Factors Affecting Farmers' Sustainable Environmental Behaviour in Egypt

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ABSTRACT

Fostering sustainable environmental behaviour is a multifaceted endeavor that hinges on understanding and leveraging various psychological, social, and socio-economic factors. Personal values and beliefs serve as the bedrock for shaping environmentally conscious mindsets, highlighting the necessity of cultivating an environmental ethos from a young age. Social norms and peer influences further bolster this by creating a culture of sustainability that encourages collective action. Economic incentives and barriers play a significant role, where targeted financial strategies can either promote or hinder green practices. Additionally, access to education and information empowers individuals and communities to make informed decisions, facilitating a shift towards sustainable living. Also, Egypt's agricultural sector faces such significant challenges, understanding these challenges and factors that influence farmers' sustainable environmental behaviour is crucial for developing effective policies and strategies to promote sustainable agriculture in Egypt. To addressing these diverse factors, drive a unified movement towards a more sustainable future, inspiring individuals and communities to actively participate in preserving our planet this study tried to give an organized, integrated, and up-to-date image for Farmer's sustainable behaviour in the study area through presenting an accurate understanding of factors influencing Farmer's sustainable behaviour, and Identify the most important obstacles influencing farmer's adoption of sustainable farming behaviour. The study was conducted in the Beheira govrneroate which considered one of the largest rural agricultural governorates in Egypt and about 75% of population lived in rural areas. Abou elmatameer district has chosen randomly, two villages called (koum alqadah, Alseddik Algadida) are chosen to the study. The total number of sample size was 315 households. Aspesific questionnaire has been prepared for the study and data collected by personal meeting with households. Factor analysis was made to achieve the study objectives, and a model has developed. The study resulted that four factors were extracted when the rotation converged in their iterations. The factors were (Farmer's good environmental behaviour, Farmer's practices to improve farming conditions, Farmer's implementation for innovative practices, Farmer's adaptation to climate changes). The analysis extracted four factors, each with Eigen values above one which explains 61.52% of the total variance while the original literature explains 68.23%. This indicates that there could be more factors influencing Farmer's sustainable environmental behaviour when more items are generated. KMO was 0.91 and MSA was 0.6 for all items which is indicating a good model.

Keywords: Sustainability, Environmental Behaviour, Sustainable Development, Farmer's Sustainable Environmental Behaviour.

INTRODUCTION

The sustainability of agricultural practices is a critical issue that has garnered increasing attention in recent years, especially in the context of developing countries like Egypt. Agriculture remains a cornerstone of the Egyptian economy, providing livelihoods for a significant portion of the population. However, the environmental impacts of traditional farming methods pose substantial threats to the sustainability of agricultural systems and the broader ecosystem (Rehman *et al*., 2022). In this regard, understanding the factors that influence farmers' sustainable environmental behaviour is essential for developing effective strategies to promote environmental stewardship and sustainable agricultural practices.

The increasing awareness of environmental issues and the pressing need for sustainable development have brought to light the critical role that farmers play in promoting environmental sustainability. Farmers, being the stewards of large tracts of land, are in a unique position to adopt practices that can significantly impact environmental health. However, achieving sustainable environmental behaviour among farmers is a multifaceted challenge influenced by a variety of factors. This literature review seeks to explore these factors comprehensively, providing a nuanced understanding of what drives or hinders farmers' sustainable environmental behaviour.

The complexity of sustainable environmental behaviour among farmers can be attributed to a convergence of diverse and interrelated factors. Studies have shown that socio-demographic characteristics such as age, education level, and household income can influence farmers' attitudes and practices towards sustainability. Psychological factors, including beliefs, values, and perceived behavioural control, also play a crucial role in shaping farmers' environmental actions. Furthermore, institutional and policy frameworks provide the structural context within which farmers

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operate, either facilitating or constraining sustainable practices (Rizzo *et al*, 2024).

Technological advancements offer both opportunities and challenges for sustainable farming. The adoption of new technologies can enhance productivity and reduce environmental impacts, yet the accessibility and suitability of these technologies for different farming contexts remain critical considerations. Additionally, environmental and ecological factors, such as climate conditions and soil health, directly affect farmers' decisions and behaviour related to sustainability (Qayyum *et al*., 2023).

Economic incentives and market forces are pivotal in influencing farmers' environmental behaviour. The financial viability of sustainable practices is often a determining factor for their adoption. Social and community factors, including peer influence, social norms, and community support, also significantly impact farmers' willingness to engage in sustainable practices (El Bakali *et al.*, 2023).

Despite the potential benefits of sustainable environmental behaviour, farmers face numerous barriers, ranging from financial constraints to lack of knowledge and resources. Understanding these barriers is essential for developing effective strategies to promote sustainable practices. This literature review aims to identify and analyze these factors, providing insights into how they interact and influence farmers' behaviour. By doing so, it seeks to inform policies and interventions that can effectively support farmers in adopting sustainable environmental practices, ultimately contributing to broader environmental and societal goals. (Rehman and Farooq, 2023).

Egypt's agricultural sector faces significant challenges due to climate change, water scarcity, and land degradation. Understanding the factors that influence farmers' sustainable environmental behaviour is crucial for developing effective policies and strategies to promote sustainable agriculture in the country. Promoting sustainable environmental behaviour among farmers in Egypt requires a multi-faceted approach that addresses economic, social, and environmental factors. By understanding and addressing these key factors, policymakers and stakeholders can develop more effective strategies to support the transition towards sustainable agriculture in Egypt, ensuring food security and environmental conservation for future generations (OECD, 2024).

Despite the growing awareness of the importance of sustainable agriculture in addressing environmental challenges and ensuring food security, many farmers in Egypt, continue to rely on traditional, less sustainable methods. This study aims to identify the key factors that hinder or promote the adoption of sustainable practices among farmers in Egypt. By addressing these research objectives, this study can provide valuable insights into the challenges and opportunities for promoting sustainable agriculture in Egypt and inform the development of effective policies and interventions to support farmers in transitioning to more sustainable practices.

Objectives:

This study seeks to give an organized, integrated, and up-to-date image for Farmer's sustainable behaviour in the study area through:

1- Presenting an accurate understanding of factors influencing Farmer's sustainable environmental behaviour.
2- Identify the most important obstacles influencing farmer's adoption of sustainable environmental behaviour.

Review of Previous Literature:

The study of sustainable environmental behaviour among farmers is underpinned by several key theoretical frameworks that offer valuable insights into the factors influencing such behaviours. The Theory of Planned Behaviour elucidates how attitudes, subjective norms, and perceived behavioural control shape individual actions. The Norm Activation Model provides a lens to understand how personal norms and awareness of consequences drive pro-environmental behaviours. Additionally, the Value-Belief-Norm Theory highlights the interplay between values, beliefs, and norms in motivating environmental actions. Social Cognitive Theory emphasizes the role of observational learning and self-efficacy in fostering sustainable practices. Integrating these theories offers a comprehensive understanding of the psychological and social factors at play. Behavioural economics further enriches this understanding by examining how cognitive biases and heuristics influence environmental decision-making (Sarmin *et al*., 2024). Context-specific frameworks are essential, as they account for the unique socio-cultural and economic settings of farmers. A critical evaluation of these models reveals their strengths and limitations, guiding future research and interventions in promoting sustainable environmental behaviour among farmers.

Behaviour al theories offer a comprehensive framework for understanding the environmental practices of farmers. The Theory of Planned Behaviour (TPB) is instrumental in predicting eco-friendly actions by emphasizing the role of attitudes, subjective norms, and perceived behaviour al control. Social Cognitive Theory (SCT) provides insights into how observational learning and self-efficacy shape environmental behaviour . Norm Activation Theory (NAT) elucidates the triggers of pro-environmental behaviour through

personal norms. The Value-Belief-Norm (VBN) Theory integrates values and beliefs to explain sustainable practices. Habit Theory underscores the influence of routine on environmental actions. Integrating these theories into policy-making is crucial, although empirical evidence highlights the challenges of applying them across diverse populations (Ajzen, 1991).

Sociological theories provide a robust framework for understanding sustainable behaviour by emphasizing the role of social structures and norms. Social structures significantly influence sustainable practices by shaping the opportunities and constraints individuals encounter. Social norms and peer influences further impact behaviour, encouraging conformity to sustainable practices within communities. Theories of social capital highlight the importance of community engagement, while behaviour al change models shed light on the processes through which individuals adopt sustainable behaviour s. Social identity and group dynamics also play a crucial role, with education and awareness acting as catalysts. Case examples illustrate the practical application of these theories, though challenges and limitations remain (Longo *et al*., 2021).

Psychological models play a crucial role in understanding farmers' sustainable environmental behaviour by examining the interplay of individual attitudes, beliefs, and values. The Theory of Planned Behaviour (TPB) and the Norm Activation Model (NAM) are particularly relevant, as they highlight how personal values, social identity, and group norms influence sustainable practices. Cognitive dissonance and behaviour change are also significant, driven by both intrinsic and extrinsic motivations. Perceived behaviour al control and habit formation further underscore the importance of psychological factors. Case examples illustrate how these models are applied to promote sustainability among farmers (Ajzen, 2002).

This section presents some of literatures made on the Sustainable Environmental Behaviour in different parts of the world. Conclusions which could be extracted from these literatures are presented in the end of this section.

Sander *et al.* (2024) examined how behavioural factors such as attitudes, subjective norms, perceived behavioural control, and trust influence farmers' intentions to participate in agri-environmental schemes. The study synthesizes information from 26 qualitative studies and compares individual and collective scheme types using the expanded Theory of Planned Behaviour. The study contributes to understanding the behavioural factors that affect farmers' decision-making, which is particularly important for the push towards more environmentally ambitious schemes, including collective schemes. The study emphasizes several important insights for policy. First, to improve participation in agri-environmental schemes, policy makers can foster social capital by viewing farm businesses as part of a community context, rather than as single entities, specifically for collective but also individual schemes. Social learning is crucial to improve skills and knowledge, as well as re-evaluating perspectives and building trust within the community, showing the interconnections between social norms and relational trust. In collaborative settings there is a complex negotiation process between farmers on whether to collaborate and participate jointly. It is important to recognize that multiple and interconnected variables influence decision-making at every stage of the collaboration process. Collaboration is not a static decision, and it can evolve over time. Qualitative research can be useful for understanding the evolution of relationships and collaborations between farmers, allowing participants to share their stories and for researchers to comprehend them.

Second, this also holds for individual schemes, policymakers should prioritize shifting farmers' attitudes and building institutional trust. Studies indicate that farmers require trust in agri-environmental policy design to participate. Negative experiences with governing institutions and frequently changing legislation have resulted in a lack of trust in the government and the scheme itself. Thus, clear regulatory frameworks and guidelines must be established, along with transparent and accessible processes for participation, monitoring, evaluation, and feedback mechanisms.

Third, flexibility, such as introducing opt-out options, could increase scheme participation to strengthen farmers' perceived ability to participate in agri-environmental schemes. However, increasing flexibility can impair the effectiveness of improving the environmental state, representing an important trade-off. Moreover, when increasing flexibility policymakers should be mindful of potential increased complexity and transaction costs.

Finally, synthesizing qualitative information using the TPB framework can enhance integration of behavioural factors in policymaking. There is opportunity for qualitative studies to provide a finer understanding of the different factors of decision making. Policymakers can tailor their strategies to better align with the needs and expectations of farmers and stakeholders, ultimately enhancing the success of agri-environmental schemes and their impact on the environment.

Saad *et al.* (2024) investigate the farmers' awareness and attitude regarding climate change and its possible impacts on olive production in the top 5 olive producing

governorates in Egypt using the Likert quintuple scale on a random sample of 256 olive farmers by a specific questionnaire based on three Indicators, The first Indicator measures farmers knowledge and attitudes towards climate change which is measured by 10 Items, The second Indicator measures farmer's role to face anticipated climate change impacts on Olive production which is measured by 9 Items, The third Indicator measures Government role to combat the climate change effects on agricultural sector in general and on Olive production as a specific case which is measured by 7 Items. Results show that the indicator related to the role of the farmer to face the expected climate change is the first among the indicators of the scale at 82.16% followed by the indicator on the awareness of climate change and its potential impacts on the agricultural sector in general, including olives at 80.44%. The role of the government in combating the anticipated climate change impacts in the last place by 45.92%. As well as there is a clear difference between the third indicator and the other indicators at the level of the total sample in the study areas where the difference between the first indicator and the third indicator with 1.81 degrees, which means that the olive farmers in the study areas are highly aware of climate change and their important role to combat it but they are suffering from the weak role of the government to address the expected effects of climate change on olives or help farmers with a possible solutions for more future climate change adaptation.

Keykhosravi *et al.* (2023) aimed to analyze environmental performance with an emphasis on farmers' environmental behaviours. The study population consisted of all rural farmers of the two provinces (n = 27860), and 666 farmers were selected from 89 county centers through stratified sampling. Data gathering was done by questionnaire and its validity and reliability were supported by AVE, Cronbach's alpha and CR indices. The results indicated that the environmental behaviour of the farmers was not in a preferred state. Also, the intention had a direct and positive association with the environmental behaviour of the farmers. The construct's attitudes toward environment, self-efficacy, and the chance of observing social norms had the highest indirect effects, in ascending order, on the environmental behaviour. 53% of changes in environmental behaviour were attributed to the constructs covered in the study. Part of environmental damage is caused by the absence of farmers' behaviour that takes care of the environment that must be change through behaviour al intentions. Local and state policymakers can use the proposed environmental behaviour model to lead farmers to proper environmental behaviour.

Mohamed *et al*. (2023) examined 172 farmers in the village of Sayedna Ayoub, Banjar region. Data analysis highlights that nine independent variables that explain 60% of the variation are sustainable practices for farmers, they include: the size of land holding, the educational level of the respondent's family, the animal holding capacity, the standard of living of the respondent's family, ownership of agricultural machinery, sources of agricultural information, opinion leadership, cultural openness, and geographical openness, the factor analysis indicate the importance of eight elements for formulating the idea of agricultural sustainability whose structural concept proves the degree Acceptable statistic of viability and reliability, including: Farmer's environmental behaviour, Crop pattern, Integrated pest management, Farmer's awareness of sound irrigation, Agricultural innovativeness, Improving farm status and conditions, Level of farmer's utilization of farm by products, Knowledge and implementation of innovations in order to overcome climate change.

Badsar *et al*. (2023) agreed that the importance of farmer's behaviour in environmental concerns may be traced back to the effect and control which behaviour has over other variables. However, the lack of appropriate environmental cognitive behaviour al and socio-psychological models and poor understanding of factors influencing the environ mental behaviour of farmers, inhibit farmers from adopting pro-environmental behaviour s in agricultural activities. This study aimed to fill this gap by combining the theory of planned behaviour (TPB) and the protection motivation theory (PMT) to identify the key predicting factors of farmers' sustainable environmental behaviour (SEB) and their behaviour al intentions in various agricultural activities (such as agronomy, horticulture, live stock and natural resources). This research was a descriptive, causal and correlational study conducted through a cross-sectional survey of 300 farmers in Zanjan Province of Iran for which the structural equation modeling (SEM) technic has been utilized for analysis. The results indicated that the PMT variables, including self-efficacy, perceived vulnerability, and severity, response costs, and efficacy could significantly explain variability of farmers' intention toward sustainable environmental behaviour. Through adding the variables of TPB consisting attitude toward behaviour, subject norm and perceived behaviour al control increased the prediction variance of intention and behaviour of farmers. Thus, the integrated model provides a better understanding of SEB, especially via the behaviour al intention of farmers. The development of SEB in agricultural activities among farmers and their inten tion toward sustainable environmental behaviour requires a comprehensive, systematic, and

multidimensional approach such as the integrated model outlined in this study.

Coulibaly *et al*. (2021) developing a new type of agriculture known as sustainable agriculture. Therefore, the goal is to "meet the food and textile needs of society in the present without risking the ability of future generations to meet their own needs. According to research, farmers' decisions to effectively adopt sustainable agricultural practices are influenced by a variety of factors. This paper, firstly give an overview of sustainable agriculture practices. Then, review the various factors affecting the adoption of these practices, and finally, high light the gap found in the literature.

Despotović *et al.* (2021) contributed to the empirical measurement of farmers' environmental awareness and improve the understanding of the role of environmental awareness in farmers' adoption of cleaner agricultural practices. We provide a theoretical and methodological framework for measuring environmental awareness as a multi-dimensional concept. The data obtained from a survey of 382 farmers in northern Serbia are used as an empirical basis to test the developed latent environmental awareness construct. This construct includes several domains: environmental knowledge, biospheric concern, connectedness to nature, environmental attitudes, and environmental behaviour. The results show that environmental knowledge contributes the most to explaining the environmental awareness construct (factor loading = 0.83), whereas biospheric concern contributes the least (factor loading = 0.23). Regarding agricultural practices, environmental awareness is higher among farmers who use biological pest control (+23%), mulching (+17%), and green manure (+9%). Thus, our results uncover the role of farmers' environmental awareness in the adoption of more sustainable agricultural practices. These results document the operational validity of the construct and its potential use in research activities and management programs geared toward promoting environmentally friendly food production.

Yusliza *et al*. (2020) aimed to examine the role of environmental commitment, environmental consciousness, green lifestyle, and green self-efficacy in influencing pro-environmental behaviour. Data were obtained through a survey of 72 students at one of the training centers in Malaysia. The hypothesized relationships were tested using partial least squares (PLS) methodology. Results showed that environmental commitment, environmental consciousness, green lifestyle, and green self-efficacy positively influenced pro-environmental behaviour, thereby providing new insights to existing literature on environmental sustainability.

Serebrennikov *et al*. (2020) provided a thorough systemic review of contemporary literature exploring factors and conditions affecting EU farmers' adoption of sustainable farming practices. The specific focus is on widely adopted and empirically explored measures, such as organic farming, manure treatment technologies and manure fertilization, as well as soil and water conservation methods. In total, 23 peer-reviewed studies were extracted by means of Google Scholar covering the time period between 2003 and 2019. The main findings show that farmers' environmental and economic attitudes in addition to their sources of information have a strong effect on the adoption of organic farming, although there is a lack of evidence of their impact on adopting manure treatment and conservation measures. Similarly, farmers' age and education are found to systemically influence organic farming adoption, but not adoption of other reviewed technologies. While other factors, such as farm physical characteristics or technological attributes, may be important determinants of adoption, it is hard to recognize definite patterns of their impact across technologies given a shortage of empirical evidence. More research utilizing standardized surveys and methods of analysis is needed to formulate qualified guidelines and recommendations for policymakers.

Dessart *et al*. (2019) reviewd the findings from the last 20 years on the behavioural factors that influence farmers' decisions to adopt environmentally sustainable practices. It also proposes policy options to increase adoption, based on these behavioural factors and embedded in the EU Common Agricultural Policy. Behavioural factors are grouped into three clusters, from more distal to more proximal: (i) dispositional factors; (ii) social factors and (iii) cognitive factors. Overall, the review demonstrates that consid ering behavioural factors enriches economic analyses of farmer decision-making, and can lead to more realistic and effective agri-environmental policies.

Mills *et al*. (2017) aimed to provide insightsfrom 60 qualitative farmer interviews undertaken for aresearch project into farmers' willingness and ability toundertake environmental management, particularly focus-ing on social psychological insights. Furthermore, itexplores farmers' level of engagement with advice andsupport networks that foster a genuine interest, responsi-bility and a sense of personal and social norm to sustainhigh quality environmental outcomes. Two conceptualframeworks are presented for usefully exploring the com-plex set of inter-relationships that can influence farmers'willingness to undertake environmental managementpractices. The research findings show how an in-depthunderstanding of farmer's willingness and ability to adoptenvironmental management practices and their existinglevel of

engagement with advice and support are necessaryto develop appropriate engagement approaches to achievesustained and durable environmental management.

In sum, the following could be extracted and highlighted from the previously presented literature review:

1/All countries face environmental issues and catastrophes in rural regions due to unsustainable agricultural practices.

2/The environmental impact of agriculture is determined not only by economic variables and product features, but also by individual and professional farmer behaviours.

3/ Farmer behaviour has a significant impact on the environment due to its influence on other variables.

4/ Farmers' ability to adopt environmental behaviours in agricultural activities is hindered by a lack of relevant environmental cognitive behaviour al and socio-psychological models, as well as a lack of awareness of the elements that influence their behaviour.

5/ Understanding the behavioural factors that influence farmers' intentions to participate in agri-environmental schemes is crucial for delivering sustainability in agricultural landscapes.

6/ Investigation of factors influencing farmer's sustainable environmental behaviour will show a negative significant role in building a sustainable agricultural farming system.

The paper in hand, addresses some of the variables considered in previous studies in the composition of the study variables and the method of understanding farmer's sustainable environmental behaviour. This is made taking into consideration the nature of agriculture process and farming system in Egypt, in general, and particularly in the study area. So, this section presents the definition farmer's sustainable environmental behaviour and related concepts.

- Environmental behaviour refers to the actions individuals take in daily life to protect the environment (Zhong and Shi, 2020). It can be categorized into three levels: willingness to act, daily protection activities, and efforts to bring about public change. Factors influencing environmental behavior include motivation, context, and habitual behaviors (do Paço and Laurett, 2019).
- Environmental behaviour means this behavior involves adopting attitudes and behaviours aiming to minimize any adverse effects on natural environment (do Paço and Laurett, 2019).
- Sustainable behaviour means taking into account the need to preserve the planet for present and future generations, while taking into account economic, environmental and social development. Several challenges arise from changing the current world scenario in terms of sustainable development. One, as debated in this text, relates to understanding and attempting to change the behaviours of individuals, institutions and organizations on behalf of the planet. We correspondingly identified six factors able to influence environmental behaviours: motivational factors, habitual behaviours, contextual factors, demographic characteristics, internal factors and external factors (do Paço and Laurett, 2019).
- Most researchers agreed that sustainable environmental behaviour in general: those actions and mechanisms adopted by the person and organization every day in order to protect environment achieve its goals and protect the environment.
- In this study, Farmer's sustainable environmental behaviour means farmer's adoption for an agricultural system depends on sustainable agricultural practices save the agricultural resources and protects the environment and makes it more sustainable for the next generations.

As seen in the literature review section, a variety of models exist to assess the Farmer's sustainable environmental behaviour, with different types of data sets. The independent variables of the study include Age, Monthly spending, Household size, Education Level, Farm area, Farming experience. Detailed discussion of the model is presented later. Two sources of data are used in this study. Secondary data such as the mapping of the villages and all the needed information about the villages. This is provided by the Central Agency for Public Mobilization and Statistics and National Population Council and its related subbranches. In addition, primary data are collected through personal interviews with each set of interviewees (the farmers).

The Study Population and Sample

The study is conducted in the Beheira govrneroate which considered one of the largest rural agricultural governorates in Egypt and about 75% of population lived in rural areas. It has 15 administrative centers (CAMPS, 2017). Abou elmatameer district has chosen randomly to be the study district and a simple random sample has chosen from villages included in the district these villages are koum alqadah which has 1557 households and Alseddik Algadida village which include 1485 households (National Population Council, 2020). The study population consists of all farmers (heads of households) in two villages. While the size of

population was relatively small and homogeneous, about 10% of the study population was taken as a sample to study its characteristics. The total number of sample size was 10% of households in each villages, 149 household from Alseddik Algadida village which is increased to 155 to avoid missed data and 156 household from koum alqadah village which is increased to 160 to avoid missed data. The total number of sample size was 315 households. A spesific questionnaire has been prepared for the study and data collected by personal interview with households.

Variables Definitions and Measurements:

Dependent variable in the study is farmer's behaviour related to their sustainable agricultural practices. Farmer's sustainable environmental behaviour in this study means farmer's adoption for an agricultural system depends on sustainable agricultural practices save the agricultural resources and protect the environment and make it more sustainable for the next generations. Independent variables in the study are (Age, Monthly spending, Household size, Education Level, Farm area, Farming experience). The study tried to find the relationship between Farmer's sustainable environmental behaviour and other expected factors affected it through 20 statements directed to farmers through interview and questionnaire (Table 1).

ANALYSIS AND RESULTS

1- Descriptive Statistics of the Primary Data of the total Sample:

This section presents a summary result of the descriptive statistics of each of the study variables.

Personal Data:

In this study, most of the farmer's age are found to be from (40: 50) years old, equivalently 45.39% of the sample. The remaining were 30.17% of the sample found in (30:40) years old, and 24.44% in the category of (≥ 30) years old (Table 2 and Graph 1).

As shown in Graph (2)**,** about 16% of the sample represents farmers who possess average education degrees. On the other hand, 27% of the sample knows only how to read and write. The set of farmers who have university degrees are 31% of the total sample.

Table 1. statements specify factors influencing farmer's sustainable environmental behaviour

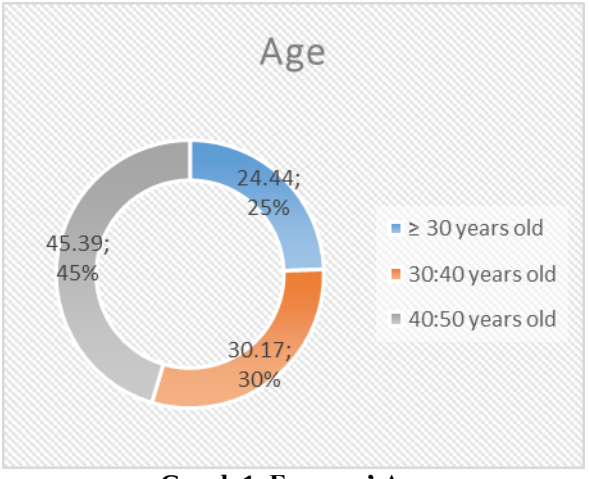
Statements	Answers	
	Agree	Disagree
1- I use animal waste as fertilizer.		
2- The agricultural activities and practices cause climate changes.		
3- I avoid disposing household's waste on the farm.		
4- I use husks, corn stalks as fuel.		
5- I committed to avoiding (disposal of dead birds, animals, sewage, and leftover chemical preparations into the irrigation canal.		
6- I use a smart agricultural methods to save the resources.		
7- I use pesticides in amounts with the specified rates.		
8- Always I add fertilizers in proportions with the specified rates.		
9- I think therer are enough laws to protect the environment in agricultural activities.		
10- I eager to save natural resources that I use in agricultural activities in my farm.		
11- I set on training courses to overcome climate changes.		
12- I believe that I am responsible for protecting the environment we are living in.		
13- I intend to produce healthy agricultural products.		
14- Iam confident that I could have good behaviour to environmental protection in agricultural activities.		
15- I can use drainage water for irrigation to overcome lack resources.		
16- I usually recycle pesticide's bags, containers, and cans.		
17- I don't burn Crop residue, dead birds, weed, garbage frequently.		
18- I feel social pressure for saving the environment.		
19- I am careful to use biological control instead of chemical to save the soil.		
20- Farmers should protect the environment to the next generation		

Source: Prepared by the researcher.

Table 2. Descriptive statistics of Personal characteristics for the study sample

Variables	frequency	%
Age		
≥ 30	77	24.44
30:40	95	30.17
40:50	143	45.39
Total	315	100
Education Level		
Illiterate	42	13.33
Read and write	86	27.30
Average Academic Degree	71	22.54
Above Average Educational Degree	49	15.56
High Educational Degree	67	21.27
Total	315	100
Household size		
Small (1:3)	10	3.17
Medium (3:5)	118	37.46
Large (> 5)	187	59.37
Total	315	100
Average Monthly Spending (L.E)	6000	
Farm area (Feddans)	0.5:12	
Average Farming experience (years)	17	

Source: calculated from the study data.

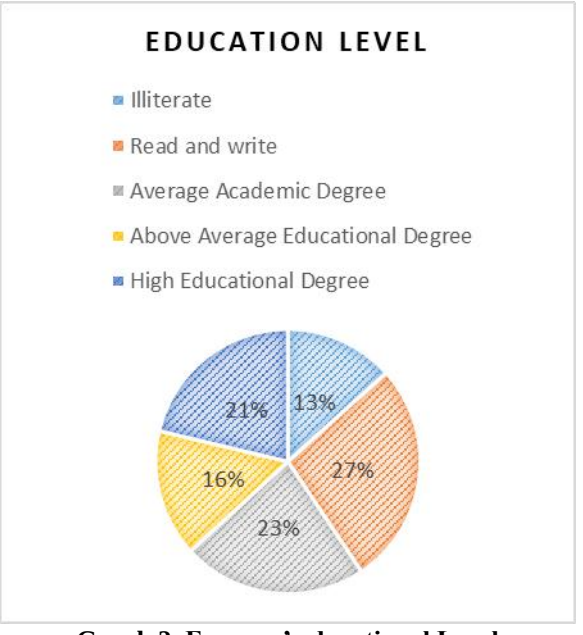


Graph 1. Farmers' Age

Source: calculated from the study data.

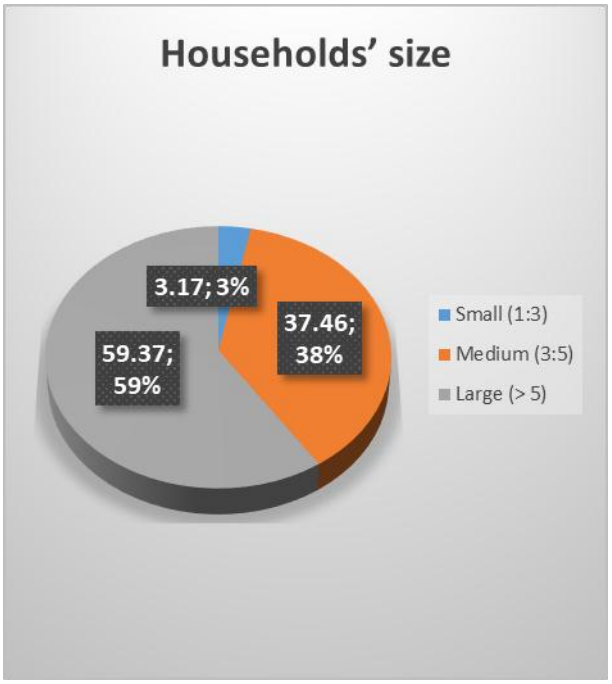
The household size in the sample varied between small which consists of (1:3) person with about 3% of households, medium which consists of (3:5) person with about 38 % of households, and large household which consists of more than (5) person with about 59% of households (Graph 3).

The average of monthly spending for all farmers in the sample was 6000 L.E. The farm area ranged between half a feddan, as a minimum, and 12 feddans, as a maximum. According to the number of years of experience in the sample varied between one year only and 55 years, with an average year of experience of 17 years (Table 2).



Graph 2. Farmers' educational Level

Source: calculated from the study data.



Graph 3. Households' Size

Source: calculated from the study data.

Factor Analysis was performed with 1.5 as the Eigen value to improve the strength of factors. Four factors were extracted when the rotation converged in their iterations.

The factors were (Farmer's good environmental behaviour, Farmer's practices to improve farming conditions, Farmer's implementation for innovative practices, Farmer's adaptation to climate changes) out of the questionnaire. The statements (1-5) were categorized as Farmer's good environmental behaviour, the statements (6-10) were categorized as Farmer's practices to improve farming conditions, the statements (11-15) were categorized as Farmer's implementation for innovative practices, and the statements (16-20) were categorized as Farmer's adaptation to climate changes (Table 3).

The analysis extracted four factors, each with Eigen values above one which explains 51.52% of the total variance while the original literature explains 58.23%. This indicates that there could be more factors influencing Farmer's sustainable environmental behaviour when more items are generated. KMO was 0.91 and MSA was 0.6 for all items which is indicating a good model.

2- Factor Analysis Results:

Table 3. Rotated Component Matrix

Items	Component	
	1	2
1- I use animal waste as fertilizer.	0.79	0.25
2- I usually recycle pesticide's bags, containers, and cans.	0.77	0.28
3- I don't burn Crop residue, dead birds, weed, garbage frequently.	0.76	0.37
4- I use husks, corn stalks as fuel.	0.75	0.08
5- I committed to avoiding (disposal of dead birds, animals, sewage, and leftover chemical preparations into the irrigation canal.	0.55	0.56
6- I avoid disposing household's waste on the farm.	0.69	0.22
7- I use pesticides in amounts with the specified rates.	0.67	0.36
8- Always I add fertilizers in proportions with the specified rates.	0.67	0.18
9- I think therer are enough laws to protect the environment in agricultural activities.	0.64	0.28
10- I eager to save natural resources that I use in agricultural activities in my farm.	0.19	0.75
11- I use a smart agricultural methods to save the resources.	0.43	0.36
12- I believe that I am responsible for protecting the environment we are living in.	0.45	0.68
13- I intend to produce healthy agricultural products.	0.48	0.51
14- Iam confident that I could have good behaviour to environmental protection in agricultural activities.	0.47	0.58
15- Farmers should protect the environment to the next generation.	0.56	-0.16
16- I can use drainage water for irrigation to overcome lack resources.	0.66	0.25
17- I set on training courses to overcome climate changes.	0.64	0.33
18- The agricultural activities and practices cause climate changes.	-0.09	0.68
19- I feel social pressure for saving the environment.	0.56	-0.16
20- I am careful to use biological control instead of chemical to save the soil.	0.11	0.47

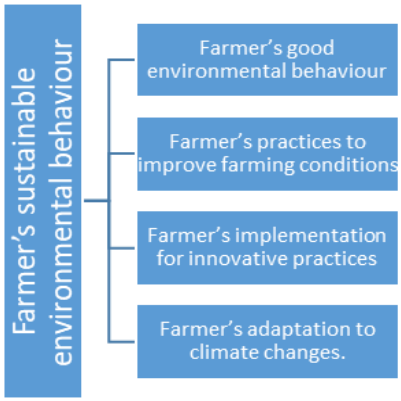
Source: calculated from the study data.

The results of the factor analysis showed the importance of the four factors that constitute farmer's sustainable environmental behaviour as all of them appeared in the factor analysis with statistically acceptable saturation levels. This indicates that these items should characterize the farmer in his behaviour towards his agricultural practices. Moreover, additional items should be included in future studies, as the percentage of cumulative variance of the four factors reached approximately 51%, meaning that about 49% should include other items.

In order to examine the relationship between farmer's sustainable environmental behaviour and independent variables correlation and regression analysis were employed. Table (4) shows the results of simple correlation coefficients between farmer's sustainable environmental behaviour and independent variables. The results show a significant correlation relationship between farmer's education level and household size in the significance level 0.01, and there are a significant correlation relationship between farm size and period of farming experience on the significance level 0.05.

To measure the reliability for the measurement, Cronbach alpha for the four factors of Farmer's sustainable environmental behaviour was done and the results as shown in Table (5).

A fitted regression model was extracted and explained 44.31% of the variance in the dependent variable on the significance level 0.05 (Table 6), which is mean that there is a significant relationship between farmer's sustainable environmental behaviour and the other four factors (Graph 4), but the relationship was moderate between the dependent variable and the other four factors.



Graph 4. Model showing the relationship between Farmer's sustainable environmental behaviour and other four factors

Table 4. Results of simple correlation coefficients between farmer's sustainable environmental behaviour and independent variables

Variables	Correlation coefficient Item
Age	-
Education Level	0.24**
Household size	0.26**
Average Monthly Spending (L.E)	-
Average Farm area (Feddans)	0.31*
Average Farming experience (years)	0.27*

* Significant on 0.05. ** Significant on 0.01.

Table 5. Cronbach alpha for the four factors of Farmer's sustainable environmental behaviour

Farmer's sustainable environmental behaviour	0.743
Farmer's good environmental behaviour (f1)	0.911
Farmer's practices to improve farming conditions (f2)	0.7.23
Farmer's implementation for innovative practices (f3)	0.606
Farmer's adaptation to climate changes (f4)	0.601

Table 6. Regression analysis results

R^2	F value	T value	β (f4)	β (f1)	β (f3)	β (f2)	VIF factor
44.31	100.62	105.46	0.51	0.57	0.33	0.41	1.00

* Significant on 0.05.

Table 7. Obstacles influencing farmer's adoption of sustainable environmental behaviour

Obstacles	Frequencies	%
1- Weak strategic planning and the integration of work between government agencies, farms, the private sector, and others.	209	66.35
2- High risk and the farmers' weak insurance against any losses beyond their control.	99	31.43
3- High fees on agricultural production inputs (seeds, fertilizers, pesticides, etc.).	308	97.78
4- The rising costs of essential infrastructure for farms, such as water, electricity, and transportation.	249	79.05
5- Reliance on traditional agricultural methods and the limitations of modern agricultural methods.	137	43.49
6- The limited water resources, the depletion of groundwater, and the fluctuation in rainfall amounts.	109	34.60
7- The fragmentation and reduction of agricultural land ownership, especially high-quality classified lands.	93	29.52
8- Climate change and the increase in arid areas are reducing agricultural production.	239	75.87
9- Weakness of agricultural marketing locally and globally.	191	60.63
10- Weakness of the regulations supports the agricultural sector.	256	81.27

3- Obstacles influencing farmer's adoption of sustainable environmental behaviour:

Aagricultural sector in Egypt, faces various and numerous challenges and problems, the most important of which as farmers in the study area review listed below.

As shown in Table (7) the most obstacles influencing farmer's adoption of sustainable environmental behaviour in the study area are high fees on agricultural production inputs like seeds, fertilizers, pesticides, etc., in the first followed by weakness of the regulations supports the agricultural sector while the rising costs of essential infrastructure for farms, such as water, electricity, and transportation as well as Climate change and the increase in arid areas are reducing agricultural production came in the third and fourth place, According to Weak strategic planning and the integration of work between government agencies, farms, the private sector, and others was in the fifth place followed by Weakness of agricultural marketing locally and globally, but the Reliance on traditional agricultural methods and the limitations of modern agricultural methods and The limited water resources, the depletion of groundwater, and the fluctuation in rainfall amounts was in the seventh and eighth place in order, followed by High risk and the farmers' weak insurance against any losses beyond their control and in the last place was the obstacle of The fragmentation and reduction of agricultural land ownership, especially high-quality classified lands.

CONCLUSION AND RECOMMENDATIONS

The agricultural sector is considered one of the most vital sectors and a cornerstone of economic development that governments should give significant importance. It is closely linked to the environment and its preservation. It is the main source of food security, which reflects social and economic security, and it is a source of income for a large percentage of the workforce. It also intersects with most other vital sectors, such as the industrial, tourism, and commercial sectors, among others. The sector has high economic importance as it contributes to solving the problem of poverty and unemployment, provides a significant area for women's work, in addition to ensuring necessary food and achieving self-sufficiency.

Sustainable environmental behavior for farmers includes a set of practices and techniques aimed at preserving the environment and reducing the negative impact of agriculture on the ecosystem. This includes the use of environmentally friendly agricultural methods such as organic farming, crop rotation, efficient irrigation techniques, and agricultural waste management. This behavior also focuses on reducing the use of harmful chemicals, improving soil quality, conserving water, and enhancing biodiversity. It is important for farmers to strive to adopt these practices to ensure the sustainability of agriculture for future generations.

This study tried to investigate sustainable farmer's environmental behaviour through the factors affecting by using Factor Analysis, Four factors were extracted when the rotation converged in their iterations. The

factors were (Farmer's good environmental behaviour, Farmer's practices to improve farming conditions, Farmer's implementation for innovative practices, Farmer's adaptation to climate changes) out of the questionnaire and interviews with farmers in the study area.

Also, the study stops on challenges and problems faced by farmers in their agricultural practices, the most important obstacles as farmers in the study area review are (Weak strategic planning and the integration of work between government agencies, farms, the private sector, and others, High risk and the farmers' weak insurance against any losses beyond their control, High fees on agricultural production inputs (seeds, fertilizers, pesticides, etc, The rising costs of essential infrastructure for farms, such as water, electricity, and transportation, Reliance on traditional agricultural methods and the limitations of modern agricultural methods, The limited water resources, the depletion of groundwater, and the fluctuation in rainfall amounts, The fragmentation and reduction of agricultural land ownership, especially high-quality classified lands, Climate change and the increase in arid areas are reducing agricultural production, Weakness of agricultural marketing locally and globally, Weakness of the regulations supports the agricultural sector.

The study suggests proposed solutions to these problems, many of them do not require financial support but rather administrative and technical solutions that rely on the responsible authorities in the sector to coordinate, organize, and share responsibility together. Among these solutions are (The necessity of integrated strategic planning with the relevant stakeholders in the sector, Providing financial and technical support to farmers to mitigate the significant risks they face and activating agricultural risk institutions or funds more effectively, Exemption of agricultural production inputs such as fertilizers, pesticides, seeds, and agricultural equipment from fees and taxes, Finding realistic solutions to reduce the costs of essential infrastructure for farms, such as electricity, by providing solar energy and water projects to support the agricultural sector, Working seriously on introducing modern technology to the farms to reduce costs and increase revenues, Training and qualifying farmers to shift towards planting varieties with low water requirements and using modern irrigation methods, Giving significant importance to the climate change file due to its impact on the agricultural sector and the change in crops in different regions, in addition to being prepared for any negative effects on the sector, Working hard and diligently to organize local production, avoid flooding the market with limited products, and support exports to foreign markets, Developing domestic agricultural products in line with global requirements to help address the issue of opening foreign markets to various agricultural products, Developing local agricultural legislation in line with global requirements to support local products).

Finally, the sustainable environmental behaviour one of the most important field which is still need more future studies in the study area and other areas in Egypt.

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الملخص العربي

العوامل المؤثرة على السلوك البيئى المستدام للمزارعين فى مصر

بسمة حسن سعد

تعزيز السلوك البيئي المستدام هو مسعى متعدد الأوجه يعتمد على فهم العوامل النفسية والاجتماعية والاقتصادية المختلفة. إن القيم والمعتقدات الشخصية تشكل الأساس لتشكيل عقليات واعية بيئيًا، مما يبرز ضرورة تنمية أخلاقيات بيئية منذ الصغر. تعزز المعايير الاجتماعية وتأثير جماعات الأقران وهذا من خلال خلق ثقافة الاستدامة التي تشجع على العمل الجماعي. فالحوافز والعوائق الاقتصادية تلعب دورًا كبيرًا، حيث يمكن للاستراتيجيات المالية المستهدفة أن تعزز أو تعيق الممارسات الخضراء. بالإضافة إلى ذلك، فإن الوصول إلى التعليم والمعلومات يمكّن الأفراد والمجتمعات من اتخاذ قرارات مستنيرة، مما يسهل عملية التحول نحو العيش المستدام. أيضًا، يواجه القطاع الزراعي في مصر تحديات كبيرة، وفهم هذه التحديات والعوامل التي تؤثر على سلوك المزارعين البيئي المستدام أمر بالغ الأهمية لتطوير سياسات واستراتيجيات فعالة لتعزيز الزراعة المستدامة في مصر. لمعالجة هذه العوامل المتنوعة، ودفع حركة موحدة نحو مستقبل أكثر استدامة، وإلهام الأفراد والمجتمعات للمشاركة الفعالة في الحفاظ على كوكبنا، حاولت هذه الدراسة تقديم صورة منظمة ومتكاملة ومحدثة لسلوك المزارعين المستدام في منطقة الدراسة من خلال تقديم فهم دقيق للعوامل المؤثرة على سلوك المزارعين المستدام، وتحديد أهم العقبات التي تؤثر على تبني المزارعين لسلوك الزراعة المستدام. ولقد أُجريت الدراسة في محافظة البحيرة التي تُعتبر واحدة من أكبر المحافظات الزراعية الريفية في مصر، حيث يعيش حوالي ٧٥% من السكان في المناطق الريفية. وتم إختيار مركز أبو المطامير ثم إختيار قريتي (كوم القدح، الصديق الجديدة) بطريقة عشوائية بسيطة للدراسة. وبلغ إجمالي حجم العينة ٣١٥ وحدة معيشية. وتم جمع البيانات من خلال لقاءات شخصية مع الوحدات المعيشية من خلال إستبيان بسيط مخصص لذلك. وتم إجراء التحليل العاملى لتحقيق أهداف الدراسة، وتم تطوير نموذج لهذه العوامل وأظهرت النتائج أن أربعة عوامل تم استخراجها من النموذج وكانت هذه العوامل كالآتى (سلوك المزارع الجيد تجاه البيئة، ممارسات المزارع لتحسين ظروف الزراعة، تنفيذ المزارع للممارسات الابتكارية، تكيف المزارع مع التغيرات المناخية). وأنتج التحليل أربعة عوامل كل منها بقيم Eigen فوق الواحد، مما يفسر ٦١,٥٢% من التباين الكلي بينما تفسر الدراسات السابقة ٦٨,٢٣ .% هذا يشير إلى أنه قد تكون هناك عوامل أكثر تؤثر على سلوك المزارع البيئي المستدام عندما يتم إنتاج المزيد من العناصر. كان KMO 0.91 ، MSA 0.6 لجميع العناصر مما يشير إلى نموذج جيد.

الكلمات المفتاحية: الاستدامة، السلوك البيئي، التنمية المستدامة، السلوك البيئي المستدام للمزارعين.