Problems facing solar energy users from the perspective of agricultural extension workers in Nineveh Governorate

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Abstract

This study was conducted to identify the obstacles facing the use of solar energy technology from the perspective of agricultural extension workers in Nineveh Governorate. These obstacles were ranked according to the average responses of the respondents, and the correlation between these obstacles and some independent variables (age, academic qualifications, length of service in agricultural extension, experience with solar energy systems, training, and sources of information related to solar energy systems). To achieve the study objectives, a questionnaire was distributed to agricultural extension workers in the Nineveh Agriculture Directorate and its affiliated agricultural divisions. Research data was collected during the period from January 1, 2025 to February 1, 2025. A simple random sampling method was used to select the study sample, resulting in a total of (313) employees. After excluding (30) employees from the total study population who were included in the stability sample for the study scale, a simple random sample of (60%) was taken, So, the total number of employees in the study sample to (188). The data were analyzed using SPSS. The results showed that the use of solar energy presents some problems. The most significant of these, according to the respondents' perspective, was the lack of a plan to manufacture and supply solar energy, as it is mostly imported. The second most significant problem was the high initial cost of solar panels, making them unaffordable for farmers. The least significant problems were related to government legislation. The results also showed that some independent variables, such as age, experience with solar energy systems, training, and level of contact with information sources on solar energy use, had a significant and effective impact on the respondents' opinions regarding the obstacles to solar energy use. The study concluded that concerted efforts must be made to solve the problems of solar energy use by working to manufacture it locally and providing soft loans for solar energy installation.

Keywords: Solar energy, problems, agricultural extension.

Introduction

Iraq suffers from a problem where agricultural production is insufficient to meet local food demand due to the difficult circumstances it has experienced over the past decades, which have had negative repercussions on the agricultural sector, as well as other sectors of the national economy. The recent global food crisis is another negative factor affecting the agricultural sector in Iraq, hindering its development and progress. This crisis has contributed to raising food prices, as well as the prices of various agricultural inputs essential for agricultural production (1).

The use of fossil fuels in agriculture accelerates climate change due to the

emission of numerous greenhouse gases (2). This has prompted scientists, researchers, and academics to search for alternative and sustainable fuel sources in agriculture using renewable energy, such as solar panel technology, to mitigate the environmental problems that may result from global warming and climate change. While there are many potential sources of renewable energy, solar energy is the best form, available across almost all of the Earth's surface. It is pollution-free and cost-effective, and solar energy does not emit greenhouse gases, unlike fossil fuels (3). As a result, many developing countries are now turning to renewable energy, such as solar power, which can be used for various purposes in agriculture, and even in all areas of agriculture and related processes. This will reduce the environmental problems associated with agriculture (4).

The use of solar energy is fundamental to achieving food security and is an important issue that must be addressed in all countries, whether developed or developing (5). It is worth noting that countries whose economies depend on agriculture have supported food security in implementation of the United Nations goals to combat poverty and hunger. These countries, including Iraq, seek to achieve this goal within their limited economic capabilities. However, there are agricultural and economic variables specific to each country that affect local agricultural production and stand in the way of achieving this goal (6). One of these variables is the availability of a continuous and sustainable energy source (7).

Sustainable agricultural development is an integrated and comprehensive process for advancing the agricultural sector in Iraq, achieving high production volumes and yields without harming non-renewable agricultural resources, and working to sustain and preserve them. This leads to food security and supports the growth and development of other economic sectors. However, achieving agricultural development in Iraq faces numerous structural and non-structural obstacles within the agricultural sector and related sectors (8). Agricultural extension faces enormous challenges in combining the concerns of farmers with those of other stakeholders, as they address both climate change and market-related issues. Extension has the opportunity to significantly contribute to bridging this gap by enhancing farmers' decision-making. Agricultural extension agents may also play a role in assisting farmers in implementing policies and programs that address climate change adaptation. For example, extension agents may be employed to educate farmers in their area, help form community groups, link farmers with governmental, non-governmental, and private organizations at the national and international levels, and perhaps assist in preparing proposals or negotiations with other actors (9).

In this field, agricultural extension seeks to achieve rural and agricultural development in its various dimensions by bringing about desirable behavioral changes in the knowledge, skills, and attitudes of the target groups of extension work (10). Those involved in agricultural extension work are the fundamenta pillar of the extension process within the agricultural extension organization. Agricultural

extension is also considered an important link between science in research centers and farmers in rural areas, through communication and interaction between agricultural extension workers, researchers, and farmers within an integrated work system in which each party influences and affects the other, with the goal of achieving agricultural development (11).

However, the use of solar energy in agriculture presents numerous problems and obstacles. A study (12) revealed the existence of specific problems related to the use of solar energy that decision-makers face in terms of the ability to provide modern technologies, the substantial funding required, partnerships with the private sector, and training for unqualified personnel.

The study (13) concluded that there are some problems related to the use of solar energy. These problems were primarily related to household uses of solar energy technology, followed by problems related to farmers, then problems related to farm-specific uses, and finally, the lack of adequate advisory services.

Nineveh Province is considered one of the most important agricultural governorates in Iraq and possesses vast areas of cultivated land spread across the governorate's districts and sub-districts. Some districts, sub-districts, and regions have begun to use solar energy technology and incorporate it into the cultivation of arable land. Its use began with the self-help efforts of farmers and has spread from one region to another within Nineveh Governorate. However, some problems and obstacles have resulted from the use of solar energy in agriculture. Therefore, it was necessary to study these problems and obstacles that stand in the way of its use. Through the researcher's knowledge and interest in the topic of solar energy use, his communication with farmers, employees, and energy users from the Nineveh Agriculture Directorate and its affiliated divisions, and consultation with specialists, the researcher formed a picture of a flaw in the general vision for the use of this technology. As a result of what was mentioned, the researcher wanted to conduct this research officially as a scientific research to know the opinions of extension workers from the employees distributed among the centers of the Nineveh Agriculture Directorate, the branches and extension centers, and to know and evaluate the problems associated with the use of solar energy and to rank these problems according to their importance in preparation for proposing appropriate solutions for them.

Objectives :

1. To identify the obstacles to the use of solar energy technology from the perspective of agricultural extension workers in Nineveh Governorate. These obstacles were ranked according to the average responses of respondents.
2. To determine the correlation between the obstacles to the use of solar energy technology and the independent variables included in the study, namely: age, academic qualifications, length of service in agricultural extension, experience in using solar energy systems, training in their use, and related information sources.

Materials and Methods:

Nineveh Province was chosen as the research area, as it is the second largest Province in Iraq and one of the governorates famous for agriculture. The Nineveh Agriculture Directorate (directorate headquarters and its affiliated

agricultural divisions) was chosen as the research area. The research population included all agricultural employees working in agricultural extension, totaling (343) agricultural employees. A simple random sampling method was used to select the research sample. After excluding (30) employees from the total research population, they were included in the stability sample for the research scale. Thus, the total number of employees in the research population reached (313). A simple random sample of (60%) was taken, so, the total number of employees in the research sample to (188).

To identify the problems and obstacles related to the use of solar energy, sources, research, and books related to the subject of solar energy were reviewed. After consulting with specialists in the Renewable Energy Department, the Technical Institute of Technology, and the Agricultural Extension Department, a questionnaire was prepared for this purpose.

Components of the Research Tool (Questionnaire):

The questionnaire consisted of (two) parts, as follows:

1. Part One: Includes data related to the independent variables of the employees' personalities (age, academic qualifications, length of service in agricultural extension, experience with solar energy systems, training in the use of solar energy systems, and sources of information on the use of solar energy).

2. Part Two: Includes a four-part scale consisting of (14) items regarding the problems facing farmers when using solar energy. Four alternatives were provided for each problem: (highly present, moderately present, slightly present, non-existent), and the following numerical values were assigned to each: (4, 3, 2, 1), respectively.

Validity and Reliability:

After completing the questionnaire in its initial form, it was presented to researchers specializing in agricultural extension to verify the apparent validity of the scale's items. It was also presented to solar energy specialists to verify the scientific integrity of the items. Based on the specialists' comments, some items were modified to ensure they were appropriate for achieving the research objectives. To establish reliability, a random survey sample of (30) employees was selected from the total research community. The reliability of the research areas and the overall scale was calculated using the Cronbach's alpha method using SPSS. The reliability value reached (0.92). Data for the reliability sample was collected from November 1, 2024, to December 1, 2024.

Measuring Research Variables:

A. Measuring Independent Variables:

1. Age: This was measured by the number of years the respondent was aged at the time of data collection.

2. Educational Qualification: Measured according to the following levels: Agricultural Secondary School Graduate, awarded one (1) score; Agricultural Institute Graduate, awarded two (2) scores; College of Agriculture Graduate, awarded three (3) scores; Postgraduate Certificates, awarded four (4) scores.

3. Length of Service in Agricultural Extension: Measured by the number of years of service of employees at the time of data collection.

4. Experience in Solar Energy Systems: Measured by four alternatives (Extensive experience, awarded four (4) scores; Medium experience, awarded three (3) scores; Little experience, awarded two (2)

scores; No experience, awarded one (1) score).

5. Training in the Use of Solar Energy Systems: Measured by two alternatives: Trainee, awarded one (1) score; Non-trainee, awarded two (2) scores.

6. Sources of information on the use of solar energy: It was measured by placing several questions in the form of a table, and four alternatives were given to it: always (4), sometimes (3), rarely (2), and never (1).

B. Measuring the Dependent Variable:

(Obstacles Facing the Use of Solar Energy in Nineveh Governorate). The level of implementation was measured by setting (4) alternatives for each problem: (highly present, moderately present, slightly present, non-existent). The following numerical values were assigned to each problem: (4, 3, 2, 1), respectively. By summing each respondent's responses to the field items, the final score for each respondent on the research items (obstacles) was obtained. This score represents the final score for each respondent across the research areas. This result represents the opinion of agricultural extension workers regarding the obstacles facing the use of solar energy in Nineveh Province.

Research Data Collection and Statistical Analysis:

Research data was collected during the period from January 1, 2025 to February 1, 2025. After completing the research data collection, transcribing, and tabulating it, it was analyzed using the statistical analysis program (SPSS). Since the research data were normally distributed, the following statistical methods were used: range, class length, frequency, percentage, arithmetic mean, Pearson's correlation coefficient, and Spearman's rank correlation equation.

Results and Discussion:

First Objective: To identify the obstacles to the use of solar energy technology from the perspective of agricultural extension workers in Nineveh Governorate. These obstacles were ranked according to the average responses of respondents.

Table (1) shows that the most important problem facing the use of solar energy, according to the respondents, is "the lack of any plan to manufacture and equip solar energy, as it is mostly imported." with an arithmetic mean of 3.453. This indicates the awareness of the agricultural extension workers surveyed of this fact. Highlighting this most important problem is useful in developing solutions that require massive government investments or private sector participation by expanding the size of the local market for the manufacturing sector. This is especially true given that the manufacturing process achieves Goal 9 of the Sustainable Development Goals set by the United Nations: "Industry, Innovation, and Infrastructure." It's worth noting that manufacturing can begin using simple, uncomplicated technologies that are readily available and can be manufactured in developing countries. This also creates a some job opportunities necessary for the manufacture, installation, and maintenance of solar energy equipment, as well as electricity generation facilities.

The second problem, according to respondents' responses, is that "the initial cost of solar panels is high and farmers cannot afford them," with an arithmetic mean of 3.432. This indicates a lack of support and funding for the high initial costs of installing solar energy systems and utilizing them in all agricultural operations. The issue of the high initial costs of solar energy has been previously noted in more than one place in the current study, but the

returns resulting from its subsequent investment lead to a reduction in the economic cost over time. Providing initial support to farmers remains the problem. In general, implementing any new technology requires very large capital, which is beyond the capabilities of farmers, which requires agricultural departments to provide them with facilities and assistance through agricultural loans and other means.

The third problem, according to respondents' responses, was "the lack of support for training programs and plans and the preparation of human resources in solar energy," with an arithmetic mean of 3.354. This demonstrates the awareness of agricultural extension workers of the need to support training and qualification programs to ensure that extension workers and human resources working in the field of manufacturing, investing, and operating solar energy equipment are competent and effective. This also demonstrates the ability of extension workers to effectively transfer modern technologies and deliver guidance programs specifically designed for the technology transfer process.

The two problems ranked fourth " The need to clean solar panels," with an arithmetic mean of 3.333 and fifth "the agricultural system requires a large number of batteries and is therefore expensive," with an arithmetic mean of 3.255 are included in the high cost of solar energy, as mentioned in the second paragraph above. The need to clean solar panels add an additional cost resulting from periodic cleaning costs for the panels as needed. Furthermore, the need for a large number of batteries is also included in the initial costs that require support.

Among the less significant obstacles to the use of solar energy, according to the respondents' responses, were Problem No. 8, "The water flow rate from solar pumps decreases by 30% during the winter," with an arithmetic mean of 3.083. Problem No. 9, "Requires a large area of land for installation," with an average of 2.906, and Problem No. 10, "Difficulty in accurately directing the pump toward the sun," with an average of 2.813. This means that these problems are rare in the use of solar energy. This is natural due to the limited number of hours of sunshine during the winter, which leads to a decrease in the amount of electricity that can be produced from solar energy systems. However, it is a relative problem whose impact varies from year to year, as it occurs during the winter, where its severity increases during dry years, while its impact diminishes during years of good rainfall. Furthermore, the large areas required for solar energy systems are available in the study area, based on the status of agricultural holdings.

The obstacles that came in last place among the problems of using solar energy according to the respondents' answers were paragraph No. 12 "The lack of clear legislation in supporting the import of solar energy materials and products or their manufacture and exempting them from customs duties" with an arithmetic mean of (2.511), and the paragraph that came in the penultimate place "The lack of mechanisms to actually benefit from the instructions of the Central Bank in the field of installment of systems and devices that operate on solar energy" with an average of (2.432), and the last paragraph "The Ministry of Electricity did not adopt any decisions to support agricultural lands that operate on solar energy" with an average of (2.415). This means that these problems are less important and less present in the use of solar energy, and this means that the

issue of using solar energy is not affected by government legislation.

The second objective: To determine the correlation between the obstacles to the use of solar energy technology and the independent variables included in the study, namely: age, academic qualifications, length of service in agricultural extension, experience in using solar energy systems, training in their use, and related information sources

Table (2) shows the distribution of respondents according to the independent variables studied and their relationship to their views on the obstacles to the use of solar energy.

1. Age: The research results showed that the highest age of the respondents was (62) years and the lowest age was (30) years, with an average of (45) years. The respondents were divided according to their age into three age groups using the range and the length of the group. The highest percentage of respondents was in the low-age group (30-40) at 43.1%, followed by the middle-age group (41-51) at 37.8%, while the high-age group (52-62) had the lowest percentage (19.1%). The results showed a significant correlation between agricultural extension workers' perceptions of the obstacles to using solar technology and age. The Pearson's simple correlation coefficient was (-0.044), which is significant. This indicates that respondents' perceptions were influenced by age. This means that, depending on the age of agricultural extension workers, their views on the importance of using solar energy differed. These results are consistent with (14), (15).

2. Academic Qualification: The highest percentage of respondents were College of Agriculture graduates (44.1%), followed by those with postgraduate degrees (34.6%), then those with an agricultural institute graduate (13.8%), while those with a secondary school certificate in agriculture represented the lowest percentage (7.4%). The results showed no significant correlation between the views of extension workers regarding the obstacles to solar energy use and their academic qualifications. The Spearman's rank correlation coefficient was (-0.035), which is insignificant. This means that workers' perceptions of the obstacles to solar energy use are equal regardless of their academic qualifications.

3. Length of Service in Agricultural Extension: The results showed that the highest length of service for the respondents was (30) years, and the lowest was one year, with an average of (15.5) years. The respondents were divided according to their length of service into three age groups. The highest percentage was in the middle group (12-22 years) at 68.1%, followed by the low group (1-11 years) at 27.1%, while the high group (22-32) had the lowest percentage (4.8%). The results showed no significant correlation between agricultural extension workers' perceptions of the obstacles to using solar energy and length of service. The simple Pearson correlation coefficient was (0.018), indicating that workers' awareness of the problems associated with using solar energy was equal regardless of length of service.

4. Experience in solar energy systems: The highest percentage of respondents were in the category with medium

experience in solar energy systems, at (41.0%), followed by those with extensive experience (35.1%). The low-experience group represented (21.8%), while the lowest percentage was in the category with no experience (2.1%). The results showed a significant correlation between agricultural extension workers' perceptions of the obstacles to solar energy use and the experience variable. The Spearman's correlation coefficient was (0.095), indicating a significant correlation between workers' perceptions and the experience variable. These results are consistent with (16).

5. Training on the Use of Solar Energy Systems: The results showed that the majority of respondents (91.5%) had not received training on the use of solar energy systems, while only (8.5%) of respondents had received training. The results showed a significant correlation between agricultural extension workers' perceptions of the obstacles to solar energy use and the training variable. The Spearman's correlation coefficient was (0.121), which is significant. This is logical given the positive impact of training on the perceptions of agricultural extension workers. This is because their awareness and understanding of solar energy problems increases and crystallizes with the increased experience they gain with solar energy systems through training.

6. Levels of contact with information sources on the use of solar energy: The results indicated that the highest value for the levels of contact with information sources for the respondents was (28) and the lowest value was (7). The respondents were divided according to the levels of contact with agricultural information sources into three categories using the range and length of the category. The highest percentage of respondents was in the medium category (15-22) and amounted to (85.1%), followed by the percentage of respondents from the low category (7-14) which amounted to (8.5%), then followed by the percentage of respondents from the high category (23-30) which amounted to (6.4%) and the arithmetic mean (16.995). The results showed a significant positive correlation between the opinion of agricultural extension agents on the obstacles to the use of solar energy and the variable of agricultural information sources. The value of Pearson's simple correlation coefficient reached (*0.051) and is significant at the (0.05) level, indicating the strong influence of the information source and the knowledge of agricultural extension workers of modern topics in solar energy technologies affects their views on the obstacles and problems of using solar energy in agriculture.

Table (1): Distribution of obstacles according to the average response of the respondents, arranged in descending order:

S	Problems	Average	Sequence in the form	Sequence according to the average
1	There is no plan to manufacture and equip solar energy, as it is mostly imported.	3.453	9	1
2	The initial cost of solar panels is high and farmers cannot afford them.	3.432	2	2
3	Lack of support for training programs and plans and the preparation of human cadres in solar energy	3.354	8	3
4	The need to clean solar panels	3.333	1	4
5	The agricultural system requires a large number of batteries and is therefore expensive.	3.255	7	5
6	Reduced solar energy collection capacity when clouds, fog, and rain are present.	3.203	5	6
7	Difficulty in utilizing solar energy at night	3.167	6	7
8	The water flow rate from solar pumps decreases by 30% during the winter.	3.083	3	8
9	It requires a large area of land during its establishment.	2.906	4	9
10	Pointing it precisely at the sun is difficult.	2.813	10	10
11	Lack of community awareness of the importance of using solar energy, and weak official media	2.536	13	11
12	The lack of clear legislation to support the import or manufacture of solar energy materials and products and exempt them from customs duties.	2.511	14	12
13	The lack of mechanisms to effectively benefit from the Central Bank's instructions regarding the installment payment of solar-powered systems and devices	2.432	12	13
14	The Ministry of Electricity has not adopted any decisions to support agricultural lands that operate on solar energy.	2.415	11	14

Table (2) Distribution of respondents according to the independent variables studied and their relationship to their opinions on the obstacles to using solar energy

Independent variable	Categories	Number	Percentage %	Mean	(r) or (rs)	Significance
Age	30- 40	81	43.1	45	**r= -** 0.014	0.849 ns
	41-51	71	37.8			
	52-62	36	19.1			
Academic qualification	Secondary school	14	7.4	-	**rs= -** 0.018	0.801 ns
	Agricultural institute graduate	26	13.8			
	College of agriculture graduate	83	44.1			
	Postgraduate degree	65	34.6			
Period of service	1- 11	51	27.1	12.00	**r=** 0.010	0.889 ns
	12 -22	128	68.1			
	22-32	9	4.8			
Experience	No experience	4	2.1	-	**rs**= - 0.082	0.265 ns
	Little experience	41	21.8			
	Moderate experience	77	41.0			
	High experience	66	35.1			
Training	Trained	16	8.5	-	**rs= -** 0.102	0.165 ns
	Untrained	172	91.5			
Sources of information	7-14 Low	16	8.5	16.995	**r=** 0.043*	0.036*
	15-22 medium	160	85.1			
	23-30 High	12	6.4			
-	Total	188	100%	-	-	-

Conclusions

- We conclude that the use of solar energy presents some challenges and obstacles. The most significant of these, from the respondents' perspective, was the lack of a plan to manufacture and supply solar energy, as it is mostly imported. Second, the high initial cost of solar panels makes them unaffordable for farmers. The least significant challenges were those related to government legislation.

- We also conclude that variables such as age, experience with solar energy systems, training, and the level of access to information sources on solar energy use have a significant and effective impact on respondents' opinions in identifying the obstacles to solar energy use.

- We also conclude that regardless of the academic qualifications of the researchers and their length of service in agricultural extension, their views on identifying the obstacles to solar energy use do not differ.

Recommendations: Concerted efforts must be made to solve the problems of solar energy use by working to manufacture it locally and providing soft loans for solar energy installation.

References

1.Rahmani Amir and , Ali Bonyadi Naeini (2023). Predicting intention in applying solar energy technologies in agriculture industry: A moderated and mediated model . *Cleaner and Responsible Consumption 8 . 12 pp. 100102.*

2. IPCC (2022): Climate Change (2022). Mitigation of Climate Change. Contribution of Working Group III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [P.R. Shukla, J. Skea, R. Slade, A. Al Khourdajie, R. van Diemen, D. McCollum, M. Pathak, S. Some, P. Vyas, R. Fradera, M. Belkacemi, A. Hasija, G. Lisboa, S. Luz, J. Malley, (eds.)]. Cambridge University Press, Cambridge, UK and New York, NY, USA. doi: 10.1017/9781009157926

3. Nwankwo, R.C and P. I. kenna Enyinna. (2019). Use of Solar Technology as a Viable Option for Zero GHG Emission and Abatement of the Earth's Environmental Pollution. American Journal of Energy Science. Vol. 6, No. 1, 2019, pp. 8-13.

4.Aroonsrimorakot, S., Laiphrakpam, M. and Paisantanakij, W. (2020). Solar panel energy technology for sustainable agriculture farming: A review. International Journal of Agricultural Technology, 2020 Vol. 16(3

5. Li, Z.B., Zhang, Y., and M. Wang (2023). Solar energy projects put food security at risk. Science 381(6659):740-741

6. Pawlak K and M. Kołodziejczak (2020). The Role of Agriculture in Ensuring Food Security in Developing Countries: Considerations in the Context of the Problem of Sustainable Food Production. Sustainability 12(13):5488. DOI: 10.3390/su12135488

7.Bakhit, Abdul Jabbar Khader, Al-Naimi Saad Ahmed, and Muzahim Maher Ali (2023). The importance of the agricultural sector for achieving food security in Iraq. University of Karbala - College of Administration and Economics. Sixteenth Scientific Conference, p. 17. (In Arabic)

8.Muhammad, Omar Hamid Majeed (2020). The Possibility of Achieving Sustainable Development in Iraq. Journal of Economic and Administrative Sciences 12(26). (In Arabic)

9.Mustapha, S.B; Undiandeye, U. C. and Gwary, M.M. (2012). The Role of Extension in Agricultural Adaptation to Climate Change in the Sahelian Zone of Nigeria. Journal of Environment and Earth Science. Vol 2, No.6, 48-59.

10.Al-Khadraji, Manal Muhammad Ali (2018). Obstacles to Rural Women's Participation in Agricultural Extension Activities in Some Villages of Gharbia Governorate. Journal of the Scientific Society for Agricultural Extension. Volume 22, Issue 4, pp. 1-30. (In Arabic)

11.Ibrahim Muhammad Sayyid Ali and Iman Abdel Fattah Ali Abu Qamar (2024). Breeders' awareness of the impacts of climate change risks on livestock and ways to address them in Assiut Governorate. Journal of the Scientific Society for Agricultural Extension, 2 (28). (In Arabic)

12.Al-Tarawneh, Sultan, Muhammad Al-Sarayrah, and Mutab Al-Razi (2015). A Survey Study of the Use of Solar and Wind Energy in Electricity Generation in Kuwait. Journal of Solar Energy and Sustainable Development. Volume 4, Issue 1, pp. 35-46. (In Arabic)

ISSN 2072-3857

13.Habiba Hani Muhammad Habib, Shaima Abdul Majeed Al-Kholi, and Iman Mustafa Ibrahim (2022). Farmers' Attitudes Towards the Use of Solar Energy Technology (Renewable Energy) in the Nubaria Region. Arab Journal of Science and Research Publishing. Journal of Agricultural, Environmental and Veterinary Sciences, Volume 6, Issue 2, June 2022. (In Arabic)

14.Beatrice, M.A. and Jiang, K. (2024) Assessing Factors Influencing Solar Energy Adoption among Small and Medium Enterprises in Mzuzu City, Malawi .Energy and Power Engineering, 16: 257-284.

15.Hwang, Y., Al-Arabiat, M. and Shin, D. (2016) Understanding Technology Acceptance in a Mandatory Environment .Information Development, 32, 1266-1283

16.Sebastian Groh, S.G. and Hadley Taylor, H.T. (2015) The Role of Microfinance in Energy Access: Changing Roles, Changing Paradigms, and Future Potential .Enterprise Development & Microfinance, 26, 307-324 .

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