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Education and training needs for enhancing rural women's participation in sustainable farming systems in Iraq: a cross-sectional study

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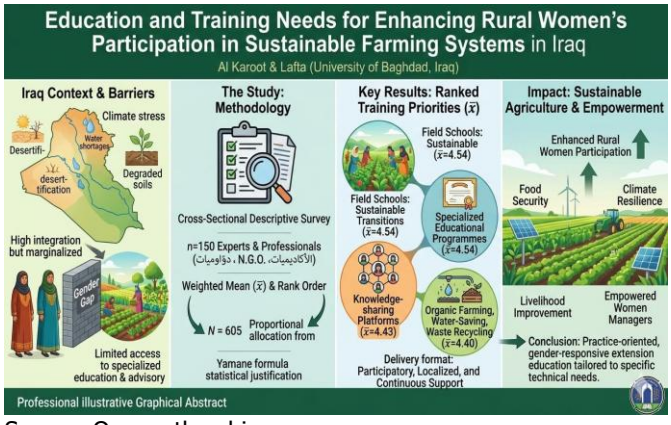
Abstract

Introduction: Strengthening rural women's participation in sustainable farming is essential for Iraq's agricultural development, yet their specific educational and training requirements remain insufficiently defined to guide effective programming. **Objective**: The study assessed the education and training requirements needed to strengthen rural women's participation in sustainable farming systems in Iraq. **Methods**: A cross-sectional descriptive survey design was adopted. Using purposive selection and proportional allocation, 150 respondents were drawn from ministries, research institutions, and development organizations involved in women-in-agriculture and agricultural extension programming. Data were collected via interview-administered structured questionnaires and analyzed using means ($\bar{x}$), percentages, and rank order. **Results**: The most critical needs identified were specialized educational programmes ($\bar{x}$ = 4.54; 90.00%), field schools ($\bar{x}$ = 4.54; 89.06%), and knowledge-sharing platforms ($\bar{x}$ = 4.43; 88.66%). Preferred delivery modalities focused on participatory and accessible formats, particularly local learning platforms and follow-up support. Key extension agendas included training in organic farming, waste recycling, soil/water management ($\bar{x}$ = 4.40; 88.13%), and the integration of sustainability concepts into rural curricula ($\bar{x}$ = 4.33; 86.66%). **Conclusions**: Participation of rural women in sustainable agriculture in Iraq is contingent upon the provision of locally accessible, practice-oriented, and continuous extension education tailored to their specific technical needs.

Keywords: Women, Rural; Sustainable Agriculture; Agricultural Extension; Iraq; Education; Training Support.

Graphical Abstract



Source: Own authorship.

Introduction

Sustainable agricultural systems are now a global priority, not only for productivity but also for the present and future environmental, economic and social sustainability of agriculture. In today's context of agriculture, sustainability is not only a technological shift but a socio-technical process, in which human capital plays an important role in the rural household

[1]. These systems are only successful if farmers can internalise and make use of detailed knowledge of resource management; hence, the central role of agricultural extension in moving from global concepts to specific, feasible farm practices is paramount [2].

Although rural women play a vital role in agricultural production, they remain a marginalised group in this sustainable agenda. Women carry out a significant part of agricultural work, especially in water management, post-harvest solutions and crop cultivation on farms worldwide [3]. Empirical data, however, has always shown there is a "Gender Gap" in access to specialized education, advisory services and productive assets. This imbalance is not just an issue of social justice, but also a strategic imperative: more inclusive participation of women in agriculture can directly improve food security and climate resilience as a consequence of enhanced decision-support [4].

The shift towards sustainable agriculture in the Republic of Iraq takes place in a multifaceted environment with climate-related issues, including severe water shortages and degraded soils [5]. Recent research highlights that managing extension programs effectively is fundamental to helping farmers face these environmental stressors and climate changes [6].

While the agricultural integration of rural women in Iraq is high, they are often not recognized as primary managers of sustainable resources due to persistent systemic and cultural barriers [7]. A study of gender and innovation in agriculture in Iraq has shown that women generally struggle to participate in agricultural innovation because of the lack of gender-responsive innovation platforms and learning environments that account for local socio-cultural dynamics [8]. Thus, a move towards sustainability demands designing extension programmes that move beyond generic approaches and adopt inclusive pedagogical frameworks tailored to specific training needs [9].

Despite the importance of this issue, there remains a considerable empirical gap in identifying the specific priorities for women's education and participation in rural agriculture in a systematic way [10]. Extensive literature exists on women's access in general terms and ways to empower them [11], yet many studies rely on contexts that do not address the specific occupational stressors and training needs within the Iraqi extension system [12].

For this reason, the present study was designed to fill this gap by documenting the educational environment for rural females in Iraq. In particular, the study aimed to: (i) identify and rank the technical and vocational training requirements needed for sustainable agriculture; (ii) assess the training modalities that are considered easily accessible by stakeholders; and (iii) outline strategic agendas for extension programs to ensure women can meaningfully participate in Iraq's sustainable agricultural future.

Material and Methods

Research Design

The study adopted a quantitative, cross-sectional descriptive survey design. This methodology was utilized for its efficacy in quantifying the views of expert stakeholders and systematically prioritising the educational and training needs for rural women to enable their integration into sustainable farming systems [13]. The design allowed for a robust "evaluative" approach to prioritize programme needs within a complex developmental context. The study and the reporting of its findings strictly adhere to the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines for cross-sectional research [14].

Study Area

The investigation was performed in the southern, central, and western regions of Iraq. Due to administrative variations and logistical constraints during the data collection period, the Kurdistan Region was excluded from the current scope. The selected geographical area reflects the diversity of Iraq's agricultural landscape, providing a broad national perspective on rural development needs [15].

Population and Sampling Procedure

The target population comprised 605 professionals and experts from national ministries, research institutions, academic bodies, and international organizations involved in agricultural extension and gender-specific programming. A two-stage sampling process was employed to ensure data validity. First, purposive sampling was used to identify individuals directly involved in policy formulation or specialized advisory services. Second, a proportional allocation method was applied to ensure institutional representativeness across heterogeneous strata [15]. The sample size (ni) for each institution was calculated using the formula:

ni = (Ni / N) × 150, ensuring each category represented approximately 25% of its eligible population (Table 1).

Table 1. Distribution of Respondents by Institutional Category.

Institution/Organisation	Population (Ni)	Sample (ni)	Sampling Fraction (%)
Ministry of Agriculture	120	30	25.00
Ministry of Planning	30	7	23.33
Secretariat of the Council of Ministers	40	10	25.00
Ministry of Labour and Social Affairs	40	10	25.00
Ministry of Water Resources	70	17	24.29
Ministry of Environment	70	17	24.29
Academic and Research Institutions	180	45	25.00
International and Local NGOs	55	14	25.45
Total	**605**	**150**	**24.79**

Note: Minor variances in percentages are due to rounding to the nearest whole number. Source: Field Survey, 2025.

Sample Size Determination and Rationale

To ensure the reliability of the findings and achieve statistically significant results, the sample size was determined using the **[16]**:

$n = N / [1 + N(e)^2]$

Where N is the total population (605) and e is the margin of error (set at 0.07). This yielded a required sample of approximately 144, which was rounded up to 150 to enhance statistical power and account for potential non-responses. This sample size represents 24.8% of the total population, significantly exceeding the 10–20% threshold typically recommended for descriptive social science research **[17]**.

Data Collection Instrument and Procedure

A structured, interview-administered questionnaire was used to gather empirical data. The instrument was designed across four sections: (A) Institutional demographics; (B) Education and training needs; (C) Preferred training modalities; and (D) Extension agendas. To ensure consistency and clarify technical terms, face-to-face interviews were prioritized. The variables were measured using a 5-point Likert scale, ranging from 1 (Very Low Need) to 5 (Very High Need) **[18]**.

Statistical Analysis

Data were analyzed using descriptive statistics to prioritize identified needs. The weighted mean score ($\bar{x}$) was calculated for each item to determine the perceived level of importance. To establish a hierarchy of priorities, rank ordering and percentage distributions were employed **[13, 18]**. These methods are appropriate for descriptive surveys aiming to identify programmatic interventions rather than testing causal hypotheses. All calculations were performed using Microsoft Excel and SPSS (version 26.0).

Ethical Considerations

The study was conducted in accordance with the ethical standards of the institutional research committee. The research protocol was formally reviewed and approved by the Institutional Ethics Committee of the College of Agricultural Engineering Sciences, University of Baghdad (Ref. No.: COAGRI-UOB/ETH-2025-042). Written informed consent was obtained from all respondents prior to data collection, and all data were anonymized to ensure confidentiality.

Availability of Data and Materials

The datasets generated and analyzed during the current study are not publicly available due to institutional privacy policies regarding participant confidentiality but are available from the corresponding author on reasonable request.

Results and Discussion

Objective 1: Education and Training Needs of Rural Women in Sustainable Farming Systems

The assessment of education and training requirements revealed a high level of perceived necessity across all investigated parameters, with an aggregate mean score of $\bar{x} = 4.28$ (Table 2). The data suggest a robust consensus among stakeholders regarding the multi-dimensional nature of the support required to integrate Iraqi rural women into sustainable agricultural frameworks.

Table 2. Prioritization of Education and Training Needs for Rural Women (n = 150).

Item	Mean (x^-)	Percentage (%)	Rank
Specialized and targeted educational programmes	4.54	90.00	1
Field schools for sustainable farming transitions	4.54	89.06	1
Knowledge-sharing platforms for expertise exchange	4.43	88.66	2
Training in organic agriculture and resource management	4.40	88.13	3
Literacy schools localized to rural residences	4.39	87.86	4
Secure and supportive learning environments	4.37	87.46	5
Support for sustainability-oriented education programmes	4.36	87.20	6
Integration of sustainability into rural curricula	4.33	86.66	7
Entrepreneurship, marketing, and project management	4.31	86.26	8
Vocational training centres in rural villages	4.28	85.73	9

Post-training follow-up and technical support	4.27	85.46	10
Family incentives for vocational education	4.24	84.80	11
Training on modern agricultural techniques	4.21	84.26	12
Smartphone-based climate information programmes	4.19	83.86	13
Specialized training on the green economy	4.17	83.46	14
Expert trainers in sustainability and empowerment	4.15	83.06	15
Integration of local and regional knowledge	4.11	82.26	16
Leadership and decision-making training	4.00	80.00	17
Overall Average	**4.28**	**85.77**	**--**

Source: Field Survey, 2025.

The statistical significance of specialized educational programmes and field schools ($\bar{x}$ = 4.54) indicates that stakeholders view the transition to sustainable farming not as a series of isolated technological adoptions, but as a long-term pedagogical process. This finding reinforces the paradigm that gender-responsive extension is most effective when it transcends generic "one-off" sensitization in favor of tailored content that mirrors the actual ecological and household realities of the participants **[1, 19]**. In the Iraqi context, where agricultural systems face acute environmental stressors, field-based learning provides an essential laboratory for observation and peer interaction, which are critical for building technical competence in sustainable resource management **[2, 20]**.

Furthermore, the high ranking of literacy schools and secure learning environments ($\bar{x}$ = 4.39 and 4.37, respectively) reflects a sophisticated understanding among respondents: technical knowledge transfer is fundamentally dependent on the socio-institutional conditions of access. This aligns with global evidence suggesting that women's empowerment in agrifood systems is often hindered more by structural barriers such as distance, literacy gaps, and social restrictions than by a lack of interest in the technology itself **[3, 21]**. Consequently, the "need" identified here is as much about the environment of learning as it is about the content.

Interestingly, while digital tools (smartphone-based climate info) and leadership training ranked toward the lower end of the spectrum, their scores remained significantly high (above 4.00). This suggests a strategic sequencing in extension priorities: experts advocate for a foundation of practical, field-oriented technical skills and basic literacy before transitioning toward more abstract digital and leadership competencies. This tiered approach to training design ensures that rural women can first stabilize their agricultural output and resource efficiency before scaling their influence within the broader green economy **[4, 22]**.

Objective 2: Preferred Training Modalities for Rural Women in Sustainable Farming Systems

The second objective of this study was to evaluate the most effective delivery mechanisms for extension services tailored to rural women. The data (Table 3) reveal a clear preference for participatory, localized, and continuous learning frameworks, with an overall average mean of $\bar{x}$ = 4.33.

Table 3. Preferred Training Modalities for Rural Women in Sustainable Farming (n = 150).

Item	Mean ($\bar{x}$)	Percentage (%)	Rank
Specialised and targeted educational programmes	4.54	90.00	1
Field schools	4.54	89.06	1
Knowledge-sharing platforms	4.43	88.66	2
Literacy schools localized to residences	4.39	87.86	3
Secure and supportive learning environments	4.37	87.46	4
Vocational training centres in villages	4.28	85.73	5
Post-training follow-up and technical support	4.27	85.46	6
Smartphone-based climate information	4.19	83.86	7
Leadership and decision-making training	4.00	80.00	8
Overall Average	**4.33**	**86.45**	**--**

Source: Field Survey, 2025.

The statistical parity between "Specialized Programmes" and "Field Schools" ($\bar{x}$ = 4.54) underscores a critical insight for extension policy: the method of delivery is perceived to be as vital as the content itself. Stakeholders emphasized that technical curricula, regardless of their scientific merit, often fail to achieve impact if the delivery mechanisms do not accommodate the socio-spatial realities of rural women. The prioritization of field schools and knowledge-sharing platforms suggests that experiential and social learning are expected to yield superior outcomes compared to traditional, top-down lecture-style instruction. In practice, such participatory modalities facilitate a "learning-by-doing" approach, allowing for real-time problem-solving and peer-to-peer feedback, which are instrumental in building self-efficacy among marginalized producers **[1, 23]**.

Proximity and institutional continuity also emerged

as decisive factors. The high ratings for village-based training centres ($\bar{x}$ = 4.28) and post-training follow-up ($\bar{x}$ = 4.27) highlight a common pitfall in rural development: the "one-off" training model. The findings suggest that extension should be reconceptualized as a continuous learning pathway rather than a singular event. By localizing training and providing sustained technical accompaniment, extension agencies can mitigate the barriers of distance and cultural restrictions that frequently impede women's participation **[3, 24]**.

Furthermore, the relatively lower ranking of smartphone-based modalities ($\bar{x}$ = 4.19), despite its high absolute score, indicates that while digital technology is a valued auxiliary tool, it is not viewed as a substitute for face-to-face human interaction in the Iraqi context. Digital platforms are best utilized as complementary systems for disseminating urgent climate data, whereas the core technical and social transformation required for sustainable farming still necessitates grounded, interpersonal engagement **[1, 25]**.

Objective 3: Priority Agendas for Agricultural Extension Programmes

The final objective aimed to identify the thematic priorities that should constitute the core curricula of extension programmes for rural women. As delineated in Table 4, the respondents exhibited strong consensus across the proposed agendas, yielding an overall average mean of $\bar{x}$ = 4.23.

Table 4. Priority Agendas for Agricultural Extension Programmes (n = 150).

Item	Mean (x^-)	Percentage (%)	Rank
Training in organic farming, waste recycling, soil management, and water-saving methods	4.40	88.13	1
Support for rural education programmes facilitating sustainable transitions	4.36	87.20	2
Integration of sustainability and natural-resource management into rural curricula	4.33	86.66	3
Entrepreneurship, marketing, and project-management education	4.31	86.26	4
Training on modern agricultural techniques	4.21	84.26	5
Specialised training on the green economy	4.17	83.46	6
Integration of local knowledge and regional expertise	4.11	82.26	7
Leadership and decision-making training	4.00	80.00	8
Overall Average	**4.23**	**84.78**	**--**

Source: Field Survey, 2025.

The empirical data show that the agendas assessed to be most important are dominated by resource-use efficiency and environmentally sound production. In particular, training in organic farming, waste recycling, soil management, and water-saving methods was cited as the top priority ($\bar{x}$ = 4.40, 88.13%, Rank 1). The significance of these priorities is supported by recent evidence showing that biological and organic fertilization effectively improves soil properties and enhances the yield of strategic crops within the challenging Iraqi environment **[5, 26]**. This is a highly practical and policy-relevant outcome in the Iraqi context, where systemic sustainability is tightly coupled with the need to address serious water scarcity, soil salinity, and climate-induced vulnerabilities on farms. It demonstrates that stakeholders have a clear vision of women-oriented extension as an essential tool for building ecological resilience **[6, 27]**.

The subsequent priorities, however, such as support for rural education programmes facilitating sustainable transitions ($\bar{x}$ = 4.36, 87.20%, Rank 2), integration of sustainability and natural-resource management into rural curricula ($\bar{x}$ = 4.33, 86.66%, Rank 3), and entrepreneurship, marketing, and project-management education ($\bar{x}$ = 4.31, 86.26%, Rank 4), show a multidimensional concept of sustainability. Participants did not see sustainable farming as simply an ecological issue, but clearly associated environmental care and responsibility with enterprise and market orientation. This indicates a strategic need to build the capacity of rural women to convert ecological knowledge into economically viable livelihood strategies **[28]**. this is in keeping with current discussions in agricultural extension that focus on the structural coupling of production, environment, and business in gender-specific extension systems **[23, 29,]**.

The remaining curricular components also maintained substantial agreement, including training on modern agricultural techniques ($\bar{x}$ = 4.21, 84.26%, Rank 5), specialized training on the green economy ($\bar{x}$ = 4.17, 83.46%, Rank 6), and the integration of local knowledge and regional expertise ($\bar{x}$ = 4.11, 82.26%, Rank 7). Although leadership and decision-making training ranked lowest relatively ($\bar{x}$ = 4.00, 80.00%, Rank 8), its absolute score represents a high level of institutional backing. This means that women's indigenous experiential knowledge should not be set aside, nor should their need for confidence in decision-making. These elements should be structurally mainstreamed into the technical curricula rather than treated as separate topics. This will allow for the communication of sustainable farming simultaneously

as a technical and socio-economic empowerment process. The empirical evidence as a whole call for an integrated approach to extension—one that integrates resource-management training, curriculum reform, enterprise education, and ongoing advisory accompaniment.

Limitations of the Study

While this study provides comprehensive institutional insights, certain limitations should be acknowledged. First, the geographical scope excluded the Kurdistan Region due to administrative and logistical constraints **[30]**, meaning the findings primarily reflect the context of central, southern, and western Iraq. Second, the data rely heavily on the cross-sectional perspectives of institutional experts and professionals rather than the direct, self-reported needs of the rural women themselves. Acknowledging this, the study recommends future field-based research to validate these expert priorities directly with female farmers across local communities.

Conclusion

The findings of this study indicate that enhancing rural women's participation in sustainable agriculture in Iraq requires context-sensitive, practice-based extension services. Specifically, the data emphasize field schools ($\bar{x}$ = 4.54) and knowledge-sharing platforms ($\bar{x}$ = 4.43) as critical priorities to bridge structural barriers to access. Furthermore, the results show that curricula need to actively incorporate eco-resilience concepts, such as water-saving and organic farming ($\bar{x}$ = 4.40), alongside entrepreneurship education ($\bar{x}$ = 4.31). Therefore, gender-responsive extension should transition from isolated training events into a sustained, participant-centered pedagogical pathway.

Based on these empirical findings, the following strategic recommendations are proposed:

- Implement Localized Training: Focus on field-based learning and literacy-integrated village centres to overcome geographical and social distances.
- Institutionalize Support: Formalize technical follow-up by establishing robust post-training support systems to ensure the long-term adoption of sustainable practices.
- Update Curricula: Incorporate climate adaptation and enterprise development directly into environmental sustainability training modules.
- Future Research: Validate the priorities identified by institutional experts through field-based empirical studies that directly involve the rural women beneficiaries.

CRediT

Author contributions: Conceptualization; Data curation; Formal Analysis; Investigation; Methodology; Project administration; Supervision; Writing - original draft, and Writing-review & editing- All authors.

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Ethical approval

The study protocol was approved by the Institutional Ethics Committee of the University of Baghdad. Informed consent was obtained from all participants prior to the interviews, and data were handled anonymously.

Informed Consent

It was applicable.

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Data Sharing Statement

The datasets generated and analyzed during the current study are not publicly available due to institutional privacy policies regarding participant confidentiality but are available from the corresponding author on reasonable request.

Conflict of Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Similarity Check

It was applied by Ithenticate[@].

Application of Artificial Intelligence (AI)

Not applicable.

Peer Review Process

It was performed.

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