

RESEARCH

Artificial Intelligence, Environmental Awareness, and the Future of Sustainable Behaviour: A Sociological Study in Abu Dhabi

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ABSTRACT

PURPOSE: We aim to explore the role of artificial intelligence (AI)-based environmental technologies in enhancing environmental awareness and promoting sustainable behaviour among Abu Dhabi residents.

DESIGN/METHODOLOGY/APPROACH: We used a quantitative research design and developed a questionnaire to address the study's objectives.

FINDINGS: The results revealed a positive association between environmental awareness and sustainable behaviour.

ORIGINALITY/VALUE: Our study is among the few that have examined analytically the intersection of artificial intelligence and sustainable environmental behaviour in the Gulf context.

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PRACTICAL IMPLICATIONS: This study underscores the need to increase public awareness of AI technologies to educate citizens about how these technologies improve sustainable behaviour.

KEYWORDS: *AI-Based Environmental Technologies; Environmental Awareness; Sustainable Behaviour; Abu Dhabi; Digital Transformation; Smart Cities; Environmental Sociology.*

INTRODUCTION

The prevalence of financial fraud has drawn attention to income smoothing, which compromises the accuracy and reliability of firms' financial statements. Managers might manipulations with long-term horizons.

Recently, information technologies and AI have been increasingly implemented for environmental protection, addressing issues ranging from the enhancement of smart city infrastructure and the reduction of emissions to the minimisation of resource waste and the modernisation of energy systems (Bibri and Krogstie, 2020). AI applications and programmes are pivotal in increasing public awareness of environmental issues and sustainability (Thompson *et al.*, 2024). AI mitigates the disparity between environmental awareness and the consistent adoption of scientifically grounded sustainable practices by easing access to, interpretation of, and engagement with environmental information (Malhotra *et al.*, 2024).

Abu Dhabi is regarded as a regional leader in integrating AI into its sustainability and digital transformation agenda. Over the last decades, the Emirate has successfully initiated several environmental and smart initiatives through its government institutions, in harmony with Vision 2030 and the Abu Dhabi Digital Strategy 2025–2027 (Abu Dhabi Media, 2025). In October 2025, at GITEX 2025, the Department of Government Enablement (DGE) announced that the Abu Dhabi Government had attained advanced levels of AI adoption across all sectors (Sharfi, 2021). Its most prominent achievement to date is probably TAMM 4.0, one of the world's most advanced AI government service platforms. It facilitates fully integrated multilingual services in over fifteen languages for individuals and institutions, thereby streamlining administrative processes, alleviating the cost of living, and enhancing access to humanitarian and social services (Al Maazmi, 2025; Alsulaimani, 2025).

Our study is pivotal because it advances the epistemological dimension of environmental sociology by integrating one of the most critical contemporary issues in both academic and policy debates into the analysis of social problems and sustainable behaviour. This interface has not been adequately investigated within Middle Eastern societies. Our study substantiates empirically that AI technologies

can nurture sustainable environmental behaviour, thereby enriching theoretical understanding beyond Western paradigms. In practice, this contribution provides beneficial insights for Abu Dhabi and broader UAE policymakers, planners, and environmental institutions. The findings will help inform revisions to social policies on AI and environmental sustainability and further inform the design of smart initiatives that encourage sustainable behaviour, aligning with UAE Vision 2030 and the United Nations (UN) Sustainable Development Goals (SDGs).

With the unprecedented growth in digital transformation and increased adoption of AI in our daily lives, particularly in environmental sustainability, an increasing need to explore the potential of AI to impact and transform individuals' environmental behaviour is evident. Governments worldwide, including Abu Dhabi, have incorporated smart city initiatives and AI-driven technologies to promote environmental sustainability. Nonetheless, despite these technological advancements, findings regarding individuals' environmental practices remain inconclusive and often misaligned with the rapid pace of digital innovation.

Nevertheless, existing studies note that this relationship has not been empirically tested in the Abu Dhabi context and that the progress made in AI-based environmental technologies has not been clearly reflected in citizens' commitment to sustainable behaviours. Accordingly, the following research question guides this study: "What are the key challenges individuals in Abu Dhabi encounter when implementing sustainable environmental behaviours, and how can AI help?" Answering this question involves the following underpinning hypotheses.

H1: A statistically significant negative relationship exists between socioeconomic challenges (costs, infrastructure, and social norms) and individuals' commitment to sustainable environmental behaviour.

H2: A statistically significant relationship exists between low income or limited environmental awareness and reduced levels of commitment to sustainable environmental behaviour.

H3: The incorporation of AI-based environmental technologies increases individuals' engagement in sustainable actions by improving awareness and accessibility.

LITERATURE REVIEW

Various studies have addressed the relationship between AI and environmental sustainability. Wu *et al.* (2022) investigated the environmental impacts of AI by analysing the carbon footprint associated with algorithms and hardware systems. Their

study revealed the potential of AI to improve environmental data management but also demonstrated that increased AI usage is associated with higher energy consumption. Similarly, Van Wynsberghe (2021) discussed the theme of sustainable AI, given the need to deploy AI to minimise environmental costs while promoting ecological responsibility.

In ‘Deep Learning and Artificial Intelligence in Sustainability: A Review of the Sustainable Development Goals, Renewable Energy, and Environmental Health’, Fan *et al.* (2023) evaluated current AI applications in various industries to determine the contribution of this technology to achieving sustainability, accelerating the UN SDGs, and improving environmental health. They indicated that AI directly impacts more than 134 SDG targets concerning energy management improvement by boosting fault detection rates, ensuring grid stability, and improving waste management and disease prediction. However, the study also underscored further challenges regarding scalability, model transparency, and ethical considerations of privacy (Mohamad and Anuge, 2021; Mohamad *et al.*, 2026).

Specifically, environmental behaviour can involve costs ranging from low to high. As Rau *et al.* (2024) indicated, pro-environmental actions can be categorised into low-, moderate-, and high-cost categories. Individuals who wish to change their current behaviours require hierarchical interventions involving policymakers and institutional actors to address systemic barriers related to infrastructure or access to more sustainable options. Those who wish to behave in a more environmentally conscious manner are more open to decentralised approaches, which are usually more cost-effective and focus on education, awareness, and community involvement (Zubair *et al.*, 2024).

Although many studies have addressed the relationship between AI and environmental sustainability, in most cases the technological and ethical dimensions have been attributed to energy use, carbon footprint, and issues of operational efficiency (Wu *et al.*, 2022; Van Wynsberghe, 2021; Abdelwahed *et al.*, 2022; Gundeti *et al.*, 2024; Phuangsuwan, 2025). Nevertheless, fewer studies have explored the social and behavioural ramifications of AI, especially those associated with increasing awareness and the actual adoption of sustainable practices through AI-driven environmental initiatives.

RESEARCH METHODOLOGY

Research Design

We employed a pragmatic philosophy and a mixed methods approach to investigate emerging themes and examine them within a broader sample. We chose this approach because it would yield sufficient data and rich qualitative insights to enhance the overall value of the findings and reinforce understanding of the relationship between the key research variables, namely awareness and sustainable behaviour. The questionnaire served as the primary quantitative tool to detect general trends, while in-depth interviews complemented and further supported the quantitative findings.

Participants

This study was conducted in Abu Dhabi, United Arab Emirates, between July 2024 and January 2025. The required sample size was 360; however, a cluster sampling design was used to select 350 participants for the field survey. We divided the city into six main areas: Al Mushrif, the Tourist Club Area, Al Zahiyah, Al Bateen, Al Khalidiya, and Rabdan. From each area, we randomly sampled approximately 60 individuals. Additionally, in-depth interviews were conducted with 10 purposively selected Abu Dhabi residents. We sought informed consent from all respondents before data collection. Participants were then informed of the study's objectives and assured that their personal information would remain strictly confidential.

Table 1: Participants' Demographic Characteristics

Variable	Category	Frequency	Percentage
Gender	Male	113	32.5%
	Female	237	67.5%
Age	20–29	195	55.6%
	30–39	118	33.6%
	40–49	37	10.5%
Education Level	High School	165	47.0%
	Diploma	165	47.3%
	Bachelor's Degree	20	5.7%
Monthly Income (AED)	< 5,000	173	49.6%
	5,000–9,999	24	6.8%
	10,000–14,999	104	29.6%
	20,000 or more	49	14.0%

Variable	Category	Frequency	Percentage
Occupation	Government Employee	188	53.8%
	Private Sector	32	9.1%
	Unemployed	130	37.0%

Source: Data is measured by authors

Table 1 provides a demographic profile of the study sample, comprising 350 participants. The data reveal that female respondents comprised the majority of the sample (67.5%), while male participants accounted for 32.5%. The age group of 20–29 years had the largest share at 55.6%, followed by 33.6% for those aged between 30 and 39 years. Regarding educational attainment, 47.0% of participants had a secondary school certificate, equal to the proportion of those with a diploma, while only 5.7% held a bachelor's degree. As for monthly income, about half of the participants (49.6%) earned less than 5,000 AED; 29.6% earned between 10,000 and 14,999 AED. Employment data showed that 53.8% were employed in the government sector, 37.0% were unemployed, and 9.1% were employed in the private sector.

Tools

We developed a questionnaire to evaluate the relationship between environmental awareness and sustainable behaviour based on an extensive review of the related literature. After the first draft, the instrument was presented to a team of academic experts in environmental and social studies, who assessed its validity. A pilot study was then conducted with 13 participants to determine the reliability of the research instrument. After two weeks, the questionnaire was readministered to the same sample, and the results from Cronbach's alpha indicated a very high level of consistency, verifying the reliability of the research instrument (See Table 2).

Table 2: Reliability Coefficients of the Study Instrument

No.	Scale	No. of Items	Cronbach's Alpha
1	Environmental Awareness	5	0.86
2	Sustainable Environmental Behaviour	5	0.77
3	Social and Economic Challenges	3	0.74
4	Environmental Artificial Intelligence	5	0.85

Source: Data is measured by authors

Measure

Statistical analyses were performed using International Business Machines Corporation (IBM) Statistical Package for the Social Sciences (SPSS) (version 23). Various statistical analysis techniques were used to address the research questions and test the study's hypotheses. First, we used frequencies and percentages to describe the demographic characteristics of the participants (e.g., age, educational attainment, and income level) and determine the most prevalent economic and social problems experienced by the participants. Pearson's correlation coefficient was calculated to determine the strength and direction of relationships among variables of interest, including those between ecological awareness and sustainable behaviour and between socio-economic challenges and the degree to which individuals engage in sustainable behaviour.

To further explore these associations, we performed simple linear regression to analyse the effect of ecological awareness on engagement in sustainable behaviour. Moreover, we conducted multiple linear regression to examine the mediating role of demographic factors in the relationship. Finally, we performed the following inferential statistical tests: independent samples t-tests to test differences in means between two groups (for example, male and female participants), and one-way analysis of variance (ANOVA) to test differences across three or more categories of demographic variables (e.g., age or income categories).

RESULTS

Descriptive Results

First Research Question: What are the main difficulties people in Abu Dhabi encounter regarding the adoption of sustainable environmental behaviour?

Table 3 presents the descriptive statistics for the awareness-related items addressing the third research question on the level of environmental awareness. Moreover, Table 5 illustrates the perceived challenges that might impede the adoption of sustainable environmental behaviours among Abu Dhabi residents.

Table 3: Descriptive Statistics for Perceived Barriers to Adopting Sustainable Environmental Behaviours in Abu Dhabi

Item	N	Minimum	Maximum	Mean	Std. Deviation
High Cost as a Barrier to Sustainable Behaviour	351	1	5	3.3362	1.08012
Lack of Infrastructure as a Barrier to Sustainable Behaviour	351	1	5	2.9715	0.90981
Social Norms as a Barrier to Sustainable Behaviour	351	2	5	3.4188	0.87085

Source: Data is measured by authors

Table 3 presents the descriptive statistics for perceived barriers to adopting sustainable environmental behaviours in Abu Dhabi; the findings reveal that several barriers impair sustainable environmental practices. The strongest barrier is ‘Social norms as a barrier to sustainable behaviour’ with a mean of 3.4188 and a standard deviation of 1.08012, followed by ‘High costs as a barrier to sustainable behaviour’ with a mean of 3.3362 and a standard deviation of 1.09725. Finally, ‘Lack of infrastructure as a barrier to sustainable behaviour’ had the lowest mean of 2.9715 and a standard deviation of 1.04931.

The interview results regarding the barriers to the adoption of sustainable practices among Abu Dhabi residents demonstrated that most respondents emphasised that consumerism and a culture of ongoing buying, driven by high living standards, have become deeply rooted social practices. Conversely, some participants noted a lack of designated recycling collection points, which hampered their active participation in recycling.

Inferential Statistics Results

H1: A statistically significant negative relationship exists between socioeconomic challenges (cost, infrastructure, and social norms) and individuals’ commitment to sustainable environmental behaviour. Additionally, the analysis revealed statistically significant associations between the identified challenges and sustainable behaviour. Higher perceived costs, weak infrastructure, and restrictive social norms were all associated with lower levels of commitment, thereby confirming that socioeconomic barriers are pivotal to the adoption of environmentally sustainable behaviours.

Table 4 depicts the Pearson correlation coefficients for the relationships between socioeconomic challenges and environmentally sustainable behaviour. Statistically

significant correlations were found between these challenges and sustainable behaviour, with cost-related challenges having the highest correlation ($r = 0.371$, $p < 0.001$).

Table 4: Pearson Correlation Analysis between Social and Economic Challenges and Commitment to Sustainable Behaviour

Challenge	Correlation with Commitment	Sig. (2-tailed)	Significance Level
High Cost	$r = 0.371$	< 0.001	Significant at the 0.001 level
Weak Infrastructure	$r = 0.239$	< 0.001	Significant at the 0.001 level
Social Norms	$r = 0.445$	< 0.001	Significant at the 0.001 level

Source: Data is measured by authors

Therefore, individuals who view sustainability as costly are less committed to environmentally sustainable behaviour. Moreover, the findings reveal that infrastructure constraints are economically related challenges that are highly correlated with sustainable behaviour ($r = 0.239$, $p < 0.001$). Additionally, social norms were strongly correlated with sustainable behaviour ($r = 0.445$, $p < 0.001$), indicating that cultural customs and social expectations act as strong barriers to environmental commitment, especially for individuals strongly influenced by traditional norms.

H2: A statistically significant relationship exists between low income, limited environmental awareness, and reduced levels of commitment to sustainable environmental behaviour.

One-way analysis of variance (ANOVA) revealed significant differences among income levels ($F = 63.717$, $p < 0.001$). This finding suggests that individuals' responses to environmental behaviour and their concern for sustainability differed by income level. Hence, these findings support the hypothesis that individuals with lower income tend to show lower concern for and commitment to environmental sustainability than those with higher income.

Table 5: One-Way Analysis of Variance (ANOVA) Differences in Sustainable Behaviour Across Income Groups

ANOVA					
	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	1776.358	3	592.119	63.717	.000
Within Groups	3224.639	347	9.293		
Total	5000.997	350			

Source: Data is measured by authors

In ANOVA, F is called as F-Statistic or F-Ratio, df is a degree of freedom, r is Correlation Coefficient, p (p-value) represents the probability, and sig is significance label for p-value.

These results demonstrated that social and economic challenges reduce the adoption of sustainable environmental behaviour, especially among groups with low incomes or limited awareness. The perception of sustainable practices as too costly diminished commitment, whereas infrastructure posed an economic challenge ($r = 0.239, p < 0.001$); social norms were strongly correlated with sustainable behaviour ($r = 0.445, p < 0.001$). This finding was further supported by the one-way analysis of variance (ANOVA), which showed significant differences among income categories: $F = 63.717, p < 0.001$, indicating that low-income groups were less committed to sustainability than higher-income groups.

H3: The integration of AI-based environmental technologies increases individuals' awareness of and access to a range of sustainable actions. The hypothesis was tested by analysing the Pearson correlation coefficients among environmental awareness, commitment to sustainable behaviour, and AI-based environmental technologies.

Table 6: Pearson Correlation Matrix between Environmental Awareness, Commitment to Sustainable Behaviour, and Environmental AI

Correlations				
		Environmental Awareness	Commitment	AI_MEAN
Environmental Awareness	Pearson Correlation	1	.777**	-.027
	Sig. (2-tailed)		.000	.612
	N	351	351	351
Commitment	Pearson Correlation	.777**	1	.003
	Sig. (2-tailed)	.000		.960
	N	351	351	351
AI_MEAN	Pearson Correlation	-.027	.003	1
	Sig. (2-tailed)	.612	.960	
	N	351	351	351
**. Correlation is significant at the 0.01 level (2-tailed).				

Source: Data is measured by authors

Table 6 illustrates the significant positive association between environmental awareness and commitment to sustainable behaviour ($r = 0.777, p < 0.01$). Nevertheless, the correlation coefficients between AI-based environmental technologies and

environmental awareness and between AI-based environmental technologies and commitment to sustainable behaviour are weak ($p > 0.05$), indicating that AI-based environmental efforts do not translate into substantial sustainable behaviour.

DISCUSSION

After obtaining the initial results, we selected the key findings from the previous section to discuss prior studies and relevant theoretical perspectives. One of the most striking findings among Abu Dhabi residents regarding awareness was the generally high level of awareness, particularly regarding water conservation, the risks associated with plastic use, and the importance of reducing plastic consumption.

Residents encounter challenges in adopting sustainable environmental behaviour in Abu Dhabi because a culture of overconsumption is prevalent, driven by the country's high living standards. However, this circumstance leads to a large volume of waste, which requires considerable effort to manage, particularly in areas further from the city centre.

This finding aligns with the results of Rau *et al.* (2024) study on cost and sustainable environmental behaviour, which revealed a significant association between low-cost pro-environmental attitudes and the behaviours linked to them. Moreover, an increase in the financial or effort-related costs of sustainable practices decreased participants' engagement in environmentally responsible behaviour.

Our findings also contrast with Bermans *et al.* (2022), who argue that environmental awareness is not primarily learned but is deeply embedded in society's prevailing culture. Moreover, this corroborates the findings of Handayani *et al.* (2021), who argue that cognitive awareness is pivotal to the development of environmental behaviour.

Among the independent variables, age and monthly income demonstrated significant direct effects on sustainable behaviour, with $B = -0.498$ ($p = 0.004$) and $B = 0.899$ ($p < 0.001$), respectively. This finding means that the older a person is, the less they engage in sustainable behaviour, while such behaviours increase with higher income. Education was not a significant predictor ($B = -0.065$, $p = 0.605$). Additionally, path analysis indicated that environmental awareness, as a mediating variable, significantly predicted sustainable behaviour through age and education levels ($B = 0.669$, $p < 0.001$). The results collectively verify the study's hypothesis: demographic characteristics, especially age, educational attainment, and income, impact the relationship between environmental awareness and sustainable behaviour, with stronger associations among subjects with higher incomes and educational attainment.

Furthermore, the results indicated that the relationship between the use of AI-based environmental technologies, environmental awareness and sustainable behaviour was weak, underscoring the need to translate AI-driven environmental initiatives into concrete, quantifiable sustainable actions.

CONCLUSIONS

High costs are among the challenges that contribute to the decline in sustainable environmental behaviour. As identified in the previous section, costs are frequently barriers to the adoption of sustainable practices, especially when pro-environmental attitudes lack structural or economic support. This condition demands strong, targeted social policy interventions to mitigate cost-related obstacles to sustainable action. Therefore, this gap must be filled through coordinated efforts by policymakers and institutions and community actors by providing affordable alternatives and strengthening supportive infrastructure. This approach can enable people to translate awareness into consistent sustainable behaviour and consider how AI can be used to foster and support such behaviour in the near future.

Our study focused on testing and analysing the association between environmental awareness and sustainable behaviour among Abu Dhabi residents by explicitly examining demographic factors as independent variables, namely gender, income, and education, and the mediating role of environmental awareness between those variables and sustainable environmental behaviour. The results demonstrated a high level of environmental awareness among Abu Dhabi residents. Our study undeniably expands the existing literature and urges future researchers to deeper exploration in the context of Gulf societies. Moreover, it underscores the critical role that institutions in the public and private sectors, along with civil society organisations and grassroots efforts, play in incorporating sustainability and the conservation of a healthy environment into valued cultural norms. These contributions have strong implications for the UAE Vision 2030, many of which are aligned with the UN 2030 Agenda and its 17 SDGs.

Finally, we recommend formulating additional social policies and implementing socio-economic measures to promote environmental sustainability. Additionally, we suggest exploring alternative approaches and initiatives while increasing the involvement of various social actors from the private, public, and local communities. Through this approach, sustainability can form part of the prevailing culture and a feature of individual identity. Therefore, sustainable and practical solutions must be devised to address these challenges and reduce the gap between awareness and practice, thereby promoting the United Arab Emirates' Vision for Sustainable Development 2030.

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BIOGRAPHY



Dr Ganka Ivanova, CPsychol is a seasoned professional, residing in Abu Dhabi UAE since 2008 with experience in Higher Education, Research, Training, and psychometric assessment projects management, capability analysis and development, learning programmes quality control, licensing, and institutional effectiveness. She also had the privilege to support various UAE Government projects of MOD, MOI, MOE, ADEC, and Khalifa programme, and initiated international research projects, using psychometric assessment tools. Dr Ganka has taught over 5000 students through the years while involving them in CSR events, exhibitions, and other individual growth opportunities that support Government priorities and pillars of development. She is Chartered Psychologist, registered in BPS UK, FHEA and Full Member of the EAAP. Currently research interests are in the field of social psychology, sustainability and social impact, digital learning, AI and patients' wellbeing.



Dr Rakan Alhrahshah is an Associate Professor of Sociology at Al Ain university in the United Arab Emirates. He holds a PhD in Sociology and is highly knowledgeable in applied sociology and social research. His areas of teaching include applied sociology, environmental sociology, social statistics, and the social implications of technology and health. His areas of teaching include applied sociology, environmental sociology, social statistics and the social implications of technology and health. His studies use both qualitative and quantitative research methodologies and directed and co-authored several survey-based studies of environmental concern, sustainable behaviour, social capital, health status of the population, and the interplays between artificial intelligence and society in the Arab and Gulf contexts. His scholarly work has seen him publish in local and international peer-reviewed journals, and he is the Editor-in-Chief of the *Intercontinental Journal of Social Sciences (IJSS)*. Currently, his focus is on using data-driven and sociological methods to be informative of evidence-based social policy and sustainability projects throughout the UAE and in other locations.



Dr Mostafa Mohamad is a scholar and industry expert in Digital Transformation, AI for Business, FinTech, Digital Innovation, and Business Analytics. Before joining Zayed University, he had 20 years of academic experience at Manchester Business School, Newcastle Business School, Leeds Business School, and Salford Business School. He has a record of Q1 and Q2 Scopus-listed publications and published in top Information Systems (IS) journals such as *Technological Forecasting and Social Change*, and *Management Information Systems Journal*. He served as a director of PG programmes, a director of Admissions, and a deputy DBA director. He also led significant research funding for Virtual Reality, Machine Learning, Artificial Intelligence, FinTech and Technology transfer in the Energy, automotive, tourism and telecommunications sectors.