolidated understanding of how chatbots should be used in agricultural contexts is still lacking. Existing evidence remains scattered across various sources, such as conference papers, journal articles, and technical reports, and consists largely of isolated initiatives. This fragmentation makes it difficult to identify overarching trends or pinpoint research gaps and opportunities that could inform both policy and practice. Conducting a systematic mapping of the evidence would help organize current knowledge and present it in a form that is accessible and useful for researchers and practitioners alike.

A scoping review is particularly appropriate for addressing the objectives of this study, as it enables a comprehensive examination of the available evidence—specifically how chatbots have been designed and applied in agricultural settings, and how technical, pedagogical, and ethical aspects have been considered throughout different stages of development. In an era when agricultural stakeholders seek more accessible and timely information, and there is a growing demand

to expand the reach of existing dissemination tools, chatbots are emerging as especially promising instruments. Understanding how these systems have been conceptualized, implemented, and evaluated can provide valuable insights to guide future AI applications in agriculture. Moreover, the results may support the creation of regulatory frameworks and collaborative initiatives that move the sector beyond isolated efforts toward more coordinated and effective digital integration.

METHODS

Strategy of data synthesis The research questions focus on empirical studies involving the use of chatbots in agriculture, and sought to identify the types of available evidence, how the research was conducted, and their characteristics (Aromataris et al., 2024). Given those objectives, a scoping review was the most appropriate evidence synthesis method and the study conducted according to the JBI Manual of Evidence Synthesis and reported according to the Systematic reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR) (Tricco, et al., 2018).

The study will be conducted in the following stages after a protocol was developed as defined in Aromataris et al. (2024): (1) Defining and aligning the objectives and question; (2) Developing and aligning the inclusion criteria with the objectives and questions; (3) Describing the planned approach to evidence searching, selection, data extraction, and presentation of the evidence; (4) Searching for the evidence; (5) Selecting the evidence; (6) Extracting the evidence; (7) Analysis of the evidence; (8) Presentation of the results; and (9) Summarizing the evidence in relation to the purpose of the review, making conclusions and noting any implications of the findings. The synthesis will be mainly descriptive and thematic.

The searches will be conducted following the PCC framework (Covidence, 2025). The population (P) includes farmers, ranchers, agricultural producers, agricultural extension agents, agri-tech developers, and researchers, worldwide. The concept (C) of interest is chatbots or conversational agents. The context (C) where chatbots are used in agriculture includes agricultural production, marketing, farm management, agri-food supply chain, farm diversification, agricultural policy and agricultural research.

Eligibility criteria - The publication must describe how farmers, ranchers, agricultural producers, agricultural extension agents, agricultural technology developers, and researchers are utilizing chatbots in agricultural contexts (crops,

livestock, agricultural extension, agricultural education, agricultural management, agri-food supply chain).

- The publication must be an empirical study, quantitative, qualitative, or mixed methods, with sufficient details that includes at least one of the data elements to be extracted for analysis (e.g., design, implementation, usability, adoption, or impact).

- All document types indexed in the four databases were considered for inclusion, except for those that were not available as full-text or only published as an abstract (e.g., conference abstract, posters, workshop documents).

- All geographic locations will be included, though the study must be available in English.

Source of evidence screening and selection

Searches will be conducted in four databases that included two agricultural databases, an engineering database, and a large multidisciplinary database, respectively: AGRICOLA (EBSCO), CAB Abstracts (EBSCO), Compendex (Engineering Village), and Web of Science Core Collection (Web of Science). While these four databases primary index peer-reviewed journal articles, those databases also index a large amount of gray literature such as conference papers, preprints, reports, book chapters, and theses/dissertations. With respect to gray literature, Web of Science indexes over 314,000 conference proceedings and Compendex indexes over 160,000 conference proceedings, as well as preprints from arXiv and SSRN.

No search limits will be used within the databases in terms of publication year, format, or language. A structured search was developed using a combination of keywords and subject headings (where available) related to the population (e.g., farmers) and concept (e.g., chatbots). An example search for AGRICOLA (EBSCO) is shown below which was then translated into searches for the other three databases.

(TI (agri* OR agro* OR farm* OR ranch* OR livestock OR crop*) OR AB (agri* OR agro* OR farm* OR ranch* OR livestock OR crop*) OR (DE ("agriculture" OR "agricultural industry" OR "farming systems" OR "farm management" OR "animal husbandry" OR "animal production" OR "livestock" OR "ranching" OR "agronomy" OR "crop production" OR "soil science" OR "horticulture"))) AND (TI (chatbot* OR "chat app" OR "chat apps" OR "ai bot" OR "ai bots" OR "chat bot" OR "chat bots" OR "virtual agent" OR "virtual agents" OR "virtual assistant" OR "virtual assistants" OR "generative ai" OR "generative artificial intelligence" OR "Generative Pre-Trained Transformer" OR ChatGPT OR "Chat GPT" OR

GPT-4 OR GPT4 OR "Microsoft Copilot" OR "Microsoft Co-pilot" OR "MS Copilot" OR "Google Gemini" OR "large language model" OR "large language models" OR LLM*) OR AB (chatbot* OR "chat app" OR "chat apps" OR "ai bot" OR "ai bots" OR "chat bot" OR "chat bots" OR "virtual agent" OR "virtual agents" OR "virtual assistant" OR "virtual assistants" OR "generative ai" OR "generative artificial intelligence" OR "Generative Pre-Trained Transformer" OR ChatGPT OR "Chat GPT" OR GPT-4 OR GPT4 OR "Microsoft Copilot" OR "Microsoft Co-pilot" OR "MS Copilot" OR "Google Gemini" OR "large language model" OR "large language models" OR LLM*))

Manual searches will be conducted through the retrieval of the included studies in reviews and surveys about the use and applications of chatbots.

We will use Covidence for screening, full-text reading, study selection, and data extraction. Conflicts in each stage will be solved by consensus among the PI and the researchers. The results of the four database searches will be downloaded as .ris files into EndNote and then uploaded into Covidence for screening and data extraction. The screening will be performed independently by two reviewers. Any disagreements will initially be resolved by consensus, and if not, then by a third reviewer.

Data management Data extraction will be conducted by two independent reviewers using a template in Covidence. The data fields extracted will include (1) Study characteristics (author, title, publication year, title, country/region, objectives, study design, sample size, conceptual/theoretical framework, setting, agricultural subsector); (2) Chatbot general characteristics (name, type of chatbot, details on architecture, intended use, language, connectivity, delivery platform); (3) Context and users (primary intended users, farm scale, digital literacy level); (4) Chatbot implementation/deployment (organization, stage, costs, maintenance); (5) Operationalization of the design thinking based on the five main stages proposed by the Stanford Design of School (Empathy, Define, Ideate, Prototype, Test) (Micheli et al. 2019); (6) Technology Acceptance Model Variables (Perceived Usefulness, Perceived Ease of Use, Attitude, Behavioral Intention, Actual Use) (Dissanayake et al., 2022); (6) Outcomes (production, economy, knowledge, farming-decision making, environmental, training); (7) Any other relevant consideration. Any disagreements between the two reviewers will initially be resolved by consensus, and if not, then by a third reviewer. Once extracted, the data will be managed using Excel spreadsheets and stored on an institutional

Google Drive. After completion of the project the files will be stored in a data repository as appropriate.

Reporting results / Analysis of the evidence The extracted data in Covidence will then be exported, cleaned, organized, and analyzed using R to summarize findings.. The results will be reported as outlined in PRISMA Extension for Scoping Reviews (PRISMA-ScR) guidelines.

Presentation of the results The results will be presented in three sections as follows. The first section will inform on the substantive features of the included studies, including publication information, country/region information, and agricultural field, and the methodological features of the included studies, such as the research methods employed, data collection approaches, and sample size. The second section will present the characteristics of chatbot technologies used in agriculture, including most relevant information on architectural design (e.g., conversational interface, AI capabilities), extended functions (educational support, advisory services, information dissemination), and the overall effects of chatbot use on knowledge transfer, farmer decision-making, and extension outcomes. The last section will show the gaps in design, implementation, and evaluation of agricultural chatbots within the framework of Design Thinking approach and the Technology Acceptance Model.

Language restriction Publications in English only.

Country(ies) involved United States.

Keywords Chatbots; conversational agents; artificial intelligence; agriculture; agri-food supply chains.

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