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Competencies Required of Agricultural Extension Professionals for Effective Service Delivery: Insights from A Global Scoping Review

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Abstract

Agricultural extension professionals (AEPs) play a critical role in supporting farmers and improving agricultural productivity, and their effectiveness largely depends on the competencies they possess. This study aimed to identify, and categorize the essential competencies required for AEPs to perform effectively across diverse agricultural extension systems. A global scoping review was conducted using the Arksey and O'Malley framework, which involved systematically reviewing 36 peer-reviewed journal articles published in English between 2005 and 2024. The review identified 59 competency items, which were synthesized and categorized into nine major competency domains: organization and administration, communication and networking, professionalism, leadership and teamwork, extension education programming, social and cultural, subject matter expertise, agribusiness development, and digital literacy. Among these, 38 items were considered core competencies because they were frequently cited across the reviewed studies and represent the basic competency requirements for AEPs. The most emphasized competencies included communication skills, trust building, time and task management, leadership, teamwork, conflict management, needs assessment, problem solving and decision making, program planning, extension education, program monitoring and evaluation, report writing and documentation, cultural sensitivity, natural resources management, plant protection, agribusiness and marketing, and use of information communication technologies (ICTs). The studies included in this review were drawn from multiple geographical regions, including North America, Africa, Asia, the Middle East, and South America, ensuring that the identified competencies reflect a globally relevant perspective. Therefore, the resulting competency profile provides a valuable tool to guide recruitment, training program development, competency gap assessment, and career progression within agricultural extension systems. Strengthening these competencies can help improve the overall quality and effectiveness of agricultural extension service delivery.

Keywords
agricultural extension professional, competency, scoping review, effective extension service, training program.

1. Introduction

Agricultural extension organizations (AEOs) face many challenges due to the complex social, environmental, and economic conditions in the changing landscape of agriculture, which affect their capacity to accomplish their intended services (Scheer et al., 2011). Climate change, the rapid evolution of agricultural technologies, limited public funding, globalization, and the pressure of competitive market opportunities have all contributed to the increasing complexity and significant transformation of agricultural extension services (AESs) (Charatsari et al., 2023; Norton & Alwang,

2020; Umar et al., 2017). The effectiveness of any AESs critically relies on two important factors: the efficient transfer of technology and the development of clients' capacity and potentials (Billah et al., 2025). By improving farmers' knowledge and adoption of modern farming technologies, AESs contribute to increase profitability and improve livelihood. Beyond these core functions, AESs also provide support for diverse areas including marketing strategies, food safety, biodiversity conservation, health, education, nutrition and youth development (Maulu et al., 2021). However, the success of these AESs fundamentally depends on agricultural extension professionals (AEPs) possessing the necessary competencies to perform their services effectively (Mamino-Bayot & Ortega-Dela Cruz, 2025; Suvedi et al., 2018).

The concept of competency was first introduced by Professor David McClelland of Harvard University in 1973, marking a significant shift in the field of human resource management. He emphasized the need to identify underlying characteristics that directly correlate with superior performance in specific roles, leading to the development of competency-based approaches in various fields (McClelland, 1973). Following McClelland's initial conceptualization, Boyatzis (1982) identified competencies as fundamental abilities that directly affect professional performance and can be developed over time (Boyatzis, 1982). Spencer and Spencer (1993) described competencies as underlying characteristics-including motives, traits, values, knowledge, and skills-that drive superior performance (Spencer & Spencer, 1993). Similarly, Parry (1996) emphasized that competencies are measurable combinations of knowledge, skills, and attitudes that can be developed through training and evaluated against established standards (Parry, 1996). Rajakumar (2023) further defined competencies as observable and improvable behaviors necessary for successful job performance (Rajakumar & R., 2023). These concepts emphasize that competencies are more than just tasks; they are the fundamental qualities, including knowledge, skills, abilities, and personal traits, that help individuals perform tasks effectively.

Competency can be viewed from two perspectives: i) from an individual perspective, it represents specific traits, skills, and knowledge that enhance job performance (McClelland, 1973; Boyatzis, 1982); ii) from an organizational perspective, it is an integrated set of skills, knowledge, and abilities that supports the achievement of strategic goals of extension organization (Prahalad & Hamel, 1990). Recognizing the critical role of competent personnel in ensuring effective service delivery, agricultural extension organizations (AEOs) and scholars worldwide are increasingly emphasizing the identification, assessment, and development of essential competencies to enhance the performance of their professionals (Aghaee Malekabadi et al., 2025; Halbritter et al., 2021). Therefore, developing competency standards is essential to improving both individual and organizational effectiveness within extension systems.

A competency profile provides a structured outline of the knowledge, skills, and personal characteristics required for successful job performance (Draganidis & Mentzas, 2006). Effective performers are those who consistently meet or exceed expectations, representing the threshold level of competency below which an employee cannot be considered adequately qualified (Rothwell & Lindholm, 1999). In this context, threshold competencies considered as foundational knowledge, skills, and abilities essential for adequate performance, while differentiating competencies distinguish superior performers from average ones (Arribas-Aguila et al., 2024). Lindner et al. (2003) further explained that knowledge constitutes an organized body of information; skill represents the ability to apply that knowledge effectively; and ability refers to observable behaviors that enable task completion (Lindner et al., 2003). Thus, a well-constructed competency framework serves not only as a guide for performance evaluation but also as a foundation for professional development, training design, and policy formulation (Rothwell et al., 2012).

Despite the importance of competency profiling, a fundamental question remains: What specific competencies are required for AEPs to perform effectively? Addressing this question is essential for developing competency standards that enhance workforce effectiveness and strengthen AES delivery. Although several studies have identified essential competency of extension personnel in specific countries or program contexts, the findings remain fragmented and inconsistent (Flanagan et al., 2023; Hall & Broyles, 2016; Olorunfemi et al., 2021; Toelle et al., 2024). Most prior research focuses on localized needs, uses limited or unstructured competency lists, and lacks cross-regional validation. Consequently, the absence of a comprehensive and globally validated competency framework restricts the ability of extension organizations to benchmark and standardize professional development initiatives across regions.

To address this gap, the present study adopts a global scoping review approach to identify, analyze, and categorize the essential competencies required of AEPs for effective service delivery. By systematically analyzing existing literature across diverse geographical regions such as North America, Africa, Asia, the Middle East, and South America, this research aims to synthesize, organize, and interpret global evidence on agricultural extension-related competencies. Its added value lies in providing a globally integrated competency framework that consolidates fragmented research, identifies universal and context-specific competencies, and informs policy and training initiatives for AEOs worldwide. By offering evidence-based insights into the evolving competency requirements of AEPs, this study contributes to strengthening human resource development and improving the overall efficiency and impact of agricultural extension services.

2. Materials and Methods

The scoping review employs a systematic methodology, encompassing through searching, extensive synthesis, and rigorous analysis of existing research to enhance understanding, consolidate evidence, guide future studies, and bridge knowledge (Tricco et al., 2016). The foundational framework of scoping review was first proposed by the Arksey & O'Malley, (2005), further refined by Peters et al. (2020), ensures a structured and robust synthesis of specific findings. Arksey and O'Malley's five-stage framework includes a) identification of research question, b) search for relevant studies, c) selection of appropriate studies, d) charting the data, and e) collating, summarizing, and reporting the results (Arksey & O'Malley, 2005; Peters et al., 2020). Adopting a structured and systemic methodological approach is crucial for achieving comprehensiveness, transparency, and integrity throughout the synthesis process (Munn et al., 2018). An overview of this review process is provided in Fig. 1.

2.1. Stage 1: Identifying the research question

To achieve the research objective, the guiding research question for this scoping review are as follows: What are the specific competencies require for agricultural extension professionals (AEPs) to perform effectively?

2.2. Stage 2: Inclusion and Exclusion Criteria

This scoping review adopted a structured inclusion criterion that aligned with the research question and the population, concept, and context (PCC) framework (Peters et al., 2020). The population focused on AEPs involved in crop production-based AESs. The concept of this review encompassed competency-based studies relevant to AEPs role, including production, management, and advisory services. Furthermore, this review adopted a global perspective, incorporating literatures from both developed and developing countries across different regions or continents. To ensure relevance to recent advancements, only journal articles published in English between 2005 and 2024 were considered. Conversely, the exclusion criteria filtered out studies focusing on competencies of AEPs outside the field of crop production, as well as training needs framework that do not incorporate competency assessment. Additionally, studies not published in peer-reviewed journals, those that did not specify competency items, or those with unavailable full texts were also excluded.

2.3. Stage 3: Data source and search strategy

The comprehensive search strategy was developed and executed approach across multiple electronic databases, including Google Scholar, Scopus, and Web of Science, to identify relevant articles. Given the terminological heterogeneity within the extension professionals and competency definition, a wide range of search terms was used to ensure a precise retrieval of relevant literature. Database searches were conducted using key words or combination of the key words: "competence*", "skill*", "capacity", "ability", "agricultural extension agent*", "agricultural extension officer*", "agricultural extension personnel*", "agricultural extension advisor*", "agricultural extension professional*" and "agricultural extension worker*". Additionally, a manual search was conducted, examining all journals containing a minimum of three relevant articles. The reference lists of these identified articles were also scanned to uncover any further relevant publications.

2.4. Stage 4: Study screening and selection

To refine the large number of results obtained in the search, all references were imported into Zotero for organization and duplication. A practical screening process was applied using predefined inclusion and exclusion criteria. First, the title and abstract of each study were reviewed to assess relevance, and duplicate articles were identified and removed. Three reviewers independently screened the remaining articles and reached an agreement on those that met the inclusion criteria. Following this, a thorough full-text review was conducted to determine whether the selected articles aligned with the inclusion criteria.

2.5. Stage 5: data extraction, charting and analysis

The selected articles were compiled, which included essential information such as the author, country of origin, publication year, area of study, primary objective, competency item selection and validation procedures, and the aggregate count of identified competency items. Before finalizing each competency, a careful analysis of similar or overlapping competencies was conducted in the literature and consolidated them into broader, conceptually clear competency term. To ensure the robustness of the competency profile, a competency was included only if it was present in a minimum of three independent studies, thereby reflecting widely acknowledged and validated competencies. Furthermore, the most essential competencies were identified through frequency analysis, with those cited in at least seven of the reviewed studies considered highly significant. The processes of data extraction, competency grouping, and domain classification were independently executed by three reviewers using a pre-specified

extraction form. Any disagreements were resolved through discussion or, if necessary, by consulting with an expert member.

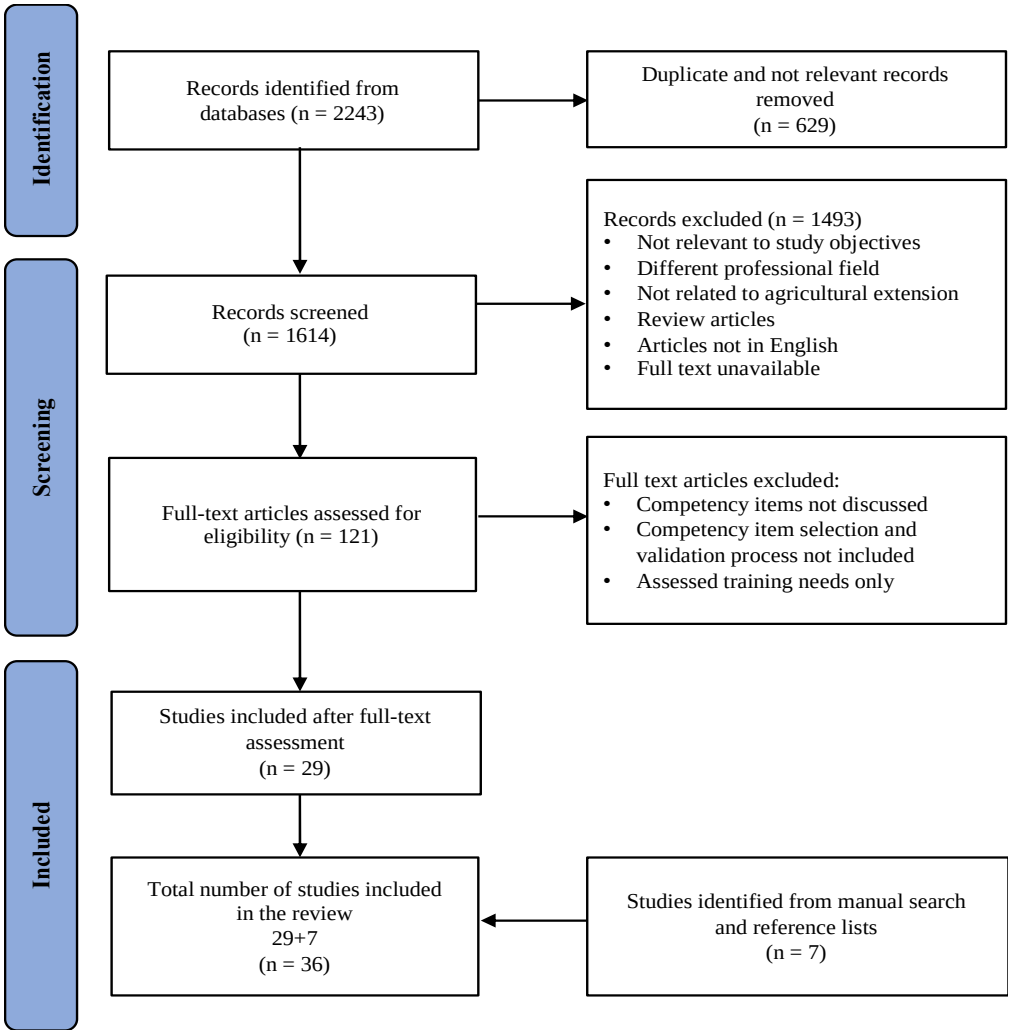

Figure 1. Search Strategy Flowchart (PRISMA flow diagram)

3. Results and Discussion

3.1. Study selection

Initially, 2,243 records were retrieved from electronic databases. Following the removal of 629 duplicate and irrelevant records, 1,614 studies underwent screening based on titles and abstracts. Subsequently, 1,493 records were excluded due to factors such as misalignment with study objectives, focus on different professional fields, lack of relevance to agricultural extension, being review articles, non-English language, or unavailability of full texts. These results demonstrate that, despite a relatively large number of competency study, only a small fraction deals with the competencies in agricultural extension. Consequently, 121 full-text articles were assessed for eligibility, with several exclusions due to the absence of specific competency item discussions, lack of information on the selection and validation process of competency items, or a sole focus on training needs assessment. Ultimately, 29 studies satisfied the inclusion criteria. Furthermore, an additional 7 studies were identified through manual searches of reference lists, resulting in a final total of 36 studies included in the review. The overall selection process is detailed in Figure 1.

3.2. Descriptive analysis of the included studies

3.2.1. Geographic location

The geographical distribution of the reviewed studies reveals significant regional concentrations, as illustrated in Figure 2. A significant portion, 31%, of the studies was conducted in North America, specifically the United States, suggesting a significant research emphasis in this region. Both West Africa (primarily Nigeria), and South Asia (India

and Pakistan) each contributed 16% of the studies, highlighting their increasing attention in competency-based research. In East Africa, including Ethiopia, Uganda, and Kenya, accounted for 11% of the studies, while Southeast Asia (Malaysia and Cambodia) contributed 6%. Additionally, 8% of the studies were conducted in the Middle East (Saudi Arabia and Iran), and 3% each were represented by Europe, South America (Colombia), and South Africa. The global distribution of the included studies demonstrates a widespread interest in agricultural extension competencies, with a notable concentration in North America, West Africa, and South Asia. By synthesizing competencies identified in 36 previous literatures across multiple countries and regions, it undoubtedly provides a thorough and globally relevant competency profile for agricultural extension professionals (AEPs).

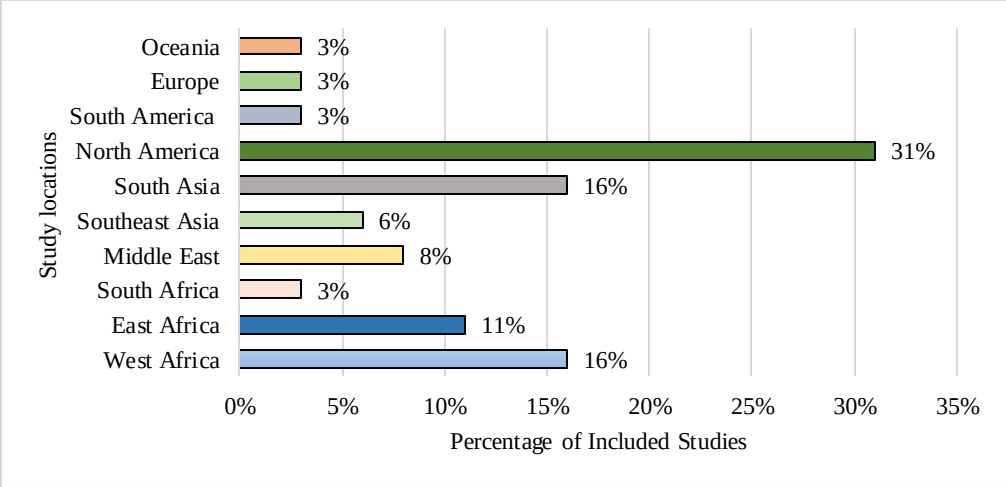

Figure 2. Percentage of Studies by Geographic Location

3.2.2. Year of publication

The overall pattern in figure 3 indicates a gradual increase in scholarly attention to competency-based human resource management in agricultural extension services. A noticeable concentration of studies observed in 2024, with six studies-the highest number recorded in a single year. Prior to this, a significant peak was observed in 2021, marked by the publication of five studies. Both 2017 and 2018 recorded four studies each, while the years 2011, 2020, and 2023 each contributed three studies. In contrast, limited research activity was noted 2007, 2010, 2014, 2015, 2016, and 2022, with only one study published in each of those years. The increasing number competency study in 2021 and 2024 highlights a growing awareness of competency-based human resource development to cope with new agricultural challenges.

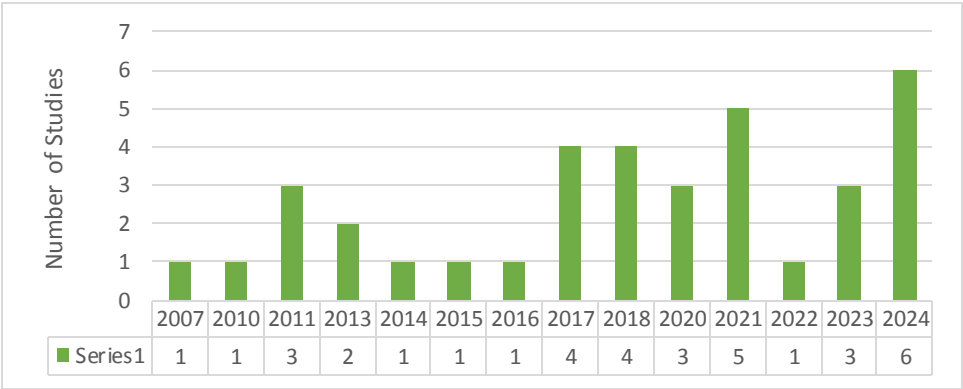

Figure 3. Number of Studies by Year of Publication

3.3. Required competencies of agricultural extension professionals

The required competencies encompassing knowledge, skill, ability, and personal attributes that constitute a competency profile for agricultural extension professionals (AEPs), as synthesized by the scoping review, is presented in Table 1. Initially, after reviewing the studies by three individual reviewers, approximately 581 competency items were distilled based on agreement. After merging overlapping concepts and deleting the competencies that were not included in at least three articles, the list was reduced to 59 items (Table 5). These competencies were further

synthesized for content similarity based on the function of competencies and categorized into nine major domains: organization and administration; communication and networking; professionalism; leadership and teamwork; extension education programming; social and cultural awareness; subject matter knowledge; agribusiness and marketing; and digital literacy. Moreover, 38 competencies were noted, as they were mentioned in at least seven of the examined literature and is deemed to represent the most important competences required for agricultural extension professionals (AEPs).

The analysis identified five core competencies under the domain of organizational and administrative functions that are necessary for the effective operation of agricultural extension services (AESs). "Office and organizational management skills" (19%) and "understanding the vision, mission, and policies of the extension service" (19%) emerged most cited key competencies. This domain highlights competencies that enable professionals to understand organizational structure, management principles, policy, and legal framework (Lakai et al., 2012).

The competency domain of communication and networking included nine key competencies were identified. This review revealed that the understanding and applying "basic communication principles" (44%) was the most frequently cited competency followed by the ability to foster "trust and build strong relationships" (33%) and effective "presentation and public speaking skills" (31%). These competencies are essentials for effectively disseminate information, facilitate knowledge exchange, and establish strong relationships with farmers and other stakeholders (Demenongu et al., 2015). Within the domain of professionalism, our analysis identified 11 distinct competencies, reflecting the broad range of personal and professional attributes required for effective performance in agricultural extension work. The most frequently cited competencies among these were "time and task management" (39%), "continuous learning" (19%), and "adaptation and flexibility" (19%). Such competencies are crucial for enabling extension professionals to remain highly responsive to technological advances, environmental changes and evolving needs of stakeholders (Elliott-Engel et al., 2021).

The ability to facilitate collective action and empower rural communities necessitates competencies in leadership and teamwork (Rohit et al., 2020). Our review identified six key competencies within this domain. The most frequently cited was "leadership and guiding role" (50%), underscoring the importance of AEPs taking initiative, inspiring trust, and providing direction to both colleagues and community members. Group management" (39%) and "conflict management and negotiation" (39%) also emerged as highly important competencies, reflecting the complex interpersonal dynamics that extension workers must navigate.

Competencies in extension education programming improve the ability to design, implement, and evaluate effective educational programs (Aregaw et al., 2023; Flanagan et al., 2023; Suvedi et al., 2018). These competencies are intended to boost the effectiveness of AESs. A total 14 key competencies were identified, with "problem solving and decision making" (47%), "strategic program planning and design" (47%), and "extension education, teaching, and adult learning" (47%) emerging as the most frequently mentioned. "Program monitoring and evaluation" (44%) and "needs assessment and problem identification" (36%) were also highly emphasized, along with "report writing and documentation" (33%).

The social and cultural competencies are essential for effective engagement with diverse farming communities in inclusive and locally suited ways (Toelle et al., 2024). Within the domain, "cultural sensitivity" (33%) being the most frequently cited. "Socio-economic conditions and rural livelihoods" (22%), as well as "gender analysis" (22%), were also highlighted as significant competencies in this domain. A detailed understanding on socio-economic conditions and rural livelihoods are necessary to address the local needs and ensure that extension interventions align with the realities of different farming communities (Flanagan et al., 2023).

Technical subject matter competences are giving emphasize on technical expertise in sustainable crop production, as well as natural resources and watershed management, climate change adaptation knowledge, and the use of weather forecasts in farming decisions to improve productivity and resilience by reducing agriculture's contribution to environmental change (Olorunfemi et al., 2021). Within the realm of subject matter expertise, our review identified nine essential competencies. The most frequently cited competency was natural resources and watershed management (25%), followed by sustainable farming practices (22%) and plant protection (19%). Additional competencies encompassed crop or variety selection and zoning (19%), nutrient management (14%), the application of weather forecasts (14%), pasture management (11%), machinery and equipment management (8%), and knowledge pertaining to climate change adaptation (8%). These competencies enable AEPs to provide informative, technical and customized support to farmers in order to meet the changing needs of farmers.

Table 1. Competencies Required of Agricultural Extension Professionals

No.	List of identified competencies	N	%	References
A	Organizational and Administrative			
A.1	Role of extension in community and agricultural development	5	14%	(Al-Zahrani et al., 2017; Elliott-Engel et al., 2021; Flanagan et al., 2023; Issa, 2013; Narine, 2024)
A.2	Vision, mission, and policies of extension service*	7	19%	(Al-Zahrani et al., 2017; Aregaw et al., 2023; Elliott-Engel et al., 2021; Issa, 2013; Lakai et al., 2014; Okwoche et al., 2011; Suvedi et al., 2018)
A.3	Own role in the extension system	4	11%	(Al-Zahrani et al., 2017; Flanagan et al., 2023; Lakai et al., 2014; Lybaert et al., 2022)
A.4	Administrative, financial, and legal frameworks	3	8%	(Al-Zahrani et al., 2017; Lybaert et al., 2022; Suvedi et al., 2018)
A.5	Office and organizational management*	7	19%	(Al-Zahrani et al., 2017; Halbritter et al., 2021; Issa, 2013; Khan, 2017; Lakai et al., 2014; Lopokoiyit et al., 2013; Nwaogu & Akinbile, 2018)
B	Communication and Networking			
B.1	Trust and relationship building*	12	33%	(Elliott-Engel et al., 2021; Flanagan et al., 2023; Harder et al., 2010; Karbasioun, 2007; Lakai et al., 2012; Lybaert et al., 2022; Oladele, 2015; Rohit et al., 2020; Sanders et al., 2024; Scheer et al., 2011; Tarekegne et al., 2017; Toelle et al., 2024)
B.2	Professional and peer networking	6	17%	(Castaño Ramírez et al., 2023; Halbritter et al., 2021; Hall & Broyles, 2016; Lakai et al., 2012; Lybaert et al., 2022; Rohit et al., 2020)
B.3	Basic communication Principles*	16	44%	(Castaño Ramírez et al., 2023; Diaz et al., 2020; Elliott-Engel et al., 2021; Flanagan et al., 2023; Hall & Broyles, 2016; Harder et al., 2010; Issa, 2013; Lakai et al., 2012; Lybaert et al., 2022; McDonald et al., 2024; Mugwanya, 2022; Nwaogu & Akinbile, 2018; Omotesho et al., 2021; Sanders et al., 2024; Scheer et al., 2011; Toelle et al., 2024)
B.4	Written communication*	7	19%	(Al-Zahrani et al., 2017; Halbritter et al., 2021; Lakai et al., 2012; Okwoche et al., 2011; Sanders et al., 2024; Shahpasand et al., 2024; Umar et al., 2017)
B.5	Constructive feedback	6	17%	(Karbasioun, 2007; Lybaert et al., 2022; Okwoche et al., 2011; Oladele, 2015; Omotesho et al., 2021; Toelle et al., 2024)
B.6	Presentation and public speaking*	11	31%	(Al-Zahrani et al., 2017; Halbritter et al., 2021; Hall & Broyles, 2016; Karbasioun, 2007; Lakai et al., 2012; Okwoche et al., 2011; Oladele, 2015; Sanders et al., 2024; Shahpasand et al., 2024; Suvedi et al., 2018; Umar et al., 2017)
B.7	Active listening*	8	22%	(Aregaw et al., 2023; Flanagan et al., 2023; Hall & Broyles, 2016; Lakai et al., 2012; Okwoche et al., 2011; Sanders et al., 2024; Suvedi et al., 2018; Toelle et al., 2024)
B.8	Creating partnerships*	8	22%	(Al-Zahrani et al., 2017; Flanagan et al., 2023; Khan, 2017; Lakai et al., 2012; Lopokoiyit et al., 2013; Lybaert et al., 2022; Mugwanya, 2022; Rohit et al., 2020)
C	Professionalism			
C.1	Self confidence	5	14%	(Castaño Ramírez et al., 2023; Flanagan et al., 2023; Lybaert et al., 2022; Okwoche et al., 2011; Oladele, 2015)
C.2	Time and task management*	14	39%	(Flanagan et al., 2023; Halbritter et al., 2021; Hall & Broyles, 2016; Lakai et al., 2012; Lopokoiyit et al.,

				2013; Lybaert et al., 2022; McDonald et al., 2024; Okwoche et al., 2011; Oladele, 2015; Omotesho et al., 2021; Rohit et al., 2020; Sanders et al., 2024; Shahpasand et al., 2024; Umar et al., 2017)
C.3	Continuous learning*	7	19%	(Flanagan et al., 2023; Harder et al., 2010; Lopokoiyit et al., 2013; Lybaert et al., 2022; Sanders et al., 2024; Scheer et al., 2011; Suvedi et al., 2018)
C.4	Commitment and dedication	4	11%	(Khan, 2017; Lybaert et al., 2022; Okwoche et al., 2011; Oladele, 2015)
C.5	Emotional Intelligence	3	8%	(Flanagan et al., 2023; Hall & Broyles, 2016; Lybaert et al., 2022)
C.6	Stress management	3	8%	(Lakai et al., 2012; Lopokoiyit et al., 2013; Rohit et al., 2020)
C.7	Work/life balance	3	8%	(Al-Zahrani et al., 2017; Elliott-Engel et al., 2021; Lopokoiyit et al., 2013)
C.8	Professional ethics	6	17%	(Aregaw et al., 2023; Diaz et al., 2020; Lopokoiyit et al., 2013; Lybaert et al., 2022; Sanders et al., 2024; Tarekegne et al., 2017)
C.9	Adaptation and Flexibility*	7	19%	(Ali et al., 2011; Castaño Ramírez et al., 2023; Flanagan et al., 2023; Hall & Broyles, 2016; Rohit et al., 2020; Sanders et al., 2024; Suvedi et al., 2018)
C.10	Accountability	5	14%	(Elliott-Engel et al., 2021; Hall & Broyles, 2016; Harder et al., 2010; Lybaert et al., 2022; Scheer et al., 2011)
C.11	Empathy	5	14%	(Ali et al., 2011; Hall & Broyles, 2016; Lybaert et al., 2022; Oladele, 2015; Sanders et al., 2024)
D	Leadership and Teamwork			
D.1	Teamwork/Collaboration skills*	10	28%	(Al-Zahrani et al., 2017; Aregaw et al., 2023; Hall & Broyles, 2016; Lopokoiyit et al., 2013; McDonald et al., 2024; Okwoche et al., 2011; Sanders et al., 2024; Scheer et al., 2011; Suvedi et al., 2018; Umar et al., 2017)
D.2	Leadership and guiding*	18	50%	(Al-Zahrani et al., 2017; Castaño Ramírez et al., 2023; Elliott-Engel et al., 2021; Flanagan et al., 2023; Hall & Broyles, 2016; Harder et al., 2010; Khan, 2017; Lakai et al., 2012; Lopokoiyit et al., 2013; Lybaert et al., 2022; Nwaogu & Akinbile, 2018; Okwoche et al., 2011; Oladele, 2015; Omotesho et al., 2021; Rohit et al., 2020; Scheer et al., 2011; Tarekegne et al., 2017; Toelle et al., 2024)
D.3	Community engagement and participatory approach*	10	28%	(Al-Zahrani et al., 2017; Diaz et al., 2020; Flanagan et al., 2023; Issa, 2013; Narine, 2024; Oladele, 2015; Omotesho et al., 2021; Shahpasand et al., 2024; Suvedi et al., 2018; Umar et al., 2017)
D.4	Delegate task and responsibilities	6	17%	(Hall & Broyles, 2016; Harder et al., 2010; Khan, 2017; Lakai et al., 2012; Lopokoiyit et al., 2013; Suvedi et al., 2018)
D.5	Group development and management*	14	39%	(Hall & Broyles, 2016; Harder et al., 2010; Lakai et al., 2012; McDonald et al., 2024; Nwaogu & Akinbile, 2018; Okwoche et al., 2011; Oladele, 2015; Omotesho et al., 2021; Panjshiri et al., 2018; Rohit et al., 2020; Scheer et al., 2011; Shahpasand et al., 2024; Tarekegne et al., 2017; Umar et al., 2017)
D.6	Conflict management and negotiation*	14	39%	(Aregaw et al., 2023; Hall & Broyles, 2016; Issa, 2013; Khan, 2017; Lakai et al., 2012; Lopokoiyit et al., 2013; Mugwanya, 2022; Nawaz et al., 2020; Omotesho et al., 2021; Rohit et al., 2020; Sanders et al., 2024;

				Shahpasand et al., 2024; Toelle et al., 2024; Umar et al., 2017)
E	Extension Education Programming			
E.1	Needs assessment and problem identification*	13	36%	(Ali et al., 2011; Al-Zahrani et al., 2017; Diaz et al., 2020; Flanagan et al., 2023; Hall & Broyles, 2016; Ifeanyi-obi & Ekere, 2021; Okwoche et al., 2011; Oladele, 2015; Omotesho et al., 2021; Rohit et al., 2020; Sanders et al., 2024; Shahpasand et al., 2024; Umar et al., 2017)
E.2	Problem solving and decision making*	17	47%	(Ali et al., 2011; Al-Zahrani et al., 2017; Aregaw et al., 2023; Castaño Ramírez et al., 2023; Elliott-Engel et al., 2021; Flanagan et al., 2023; Hall & Broyles, 2016; Harder et al., 2010; Khan, 2017; Lopokoiyit et al., 2013; Lybaert et al., 2022; McDonald et al., 2024; Mugwanya, 2022; Okwoche et al., 2011; Omotesho et al., 2021; Rohit et al., 2020; Scheer et al., 2011)
E.3	Critical thinking and innovation*	8	22%	(Castaño Ramírez et al., 2023; Diaz et al., 2020; Hall & Broyles, 2016; Karbasioun, 2007; Lakai et al., 2012; McDonald et al., 2024; Rohit et al., 2020; Sanders et al., 2024)
E.4	Strategic program planning and design*	17	47%	(Castaño Ramírez et al., 2023; Elliott-Engel et al., 2021; Flanagan et al., 2023; Halbritter et al., 2021; Hall & Broyles, 2016; Harder et al., 2010; Ifeanyi-obi & Ekere, 2021; Issa, 2013; Lakai et al., 2012; Lopokoiyit et al., 2013; Lybaert et al., 2022; McDonald et al., 2024; Nwaogu & Akinbile, 2018; Okwoche et al., 2011; Sanders et al., 2024; Scheer et al., 2011; Tarekegne et al., 2017)
E.5	SMART objective/goal setting*	7	19%	(Al-Zahrani et al., 2017; Castaño Ramírez et al., 2023; Hall & Broyles, 2016; Karbasioun, 2007; Khan, 2017; Oladele, 2015; Tarekegne et al., 2017)
E.6	Resource and financial management*	11	31%	(Al-Zahrani et al., 2017; Elliott-Engel et al., 2021; Flanagan et al., 2023; Harder et al., 2010; Issa, 2013; Lakai et al., 2012; Lopokoiyit et al., 2013; Lybaert et al., 2022; Scheer et al., 2011; Shahpasand et al., 2024; Suvedi et al., 2018)
E.7	Extension education and adult learning*	17	47%	(Al-Zahrani et al., 2017; Elliott-Engel et al., 2021; Flanagan et al., 2023; Halbritter et al., 2021; Harder et al., 2010; Ifeanyi-obi & Ekere, 2021; Issa, 2013; Karbasioun, 2007; Khan, 2017; Lakai et al., 2012; Nwaogu & Akinbile, 2018; Okwoche et al., 2011; Oladele, 2015; Omotesho et al., 2021; Rohit et al., 2020; Scheer et al., 2011; Tarekegne et al., 2017)
E.8	Marketing and promotion of extension program	6	17%	(Ali et al., 2011; Elliott-Engel et al., 2021; Issa, 2013; Nawaz et al., 2020; Sanders et al., 2024)
E.9	Field work and demonstration*	8	22%	(Ali et al., 2011; Al-Zahrani et al., 2017; Ifeanyi-obi & Ekere, 2021; Nawaz et al., 2020; Sanders et al., 2024; Shahpasand et al., 2024; Umar et al., 2017)
E.10	Use of different teaching aid*	8	22%	(Al-Zahrani et al., 2017; Castaño Ramírez et al., 2023; Issa, 2013; Nawaz et al., 2020; Sanders et al., 2024; Shahpasand et al., 2024; Umar et al., 2017)
E.11	Program monitoring and evaluation*	16	44%	(Al-Zahrani et al., 2017; Aregaw et al., 2023; Castaño Ramírez et al., 2023; Elliott-Engel et al., 2021; Flanagan et al., 2023; Halbritter et al., 2021; Harder et al., 2010; Issa, 2013; Lakai et al., 2012; Nwaogu & Akinbile, 2018; Okwoche et al., 2011; Oladele, 2015; Omotesho et

				al., 2021; Sanders et al., 2024; Scheer et al., 2011; Suvedi et al., 2018)
E.12	Design and administration of survey tools*	7	19%	(Al-Zahrani et al., 2017; Aregaw et al., 2023; Diaz et al., 2020; Issa, 2013; Shahpasand et al., 2024; Suvedi et al., 2018; Umar et al., 2017)
E.13	Manage, analyze, and interpret scientific data*	8	22%	(Aregaw et al., 2023; Castaño Ramírez et al., 2023; Diaz et al., 2020; Halbritter et al., 2021; Issa, 2013; Lakai et al., 2012; Mugwanya, 2022; Suvedi et al., 2018)
E.14	Report writing and documentation*	12	33%	(Aregaw et al., 2023; Castaño Ramírez et al., 2023; Diaz et al., 2020; Flanagan et al., 2023; Hall & Broyles, 2016; Nawaz et al., 2020; Nawaz & Khan, 2018; Omotesho et al., 2021; Sanders et al., 2024; Shahpasand et al., 2024; Suvedi et al., 2018; Umar et al., 2017)
F	Social and cultural			
F.1	Socio-economic conditions and rural livelihoods*	8	22%	(Al-Zahrani et al., 2017; Aregaw et al., 2023; Castaño Ramírez et al., 2023; Flanagan et al., 2023; Lybaert et al., 2022; Oladele, 2015; Omotesho et al., 2021; Rohit et al., 2020)
F.2	Cultural sensitivity*	12	33%	(Aregaw et al., 2023; Diaz et al., 2020; Elliott-Engel et al., 2021; Flanagan et al., 2023; Harder et al., 2010; Lybaert et al., 2022; Nwaogu & Akinbile, 2018; Oladele, 2015; Sanders et al., 2024; Scheer et al., 2011; Suvedi et al., 2018; Toelle et al., 2024)
F.3	Gender analysis*	8	22%	(Diaz et al., 2020; Elliott-Engel et al., 2021; Flanagan et al., 2023; Rohit et al., 2020; Shahpasand et al., 2024; Suvedi et al., 2018; Tarekegne et al., 2017; Umar et al., 2017)
G	Subject matter expertise			
G.1	Crop or variety selection and zoning*	7	19%	(Ali et al., 2011; Aregaw et al., 2023; Flanagan et al., 2023; Halbritter et al., 2021; Narine, 2024; Olorunfemi et al., 2021; Panjshiri et al., 2018)
G.2	Natural resources and watershed management*	9	25%	(Aregaw et al., 2023; Flanagan et al., 2023; Halbritter et al., 2021; Ifeanyi-obi & Ekere, 2021; Issa, 2013; Narine, 2024; Nawaz & Khan, 2018; Olorunfemi et al., 2021; Panjshiri et al., 2018)
G.3	Plant protection*	7	19%	(Aregaw et al., 2023; Flanagan et al., 2023; Halbritter et al., 2021; Issa, 2013; Narine, 2024; Panjshiri et al., 2018; Shahpasand et al., 2024)
G.4	Sustainable farming practices*	8	22%	(Ali et al., 2011; Flanagan et al., 2023; Ifeanyi-obi & Ekere, 2021; Narine, 2024; Olorunfemi et al., 2021; Panjshiri et al., 2018; Rohit et al., 2020; Tarekegne et al., 2017)
G.5	Nutrient management	5	14%	(Flanagan et al., 2023; Halbritter et al., 2021; Olorunfemi et al., 2021; Panjshiri et al., 2018; Shahpasand et al., 2024)
G.6	Use of weather forecasts	5	14%	(Flanagan et al., 2023; Ifeanyi-obi & Ekere, 2021; Issa, 2013; Nawaz & Khan, 2018; Olorunfemi et al., 2021)
G.7	Pasture management	4	11%	(Halbritter et al., 2021; Narine, 2024; Nawaz & Khan, 2018; Olorunfemi et al., 2021)
G.8	Machinery and equipment management	3	8%	(Olorunfemi et al., 2021; Panjshiri et al., 2018; Shahpasand et al., 2024)
G.9	Knowledge on climate change adaptation	3	8%	(Flanagan et al., 2023; Ifeanyi-obi & Ekere, 2021; Nawaz & Khan, 2018)
H	Agribusiness Development			
H.1	Agribusiness and marketing*	11	31%	(Aregaw et al., 2023; Flanagan et al., 2023; Issa, 2013; Karbasioun, 2007; Narine, 2024; Panjshiri et al., 2018;

				Rohit et al., 2020; Sanders et al., 2024; Shahpasand et al., 2024; Suvedi et al., 2018; Umar et al., 2017)
H.2	Develop entrepreneurship among farmers	6	17%	(Elliott-Engel et al., 2021; Flanagan et al., 2023; Harder et al., 2010; Rohit et al., 2020; Suvedi et al., 2018; Tarekegne et al., 2017)
I	Digital Literacy			
I.1	Use of information communication technologies (ICTs) *	21	58%	(Ali et al., 2011; Al-Zahrani et al., 2017; Aregaw et al., 2023; Castaño Ramírez et al., 2023; Diaz et al., 2020; Elliott-Engel et al., 2021; Flanagan et al., 2023; Harder et al., 2010; Issa, 2013; Lakai et al., 2012; Lybaert et al., 2022; Narine, 2024; Nwaogu & Akinbile, 2018; Olorunfemi et al., 2021; Panjshiri et al., 2018; Rohit et al., 2020; Sanders et al., 2024; Scheer et al., 2011; Shahpasand et al., 2024; Suvedi et al., 2018; Umar et al., 2017)

N = Number of studies; % = Percentage of studies

* Indicates core competency items most frequently cited across the reviewed studies (n = 36). These items represent the minimum qualifications that Agricultural Extension Professionals (AEPs) must possess.

Beyond technical proficiency related to crop production, competency studies increasingly highlight market-oriented skills, including agribusiness, marketing, and entrepreneurship, to guide farmers toward profitable and sustainable agricultural practices within a competitive, globalized economy. The agribusiness and marketing competency (36%) emerged as the most emphasized competency in the area of agribusiness development, highlighting the necessity for AEPs to support market-oriented farming. Additionally, fostering entrepreneurship (17%), among farmers was identified as an important competency, indicating the increasing role of extension in promoting rural economic development and innovation.

Finally, the domain of digital literacy reflected an essential competency for AEPs, allowing them to efficiently access, create, assess, and disseminate information via digital tools and media (Petropoulos et al., 2025). During the identification of competencies under the digital literacy domain, all reviewers agreed to synthesize and represent information and communication technology (ICT) related competencies such as ICT implementation (Elliott-Engel et al., 2021), use of internet (Aregaw et al., 2023), use of social media (Sanders et al., 2024), able to utilize technology for program delivery (Harder et al. 2010), use of Microsoft office (Suvedi et al., 2018), make good use of ICTs access and use web-based resources (Aregaw et al., 2023) under a broader and inclusive item: "use of information communication technologies (ICTs)" to ensure a more generalized and coherent competency profile. In the era of digitalization, AEPs must have the capacity to interpret real-time data, use of mobile and web-based platforms, and convey information via digitalized media. Digital proficiency not only enhances operational efficiency but also broadens the scope and influence of extension services, particularly in remote and underserved farming communities.

5. Conclusion and Recommendations

The development of a competency profile by identifying essential competencies is crucial for agricultural extension organization (AEO), as it provides a valuable tool for designing strategies to develop competent agricultural extension professionals (AEPs). This scoping review successfully identified 59 competencies and categorized them into nine competency areas from 36 previous literatures. These competencies were identified as essential for effective extension service delivery. Since the number of essential competencies is quite large and it is difficult to develop all of them at once, the 38 most frequently cited core competencies can be used as minimum qualifications that an AEP must possess.

The studies included in this review covered diverse geographical areas, such as North America, Africa, Asia, the Middle East, and South America, ensuring that the identified competencies reflect a globally relevant and comprehensive perspective. This broad geographical representation underscores the universal applicability of these competency domains while acknowledging regional nuances in agricultural practices and challenges. By grasping and prioritizing these competencies, AEOs can adopt more customized approaches to recruitment, training, competency gap assessments, and performance management. Furthermore, such a systematic approach enables the strategic alignment of professional development initiatives with the evolving demands of agricultural sectors worldwide, thereby enhancing the overall effectiveness of extension services.

Future research should focus on validating this competency framework by considering the socio-economic, technological, cultural, and career stage-specific realities of different countries and regions. Furthermore, integrating the perspectives of diverse stakeholders-including farmers, policymakers, academicians, and private sector actors is

essential to ensure that the developed profiles are inclusive, contextually relevant, and responsive to real-world needs. Empirical research also holds undeniable significance in assessing how competency-based capacity-building initiatives influence the performance of agricultural extension systems (AESs) and improve the overall effectiveness of extension service delivery.

Despite achieving the proposed objectives, this study has several limitations. Firstly, the use of a diverse set of terminology to describe AEPs in literature may lead to the exclusion of relevant research during literature searches. Secondly, we considered citation frequency as an indicator to measure the importance of each competency item. However, the perceived level of importance of these competencies may differ across different environments and regions. In addition, we included only those competency items in our proposed competency profile that were cited in at least three literatures. As a result, many possibly important competencies that did not meet this threshold criterion may have been excluded. Thirdly, we synthesized multiple research article written in English, therefore, relevant articles published in other languages and gray literature may have been incidentally overlooked.

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