



Research Article

Empowering Rural Women Socially as a Pathway to Enhancing Their Effective Participation in the Transition toward Sustainable Agricultural Systems in Iraq

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Abstract | Rural women constitute a vital segment of rural development, forming a key part of the social structure and acting as a catalyst for change in their communities. Allocating resources to empower rural women generates substantial societal benefits. This study aims to develop a conceptual framework to enhance the social empowerment of rural women, thereby promoting their active participation in advancing sustainable agricultural practices in Iraq. The research population included all Iraqi governorates, excluding the Kurdistan Region, as well as academics and professionals from governmental agencies, research institutions, and organizations focused on women's empowerment in general and rural women in particular. The total sample comprised 150 participants. Data were collected through structured questionnaires complemented by personal interviews and analyzed using the Statistical Package for the Social Sciences (SPSS). The findings revealed that social participation was the strongest contributor to empowering rural women, achieving the highest relative weight (90.8%) and weighted mean (4.54). Providing genuine opportunities for rural women to engage in agricultural and social activities enhances their confidence, skills, and decision-making capacity, allowing them to overcome cultural barriers and assume more active roles in local development. Based on these results, the study recommends inclusive policies that ensure rural women's voices are heard in decision-making processes, particularly in the management of natural resources. Training programs targeting key areas, such as water and land management and renewable energy, are also essential to enable their meaningful contribution to sustainable agricultural planning and community governance.

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Introduction

Empowerment is a basic procedure that helps to enhance competencies of individuals and

social groups as it provides an opportunity to regulate material and moral resources, make future choices, act independently and even be involved in diverse activities on individual and organizational

level (Adnan and Lafta, 2022; Willems, 2022). Empowerment is important in empowering people and groups to deliver their aims and to increase their involvement in developmental processes.

Empowerment is based on empowering the women by enhancing their social and economic ability. This has increased the ability of women in decision-making, their accessibility to resources (Ridha *et al.*, 2020) and enables their fitting into the agricultural systems by developing skills and building capacity programs offered through agricultural extension organizations. The purpose of such programs is to bring social justice and foster the collective and individual autonomy of rural women (Cook *et al.*, 2021).

The rural women are the part of the rural development because they are the members of the inner world and the active forces of the changes in the local society (Surya and Kaur, 2023). When women living in the rural areas are invested in developing them, there are significant returns to the society (Medina and Herrarte, 2020). The adoption of rural women in vocational training and educational initiatives will enable them to learn the skills to boost the productivity and also increase household income and rural economy, thus aiding the shift to sustainable agricultural systems (Amirsh, 2023; Aswad *et al.*, 2026).

Depending on national policies and socio-economic status, the agricultural roles, practices, and environmentally sustainable behavior of rural women differ among countries (Chwialkowska *et al.*, 2024). In Iraq, women in the rural areas are those who play very crucial roles in agricultural activities (Rakhit and Lafta, 2025) and are about 49.68 percent of the population. Nevertheless, over half of the Iraqi women are heads of their families (Iraqi Ministry of Planning, 2025), which points to the amount of their social and economic burden.

The participation is regarded as one of the most important indicators of the role played by rural women in an agricultural system (Al-Hafidh and Lafta, 2024). Rural women also play a significant role in the agricultural production as not only workers but also as participants in all processes of agricultural activities, such as land preparation, planting, seedling transfer, weeding, irrigation (Challob *et al.*, 2020), harvesting, storage, livestock control and food processing (Patel and Athya, 2025).

Besides farming, women in the rural areas contribute to economic empowerment by generating income which is used to finance their households and develop their local economies (Ramadan and Lafta, 2023). They are also involved in terms of access to credit, market opportunities, commercial and digital services, and integration into more and more competitive labor markets (Al-Kubaisy and Lafta, 2021). These aspects indicate the crucial role of the involvement of women in the shift to the sustainable agricultural systems (Keshava *et al.*, 2025).

According to Food and Agriculture Organization, agricultural systems are current trends of agriculture that must be adapted or substituted with a method of local environmental conditions to meet the climate change and production challenges (FAO, 2024). In this regard, it is important to embrace policies that encourage quality education and skills acquisition to empower women in agricultural systems (Adnan and Lafta, 2022). Offering the training programs and through connection with market conditions will be able to help rural women gain access to resources, services, and agricultural information more efficiently (FAO *et al.*, 2025).

Research objectives

This study aims to:

- It is possible to develop the idea of feminine empowerment of rural women.
- Study how social empowerment contributes to the successful involvement of rural women in the process of decolonizing agricultural systems into sustainable production systems in Iraq.
- Determine the main social, institutional, and capacity-based aspects that can affect the involvement of women in sustainable farming.

Literature review

Social empowerment of rural women

Social empowerment is the process whereby the individuals become empowered to contribute effectively in social systems, affecting the decision-making, and have access to resources that shape their livelihoods (Willems, 2022; Surya and Kaur, 2023; Al-Khafaji and Lafta, 2022). The social empowerment of women in the rural setting strengthens self-confidence, community participation, and power in agricultural and household matters (Amirsh, 2023; Medina and Herrarte, 2020). The rural women will have more chances to take collective activities, enroll in extension,

and learn better methods of agriculture when they are empowered (Cook *et al.*, 2021; Ridha *et al.*, 2020).

The literature underlines that social empowerment is not solely related to the economic benefits, but it is also about education, social recognition, access to information, and institutional support (Keshava *et al.*, 2025; Surya and Kaur, 2023). Empowering such capacities empowers rural women to become change agents in their societies (Medina and Herrarte, 2020; Surya and Kaur, 2023) enhancing their capacities to become part of the sustainable agricultural systems.

Women's participation in agricultural systems

Rural women are an important labor force in the agricultural sector, they participate in labor, livestock handling, processing of products after harvest, and food security of the home (Patel and Athya, 2025; Rana and Lafta, 2025). They are involved at each of the agricultural production phases, including land preparation and planting, irrigation, harvesting, and food processing (Rakhit and Lafta, 2025; Patel and Athya, 2025).

Although this is a major contribution, women involvement is usually informal and not adequately acknowledged in agricultural planning and policy (Rana and Lafta, 2025; Challob *et al.*, 2020). Their effective engagement is limited by barriers including, but not limited to, limited access to land, extension services, and institutional support (Ramadan and Lafta, 2023; Ridha *et al.*, 2020). The literature indicates that promotion of meaningful participation may involve the tackling of social norms, organizational inclusion, and availability of knowledge and resources (Amirsh, 2023; Keshava *et al.*, 2025).

Sustainable agricultural systems and social dimensions

Sustainable agriculture will also strike a balance between productivity, protecting the environment, and social equity (Chwialkowska *et al.*, 2024; FAO *et al.*, 2025; Ajeel and Al-Hakeim, 2024; Ajeel *et al.*, 2025). Social aspects, such as human capital, social inclusion, and participatory decision-making, are important agents of sustainability transitions (Rana and Lafta, 2025; Cook *et al.*, 2021). The failure to consider the social aspects undermines technical and environmental interventions. Social empowerment of rural women has been found to contribute to the rise in the realization of sustainable practices, enhanced resilience to environmental stress, and long-term agricultural stability (Rana and Lafta, 2025; Amirsh, 2023; Surya and Kaur, 2023).

Rural women and the transition toward sustainable agriculture

The shift to sustainable agricultural systems needs to be based on the shift in practices, institutions, and behaviors (FAO, 2024; Rana and Lafta, 2025). The involvement of women improves management of resources, food security and environmental practices that are sustainable (Patel and Athya, 2025; Rana and Lafta, 2025). The involvement rates, however, are heavily dependent on social status, education and institutional inclusion (Medina and Herrarte, 2020; Surya and Kaur, 2023).

It has been shown empirically that when rural women are given specialized support in the form of extension services, training, and social inclusion programs, the contributions of rural women to sustainable agriculture becomes more visible and effective (Al-Hafidh and Lafta, 2023, 2024; Amirsh, 2023; Rana and Lafta, 2025).

Context of rural women in Iraq

Rural women in Iraq are in a context where they have limited access to education and healthcare. Included in the context of rural women in Iraq is the fact that women have little access to education and healthcare.

Women in rural areas in Iraq are critical in agricultural production and rural livelihoods (Rakhit and Lafta, 2025; Al-Khafaji and Lafta, 2022; Adnan and Lafta, 2022). Research has shown that the effective participation of the same is hampered by cultural constraints, lack of institutional involvement and lack of policy focus (Ramadan and Lafta, 2023; Al-Kubaisy and Lafta, 2021; Challob *et al.*, 2020). The major agricultural development policies focus on technical measures and little focus is given on social empowerment (Jasim *et al.*, 2016; Ridha *et al.*, 2020). The literature identifies a lack in frameworks of connecting social empowerment of women in the rural setting to progressive agriculture in Iraq (Rana and Lafta, 2025; Amirsh, 2023; Surya and Kaur, 2023). This gap is very important to fill in order to make development programs more effective and to make the women more practical to sustainable agricultural systems.

Research gap

Although the issues of women empowerment and sustainable agriculture have been explored in the past, little has been done on the linkage between social

empowerment of rural women and their engagement in ensuring the shift toward sustainable agricultural systems, particularly in Iraq (Amirsh, 2023; Rana and Lafta, 2025; Surya and Kaur, 2023). Empirical studies that establish combined models relating social empowerment dimensions and the outcomes of sustainability are needed and this paper will provide them.

Materials and Methods

Research design

This paper uses a survey-based research design on the descriptive research approach, which is appropriate in measuring perceptions and opinions on social empowerment and involvement in sustainable agricultural systems. The plan permits an organized gathering of quantitative and qualitative information. The research was planned to take place during the three-month period (January 2025 to March 2025) in order to cover the entire scope of the research and gather sufficient time to collect data among all the intended respondents. By doing so, it is possible to grasp the most important factors that affect empowerment of rural women and their involvement in the process of sustainable farming.

Research population and sampling

The study sample comprised of fifteen governorates of Iraq, except Kurdistan Region, and was made of:

- It includes agricultural and social science academics and researchers.
- Governmental institutions dealers who work in the development of agriculture and empowerment of rural women.
- The representatives of the local and international organizations that favor the efforts of women empowerment.
- These respondents were identified because they are directly involved in policy making, program execution, and research with regards to the rural women and sustainable agriculture.
- Purposive sampling method was used to make sure that all the respondents knew and had practical experience relevant to the study. The overall population was about 200 experts and a sample of 150 respondents was chosen out of the whole population, which is 75% of the total population. This was deemed to be an adequate sample size able to represent a variety of specialists. The respondents who did not have enough experience

or knowledge were not included. The response rate was 93%). The respondents distribution across institutional bodies and governmental is presented in Table 1.

Data collection instrument

Data were collected using a structured A structured questionnaire was used to collect the data with the additional ability with the personal interview to clarify or refine the questions and guarantee correct and comprehensive answers. The questionnaire contained 44 items that comprised the following domains:

- Social participation and community engagement.
- Decision-making and leadership roles.
- Access to resources and training.
- Psychosocial support and self-confidence.
- The respondents rated each of the items on a 5-point Likert scale (1= Strongly Disagree, 5= Strongly Agree). Qualitative insights also could be gathered through personal interviews to supplement quantitative results. The detailed items related to the social empowerment domain are shown in Table 2.

Validity of the instrument

- To ensure content validity
- The questionnaire was prepared according to a thorough literature review, and past empirical research conducted on women empowerment and sustainable agriculture.
- The items were matched to objectives and conceptual framework of the study.
- The instrument was examined by a panel of five academic experts and specialists in agricultural development and women empowerment on the criteria of clarity, relevance, and comprehensiveness. The response of this panel was utilized in order to make refinements and to finalize the questionnaire.

Reliability of the instrument

The internal consistency analysis with the alpha of Cronbach was used to measure reliability. A pilot test was done on 15 respondents that were not to be used in the final sample. All the domains showed a Cronbach alpha value greater than 0.80, which means that the items were strongly reliable and consistent. This proved that the instrument could generate consistent and reliable results.

Data analysis

The data were coded and analyzed with SPSS 28.

The characteristics of the respondents and the assessment of their perception of social empowerment and involvement in sustainable agriculture were summarized with the help of descriptive statistics including weighted means, percentages, and rankings. Further, cross-tabulations and correlation analysis was conducted to investigate the relationship between the key social empowerment dimensions and the participation indicators. The results were analyzed considering the study objectives to give practical information to policy and practice.

Ethical considerations

The study was done voluntarily and the respondents were informed of the aims of the study. Anonymity and confidentiality were ensured and prior to the participation, the respondents included informed

consent. The data were utilized in the course of research.

Table 1: *Distribution of respondents.*

No.	Government Bodies	Number of respondents
1	Ministry of Agriculture	31
2	Ministry of Planning	5
3	General Secretariat of the Council of Ministers	13
4	Ministry of Labour and Social Affairs	8
5	Ministry of Water Resources	20
6	Ministry of Environment	20
7	Research Institutions	33
8	International and Local Organizations	20
Total = 150 Respondents		

Table 2: *Items related to the domain of social empowerment.*

Code	Item
Item1	Providing opportunities for rural women to participate socially on a wide range
Item2	Encouraging rural women's participation in decision-making related to sustainable agricultural systems
Item3	Empowering rural women to establish sustainable agricultural projects
Item4	Enacting laws that protect the rights of women working in agriculture
Item5	Sending media invitations to specialists to highlight sustainable agriculture and food security
Item6	Training rural women in decision-making skills
Item7	Educating rural women to express their ideas and suggestions without hesitation
Item8	Implementing awareness programs on the importance of rural women's role in sustainable agriculture
Item9	Creating a supportive environment for social justice in rural communities
Item10	Enabling rural women's participation in agricultural activities supporting sustainable systems
Item11	Providing opportunities for rural women to join awareness campaigns and community initiatives
Item12	Focusing media and social media on success stories about sustainable agriculture
Item13	Raising community awareness to support and assist rural women
Item14	Presenting effective models of female leaders to motivate rural women
Item15	Encouraging the establishment of women's agricultural cooperatives
Item16	Enhancing rural women's participation in implementing agricultural programs
Item17	Integrating rural women into agricultural product marketing networks
Item18	Consolidating the role of rural women in prioritizing their transition needs
Item19	Adopting flexible decision-making policies supporting rural women
Item20	Enhancing rural women's representation in local committees
Item21	Supporting rural women's psychological skills for developing effective projects
Item22	Establishing participatory communication platforms with civil society organizations
Item23	Empowering rural women in self-assertion topics
Item24	Encouraging women to make bold decisions showing strong will
Item25	Adopting laws guaranteeing rural women's right to own agricultural land
Item26	Training rural women in self-development and self-confidence
Item27	Encouraging rural women to freely express opinions on sustainable agriculture
Item28	Addressing gender bias to ensure social justice

Table continues on next page.....

Code	Item
Item29	Supporting female leaders in local communities to influence sustainable agriculture
Item30	Promoting self-confidence-based awareness affecting social reality
Item31	Supporting rural women's representation in agricultural bodies and government councils
Item32	Motivating rural women to join leadership forums
Item33	Training rural women to become ambassadors of local culture
Item34	Increasing representation of rural women in councils and committees
Item35	Enabling rural women to participate in planning agricultural extension programs
Item36	Combating gender-based discrimination in resource distribution
Item37	Supporting the establishment of women's leadership unions
Item38	Improving agricultural working conditions and providing social protection
Item39	Determining minimum wage for working rural women
Item40	Encouraging women's participation in local markets with equal opportunities
Item41	Incorporating rural women's issues into national agricultural plans and policies
Item42	Supporting rural women's access to fair wages
Item43	Supporting social media platforms for community awareness among rural women
Item44	Providing real opportunities for rural women to start sustainable agricultural projects

Results

The social empowerment domain analysis with 44 items showed weighted mean between 4.54 and 3.42 with 90.8 per cent weight and 68.4 per cent weight. The mean weight was 4.17, and the average percentage weight is 83.58 meaning that the respondents generally agreed on the significance of the elements of social empowerment.

With the weighted mean of 4.54 and the percentage weight of 90.8, which illustrates its vital importance in ensuring active social participation, the top-ranked item was Providing opportunities, rural women, to engage socially on a wide range. The second-ranking item, Uplifting participation of rural women in the making of decisions on the transition to sustainable agricultural systems took 4.52 weighted mean with a percentage weight of 90.4, which stressed the importance of women participation in decision making.

Others with the highest ranking were Empowering rural women to initiate sustainable agricultural projects (WM= 4.5, PW= 90%) and Enacting laws that safeguard the rights of women working in the agricultural sector during transition to sustainable agricultural systems (WM= 4.48, PW= 89.6%). The questions that dealt with community education e.g. invitations sent by media to put emphasis on sustainable agriculture and food security also scored high (WM= 4.47, PW= 89.46%).

On the other hand, the least ranked item was Providing real opportunities to rural women to initiate sustainable agricultural projects and rural entrepreneurship promotion, its weighted mean was 3.42, its weight was 68.4%, representation of a perceived restriction in awareness and encouragement of entrepreneurial projects. Other objects pertaining to entrepreneurship and project initiation also got lower scores than the average.

On the whole, [Table 3](#) indicates that the majority of items scored above the neutral level, which means that there has been a great deal of consensus on the significance of the dimensions of social empowerment. Social participation and decision-making items were the most rated, whereas entrepreneurship and project start were rated relatively low, which can be a focus and intervention area in the future.

Discussion

The results of [Table 3](#) suggest that social empowerment of rural women in sustainable agricultural system is multidimensional, meaning that it involves social participation, decision making, psychosocial support, legal protection and community education. All the dimensions play varying roles in improving the roles and influence of women ([Amirsh, 2023](#); [Medina and Herrarte, 2020](#); [Patel and Athya, 2025](#); [Rana and Lafta, 2025](#); [Surya and Kaur, 2023](#)).

Table 3: *Distribution of respondents according to items related to the domain of social empowerment.*

Rank	Rank (Questionnaire)	Items	Strongly agree	Agree	Neutral	Disagree	Strongly disagree	Weighted mean	Percentage weight (%)
1	11	Item1	81	69	0	0	0	4.54	90.8
2	1	Item2	82	64	4	0	0	4.52	90.4
3	27	Item3	78	69	3	0	0	4.5	90
4	33	Item4	80	63	6	1	0	4.48	89.6
5	42	Item5	72	77	1	0	0	4.47	89.46
6	2	Item6	74	72	4	0	0	4.46	89.33
7	24	Item7	75	67	8	0	0	4.44	88.93
8	40	Item8	68	79	2	1	0	4.42	88.54
9	38	Item9	67	80	0	3	0	4.40	88.13
10	16	Item10	63	84	3	0	0	4.4	88
11	39	Item11	61	87	2	0	0	4.39	87.86
12	41	Item12	76	61	8	5	0	4.38	87.73
13	23	Item13	64	79	6	1	0	4.37	87.46
14	8	Item14	69	65	16	0	0	4.35	87
15	18	Item15	60	83	6	1	0	4.34	86.93
16	15	Item16	52	95	2	1	0	4.32	86.4
17	7	Item17	66	65	19	0	0	4.31	86.26
18	14	Item18	57	82	11	0	0	4.30	86.13
19	5	Item19	60	75	14	1	0	4.29	85.86
20	4	Item20	53	82	15	0	0	4.25	85.06
21	20	Item21	50	90	7	3	0	4.246	84.93
22	9	Item22	58	72	18	2	0	4.24	84.8
23	19	Item23	56	75	16	3	0	4.22	84.53
24	22	Item24	57	71	19	3	0	4.21	84.26
25	29	Item25	55	77	11	5	2	4.186	83.73
26	26	Item26	55	75	13	5	2	4.17	83.46
27	28	Item27	40	96	13	1	0	4.16	83.33
28	32	Item28	45	85	14	5	1	4.12	82.4
29	25	Item29	54	75	10	6	5	4.11	82.26
30	21	Item30	46	79	20	5	0	4.10	82.13
31	35	Item31	45	78	23	3	1	4.08	81.73
32	3	Item32	42	80	24	4	0	4.06	81.33
33	17	Item33	44	71	32	3	0	4.04	80.8
34	12	Item34	60	50	30	5	5	4.03	80.66
35	13	Item35	34	85	28	3	0	4	80
36	30	Item36	43	65	40	1	1	3.98	79.73
37	6	Item37	50	48	46	5	1	3.94	78.8
38	37	Item38	37	60	52	1	0	3.88	77.73
39	34	Item39	39	67	28	13	3	3.84	76.8
40	31	Item40	30	80	25	9	6	3.79	75.86
41	10	Item41	47	44	39	13	7	3.74	74.8
42	36	Item42	34	42	70	3	1	3.7	74
43	43	Item43	18	72	55	5	0	3.68	73.73
44	44	Item44	19	51	57	20	3	3.42	68.4

Social participation

The most important dimension was social participation. The most ranked position, which offers rural women chances to engage in society in the most varied activities (WM= 4.54, PW= 90.8%), proves the key position of the community engagement in empowerment (Amirsh, 2023; Patel and Athya, 2025). Involvement enables women to take part in agricultural and social work enabling them to exercise leadership, cooperation, and exchange of knowledge. Women should be encouraged to express their views freely (WM= 4.16, PW= 83.33%), which helps instill confidence and psychosocial empowerment and allows women to overcome boundaries of the culture and impose their views on sustainable agricultural practices (Rana and Lafta, 2025; Surya and Kaur, 2023).

Decision-making and leadership

Empowerment heavily relies on decision-making. The fact that the item raises the engagement of rural women in the decisions connected with transition to sustainable agricultural systems (WM= 4.52, PW= 90.4) indicates the role of women in planning and governance (Amirsh, 2023; Medina and Herrarte, 2020). Involvement in the decision-making process turns women into active contributors and not passive receivers of policies and resources to prioritize and allocate resources in meaningful ways and to make agricultural policies transformative and fair (Patel and Athya, 2025; Rana and Lafta, 2025).

Psychosocial support and project initiation

Empowerment is improved by psychosocial support in terms of establishment of projects. The product that enables women to develop lasting farming initiatives (WM= 4.5, PW= 90%) gives them more power in the changes of agricultural systems (Amirsh, 2023; Keshava et al., 2025). These programs encourage networking and sharing of experiences and contact with institutions. But the existence of items related to entrepreneurship, e.g. offering real opportunities to women to open sustainable projects (WM= 3.42, PW= 68.4%), had the lowest score. This represents a lack of awareness, institutional support, and economic initiative seems less viable than social participation, and there is a necessity to involve a combination of psychosocial support and financial and technical help (Keshava et al., 2025; Surya and Kaur, 2023).

Legal protection and social justice

Legal systems are essential. The item against

the violation of the rights of women involved in agriculture (WM= 4.48, PW= 89.6) shows that there is a lot of consensus regarding the necessity of legal protection (Amirsh, 2023; FAO, 2024). Legal interventions provide equal rights to land, financing, and resources and protect the capability of women to make significant contributions to society and be rewarded (Amirsh, 2023; Rana and Lafta, 2025).

Community education and awareness

Available education in the community increases the visibility and validity of the roles of women. The object associated with the transmission of media invitations to encourage women in the field of sustainable agriculture and food security (WM= 4.47, PW= 89.46) demonstrates that the media campaigns, workshops, and seminars contribute to the strengthening of the social recognition, social cohesion, and the engagement of more people in the activities (Amirsh, 2023; FAO, 2024; Rana and Lafta, 2025).

Implications

The social participation strengthens confidence and decision-making, psychosocial support network, legal protection right and community education support, and all these works together (Amirsh, 2023; Keshava et al., 2025; Rana and Lafta, 2025; Surya and Kaur, 2023). Poor scores from entrepreneurship imply that the issue of economic empowerment is still a challenge (Keshava et al., 2025). Policies should combine financial assistance, technical training, and mentoring with social and legal actions to put the rural women in the position of being able to fully participate in sustainable agricultural systems in order to improve productivity, equity, and sustainability (Amirsh, 2023; Rana and Lafta, 2025; Surya and Kaur, 2023).

Conclusions

- When rural women are given a chance to make decisions related to agriculture, it makes the management of natural resources more efficient and the agricultural production more sustainable.
- Social empowerment of rural women can be empowered in a meaningful and active way through a specific program and policies to address the issues of social empowerment and to ensure social justice.
- The environment can be created in support of women to develop the capacities, enhance self-

confidence, and dedicate themselves to sustainable agriculture.

- Capacity-building trainings such as leadership and management trainings enhance active participation of women in the decision-making process.
- Sensitization of the community through media campaigns and environmental awareness increases awareness of the environment and agriculture, which further enhances the participation and encouragement of the women in the sustainable agricultural procedures.

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Novelty Statement

This study uniquely links social empowerment of rural women in Iraq to their active participation in transitioning toward sustainable agricultural systems, providing an empirically validated framework to guide policy and capacity-building programs.

Author's Contribution

Afaf Shuaib AL- Karoot: Wrote the original draft manuscript, contributes by methodology, data collection, and analyzing results as the corresponding author.

Ahmed Hamdan Lafta: Project administration and overall direction and planning A.

Generative AI and AI assisted technology statement

The authors declare that no generative AI and AI assisted technology was used in the creation of this manuscript.

Statement of conflict of interest

The authors have declared no conflict of interest.

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