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The Impact of Using Clean Energy in Managing Climate Change in Iraq

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Abstract. This study aims to analyze the impact of using clean energy on climate change management, with a focus on Iraq as a developing country facing escalating environmental challenges. The research problem centers on questioning the effectiveness of clean energy in mitigating the effects of climate change, and Iraq's ability to integrate such energy sources within its national environmental and development policies. The study adopted a descriptive-analytical approach based on a review of relevant literature and the design of a structured questionnaire to measure the relationship between the variables under investigation. The study involved two main variables: clean energy utilization as the independent variable, and climate change management as the dependent variable. A comprehensive questionnaire was developed and distributed to a random sample of employees working in Iraqi ministries and institutions related to the energy and environmental sectors. The sample size was (224), and data were analyzed using descriptive and inferential statistical methods to test the study's hypotheses and assess the nature of the relationship between the variables. The results indicated that the use of clean energy significantly contributes to reducing carbon emissions and enhancing both environmental and economic sustainability. The findings also revealed that Iraq requires integrated policies to support the transition toward renewable energy, improve resource management efficiency, and develop infrastructure and relevant legislation. The study recommends providing institutional and technical support for this transition, encouraging investment in clean energy projects, and intensifying awareness campaigns targeting decision-makers and the public on the importance of clean energy as a tool for climate resilience and a sustainable future.

1. FUNDAMENTALS OF CLEAN ENERGY

Clean energy is a vital and sustainable solution for meeting global energy needs. It is derived from renewable sources such as solar, wind, hydropower, geothermal, and some forms of biomass. These sources are abundant, environmentally friendly, and do not deplete over time. Clean energy plays a crucial role in reducing greenhouse gas emissions, combating global warming, and improving air and water quality.

In addition to its environmental benefits, clean energy contributes to energy access and poverty reduction, as emphasized by the United Nations. It is useful in various sectors like agriculture, water desalination, heating, cooling, and electricity generation. According to the UNDP (2023), expanding clean energy and improving efficiency are key to achieving universal energy access.

Studies have shown that clean energy technologies—such as solar, wind, and geothermal—can provide carbon-free power. With the growing global focus on environmental costs, clean energy is now seen as more economically viable than fossil fuels, especially under carbon pricing systems like carbon taxes or emissions trading. For example, in 2023, global carbon pricing revenues exceeded $104 billion, highlighting the economic shift toward cleaner solutions.

Organizations like the OECD and World Bank stress that assigning a monetary value to carbon emissions makes clean energy projects more attractive. As more countries adopt clean energy agendas and technology advances, costs continue to fall, making clean energy not only a cleaner alternative but also a smarter economic choice for the future.

2. ENVIRONMENTAL SUSTAINABILITY OF CLEAN ENERGY

Clean energy is considered one of the fundamental pillars of achieving environmental sustainability, as it contributes to reducing harmful emissions, preserving natural resources, and enhancing ecological balance. Environmental sustainability of clean energy relies on the use of renewable sources such as solar, wind, hydropower, and biomass to meet present needs without compromising the ability of future generations to meet theirs (United Nations, 2023: website). These sources are characterized by a low carbon footprint compared to fossil fuels, which directly contributes to mitigating climate change effects and improving air quality and public health (IEA, 2022: website).

According to the International Energy Agency (IEA), the global shift to clean energy could account for up to 70% of the emissions reductions needed to achieve carbon neutrality by 2050. Furthermore, investment in renewable energy enhances energy security and generates new employment opportunities in innovative sectors, thus strengthening environmental, economic, and social sustainability dimensions (IRENA, 2023: website). However, advancing environmental sustainability requires a clear regulatory and legislative framework, adequate financing, and international cooperation to accelerate the transition to clean energy sources.

3. ENERGY SECURITY

Energy security is a crucial element in the stability and economic prosperity of nations. It refers to a state's ability to ensure the continuous availability of energy sources at affordable prices, without interruption, while reducing dependence on external

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sources and minimizing exposure to geopolitical crises or natural disasters (Cherp & Jewell, 2014: 415–421).

Energy security encompasses several dimensions, including supply security, market stability, infrastructure resilience, adaptability to disruptions, and environmental protection. In light of rising global energy demand, enhancing energy security increasingly depends on transitioning to more reliable and sustainable renewable energy sources. International experiences, particularly during crises such as the war in Ukraine or the COVID-19 pandemic, have shown that over-reliance on imported fossil fuels exposes nations to price fluctuations and supply disruptions (IEA, 2022: website). Therefore, the IEA recommends accelerating the shift toward clean energy sources like solar, wind, and hydropower as a foundation for long-term energy security. Additionally, diversifying energy sources and upgrading transmission and distribution infrastructure strengthens the energy system's flexibility and crisis response capacity.

4. ENERGY EQUITY

Energy equity refers to the fair and inclusive access to energy resources across all segments of society, regardless of income, gender, geographic location, or social background. It entails providing safe, reliable, and sustainable energy for all, thereby supporting improved quality of life, empowering marginalized communities, and reducing developmental disparities (Sovacool et al., 2021: 72).

Energy equity is an integral part of the Sustainable Development Goals (SDGs), particularly Goal 7, which focuses on ensuring access to affordable, reliable, sustainable, and modern energy for all (United Nations, 2023: website). Many countries face major challenges in achieving energy equity, as some rural areas or low-income populations suffer from limited access to electricity or clean energy, hindering economic, health, and educational development (Bazilian et al., 2019: 129). To promote energy equity, comprehensive policies must be adopted that guarantee financial and technical support for disadvantaged groups, while expanding renewable energy infrastructure and improving energy efficiency in homes and industries.

4.1. Fundamentals of Climate Change Management

4.1.1. Climate Change: Concept and Definition

According to the United Nations Framework Convention on Climate Change (UNFCCC), the term *climate change* refers to "a change in the climate that is attributed directly or indirectly to human activity that alters the composition of the global atmosphere, in addition to natural climate variability observed over comparable time periods" (Hassan, 2021:13).

Climate change involves variations in the average state or variability of the climate over extended periods—typically decades or more. It includes global warming, rising sea levels, altered precipitation patterns, and increased frequency of extreme weather events.

The Intergovernmental Panel on Climate Change (IPCC) defines climate change as a change in the state of the climate that can be identified by changes in the mean or variability, and that persists for an extended period, usually decades or longer. It includes any change over time, whether due to natural causes or human activities (IPCC, 2007:6). Similarly, it can be described as a disruption in the general climate pattern of Earth, affecting various systems differently depending on the region (Mohammed, 2016:243).

4.1.2. Evidence of Global Climate Change

Scientists and researchers have identified several scientific indicators of climate change, including:

1. Global Temperature Rise: Ground station and satellite data show a noticeable increase in global temperatures, with recent decades being among the warmest on record (Al-Saadi, 2015:374–377).
2. Melting Ice and Glaciers: Rapid melting is observed in polar regions and glaciers worldwide, impacting water levels in lakes and rivers (ipcc, 2021:123–125).
3. Sea Level Rise: Caused by melting ice and thermal expansion of seawater, sea levels have risen significantly in recent decades, threatening low-lying coastal and island areas (Jabbour, 2003:36–45).
4. Changes in Weather Patterns: Increases in the intensity and frequency of hurricanes, heatwaves, floods, and droughts have been observed, severely impacting ecosystems and human systems (IPCC, 2021:113–119).

4.1.3. Impacts of Global Climate Change

The impacts of climate change are broad and unprecedented. Key findings from the IPCC's "Summary for Policymakers" report (Naamah, 2023:2) include:

- More frequent and intense heatwaves.
- Increased disturbances in boreal forests, including drought and wildfires.
- More frequent and severe droughts, especially in the Mediterranean and southern Africa.
- Greater intensity of extreme rainfall events in many regions.
- Decreases in crop and livestock productivity and changes in plant species distribution.
- Disruptions to food chains, threats to livelihoods, and loss of biodiversity.
- Shifting agricultural zones and food production centers, altering global food power dynamics.
- Up to 12% increase in food prices in sub-Saharan Africa and heightened food insecurity risks.
- Increased mortality due to heat and changes in the spread of infectious disease vectors in certain regions.

4.1.4. Adaptation to Climate Change

Climate change adaptation includes strategies and actions designed to reduce negative impacts and seize potential opportunities. Adaptation can occur at individual, community, national, and international levels. Key strategies include (ICBA, 2016:1–8):

1. Sustainable Urban Planning: Enhancing urban design to resist floods and heatwaves, and creating green spaces to lower urban temperatures and improve air quality (Mohammed, 2023:1).
2. Water Management: Developing more efficient irrigation systems, building dams and reservoirs to manage water resources, and mitigating the impacts of drought and floods (ESCWA, 2017:12).
3. Public Health: Strengthening healthcare systems to address climate-related illnesses such as waterborne and heat-related diseases, and conducting awareness programs to educate communities on protecting themselves in extreme climate conditions (Jordanian Ministry of Environment, 2020:1).
4. International Cooperation: Enhancing collaboration among countries to share knowledge and technologies related to climate adaptation, and providing financial and technical support to developing countries to build their adaptive capacity (IPCC, 2014:151–171).

4.1.5. Climate Justice

The UN Special Rapporteur on the Right to Development, Surya Deva, presents an integrated framework for climate justice built on four interconnected pillars: mitigation**,** adaptation**,** remedy, and transformation—supported by twelve ethical and legal principles. The report emphasizes that loss and damage caused by climate change represent one of the greatest threats to the right to development, especially for vulnerable communities in developing countries.

The framework proposes incorporating loss and damage into the "remedy" pillar, highlighting a human rights-based approach to climate justice. It underscores principles such as intergenerational equity, non-harm, and full reparation, and stresses that climate responsibility lies not only with individuals but also with states, financial institutions, and multinational corporations**.**

The report identifies a “triple injustice” of climate change:

1. Those least responsible are the most affected.
2. These communities lack the resources to adapt.
3. The global green transition may impose new burdens on the poor.

Mitigation involves reducing emissions and halting fossil fuel expansion. Adaptation focuses on resilient infrastructure and community preparedness. Remedy calls for compensation, repair, and guarantees of non-repetition. Transformation entails a fair and sustainable restructuring of economic systems.

The twelve guiding principles include: intersectional justice, intergenerational justice, non-discrimination, meaningful participation, precaution, "polluter pays", differentiated responsibilities, just transition, transparency, and international solidarity.

Climate-related loss and damage weaken livelihoods, divert essential resources, increase debt burdens, and trigger forced migration.

To address this, the report proposes a "rainbow approach" involving compensation, restoration, rehabilitation, and guarantees. It calls on states, international financial institutions, and corporations to fulfill these duties not only as moral obligations but as legal responsibilities under international human rights law (UN General Assembly, A/79/168, 2024).

4.2. Research Objectives

This study aims to identify the environmental, economic, and social benefits of adopting clean energy sources such as solar, wind, and hydropower. It also seeks to provide practical recommendations to promote the use of clean energy in Iraq, contributing to climate change mitigation and the achievement of sustainable development. The main objectives of this research are:

1. To analyze the relationship between the use of clean energy sources and climate change management.
2. To identify the main challenges facing countries, particularly developing nations, in adopting effective clean energy policies.
3. To formulate evidence-based recommendations, informed by the analysis of selected country experiences, to support policymakers in developing clean energy strategies.

4.3. Research Problem

The world is currently witnessing a significant increase in the pace of climate change, manifested in rising temperatures, recurrent droughts and floods, and the growing frequency of natural disasters. These changes have intensified pressure on natural resources and threatened both environmental and economic security—particularly in developing countries. These phenomena are largely attributed to human reliance on conventional energy sources, which are the primary drivers of greenhouse gas emissions.

Despite technological advancements and rising global awareness of the need to transition to clean energy, many countries still face challenges in adopting effective policies for clean energy transformation, due to economic and institutional barriers. Moreover, the relationship between the use of clean energy and climate change management remains insufficiently analyzed and evaluated, especially regarding the actual impact of this transition on emission reduction, climate adaptation, and the achievement of sustainable development.

Accordingly, the research problem is embodied in the attempt to answer the following question: To what extent does the use of clean energy contribute to climate change management, and what are the key successes and challenges—particularly for developing countries—in this context**?**

Research Hypotheses

This study is based on the following main and sub-hypotheses:

1. First Hypothesis:
   There is a statistically significant correlation between the use of clean energy and climate change management, including the following sub-hypotheses:
   a. A significant correlation exists between energy security and climate change management.
   b. A significant correlation exists between energy equity and climate change management.
   c. A significant correlation exists between environmental sustainability and climate change management.
2. Second Hypothesis:

The use of clean energy has a statistically significant impact on climate change management, including the following sub-hypotheses:
a. Clean energy security significantly influences climate change management.
b. Energy equity significantly influences climate change management.
c. Environmental sustainability significantly influences climate change management.

4.4. Research Hypothetical Framework

The hypothetical framework of this research has been designed to illustrate both the correlational and causal relationships between the independent variable (clean energy use) and the dependent variable (climate change management), at the level of main variables and their sub-dimensions, as shown in Figure 1.

The triangle shape was chosen to represent the independent variable (clean energy use) to reflect a hierarchy of importance—where the apex of the triangle represents the most significant and impactful dimension on the dependent variable (climate change management), while the base represents the foundational aspects that support the other dimensions.

In contrast, the circle shape was selected for the dependent variable (climate change management) to symbolize the interconnectedness and integration among its dimensions. This indicates that no single dimension (e.g., economic, justice, or adaptation) has absolute priority over the others, as modern climate studies emphasize the holistic and overlapping nature of these elements.

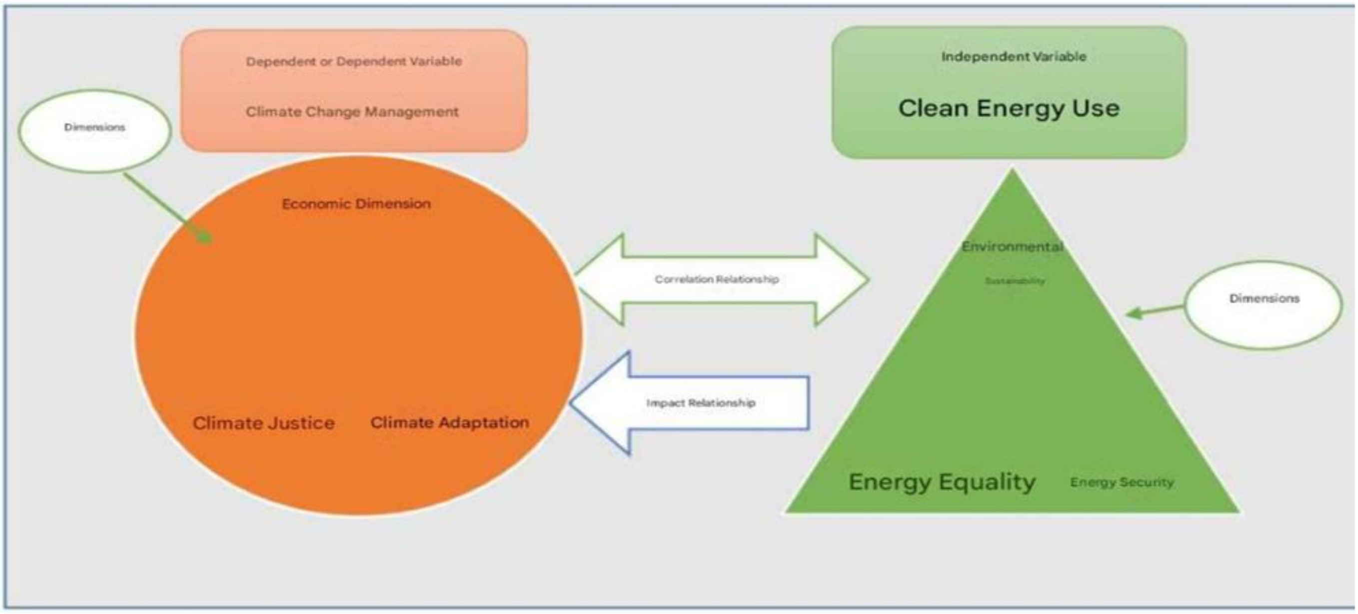

Figure 1: Hypothetical study diagram.

4.5. Statistical Analysis of the Variables: Clean Energy Use and Climate Change Management

The questionnaire items were developed based on the theoretical foundation established around the research topic, following a comprehensive review of relevant literature addressing both variables. The instrument was designed according to established scientific methodology to ensure precision in measurement and clarity of purpose. The questionnaire was then reviewed by a panel of 10 expert academic referees holding titles such as Professor and Assistant Professor. Their role was to assess the validity and relevance of the items in relation to the variables under study. The panel agreed unanimously (100% agreement) on the validity of the questionnaire items, with some constructive feedback and suggestions for improvement, which were incorporated into the final version.

4.6. Research Population and Sample

4.6.1. Research Population

The population consists of staff members from selected Iraqi governmental ministries involved in clean energy and climate change issues, namely:

- Ministry of Electricity
- Ministry of Environment
- Ministry of Science and Technology
- Central Bank of Iraq

4.6.2. Research Sample

The sample comprises employees from the above-mentioned ministries, as they represent the main institutions involved in clean energy and climate change in Iraq. The dimensions of the independent variable (clean energy use) were selected based on the classification by the World Energy Council, which identifies three primary dimensions: Energy Security, Energy Equity, and Environmental Sustainability.

For the dependent variable (climate change management), dimensions were adopted based on the Paris Agreement (2015), which emphasizes both mitigation and adaptation as essential goals, along with sustainable development and the creation of

green job opportunities. It also draws from SDG 13 (Climate Action), SDG 10 (Reduced Inequalities), and the IPCC Sixth Assessment Report (AR6), which integrates climate justice as a core element.
Based on these sources, three primary dimensions of climate change management were adopted:

- Sustainable Economic Development
- Adaptation to Climate Change
- Climate Justice

4.6.3. The Questionnaire

The questionnaire, as a key tool for data collection, was designed to test the hypotheses and answer the research questions. It consists of two sections:

1. Demographic Information — includes: gender, age, marital status, and educational level.
2. Research Variables — contains 31 items across six dimensions, divided as follows:

- Independent Variable: Clean Energy Use, which includes 3 dimensions:
    1. Energy Security – 6 items
    2. Energy Equity – 5 items
    3. Environmental Sustainability – 5 items
- Dependent Variable: Climate Change Management, which includes 3 dimensions:
    1. Economic Dimension – 6 items
    2. Adaptation Dimension – 5 items
    3. Climate Justice – 4 items

The data was processed using the SPSS statistical software package. Out of 224 questionnaires distributed, 210 were successfully retrieved and deemed usable. 14 questionnaires were excluded due to incomplete or invalid responses.

4.7. Validity and Reliability

To ensure the accuracy and dependability of the results derived from the questionnaire, it was essential to test the tool's validity and reliability**.**

4.7.1. Reliability (Internal Consistency)

Reliability refers to the consistency of the instrument in yielding similar results under similar conditions. Cronbach's Alpha was used to measure internal consistency, and the result was 0.887, indicating a high level of reliability**.**
The following table (Table 1) presents the results of the reliability test.

Table 1: Cronbach's Alpha Method for Measuring Reliability.

N of Items	Cronbach's Alpha
31	0.887

Source: Table prepared by the researcher based on statistical analysis data.

To ensure the reliability of the research instrument, Cronbach's Alpha coefficient was used, which is one of the most commonly employed methods for measuring the internal consistency among the items of a tool. The Cronbach's Alpha value reached 0.887, which is considered high and indicates that the instrument has a strong level of reliability. Acceptable alpha values generally start from 0.70 and above, and the closer the value is to 1.00, the stronger the reliability. Therefore, this result reflects that the 31 items of the instrument demonstrate good internal correlation, enhancing its credibility in collecting data and achieving the research objectives.

4.7.2. Validity Measurement (Construct Validity)

Validity, also known as construct validity, is used to confirm whether the tool accurately measures what it is intended to. To test the validity of the questionnaire, the Comparison of Extreme Groups method was adopted. This method involves calculating the total scores of the sample responses, arranging them in ascending order, and selecting the top 27% and bottom 27% of the scores. Then, a t-test is conducted to compare the means of the two groups, based on the following hypothesis:
H0: $\mu_1 = \mu_2$ VS H1: $\mu_1 > \mu_2$
This method is illustrated in Tables (2) and (3) as follows:

Table 2: Comparison of Extreme Groups Method.

	Groups	N	Mean	Std. Deviation	Std. Error Mean
Res.	1.00	28	5.0000	0.00000	0.00000
	2.00	28	4.4078	0.02189	0.00414

Source: Table prepared by the researcher based on statistical analysis data.

Table 3: T-Test for the Means of the Two Groups.

Mean Difference	Sig. (2-tailed)	df	t	Sig.	F	Total res.
0.59217	0.000	54	143.171	0.000	80.496	Equal variances assumed
0.59217	0.000	27.000	143.171			Equal variances not assumed

Source: Table prepared by the researcher based on statistical analysis data.

It is observed from the results that the difference between the two means is statistically significant and not due to random chance, as the p-value was found to be less than 1%. Accordingly, this indicates that the questionnaire is valid in measuring the intended constructs.

4.7.3. Mean Comparison Test

A test was conducted to compare the means of the questionnaire responses across the Ministries of Science and Technology, Electricity, Environment, and the Central Bank in order to determine whether statistical analysis should be carried out collectively or separately for each entity. This was assessed in light of the following hypothesis:

H_0: $\mu_1 = \mu_2 = \mu_3 = \mu_4$

VS

H_1: At least one group mean is different

The Kruskal-Wallis Test, a non-parametric statistical test, was applied at the item level. This test is used to compare three or more groups to determine whether there are statistically significant differences among their medians. The results are presented in the following Tables (4), (5), and (6).

Table 4: Kruskal-Wallis Test.

	x1	x2	x3	x4	x5	x6	x7	x8	x9	x10
Chi-Square	0.168	1.366	0.942	0.129	0.502	3.836	2.084	3.405	0.336	2.095
Df	2	2	2	2	2	2	2	2	2	2
Asymp. Sig.	0.919	0.505	0.624	0.937	0.778	0.147	0.353	0.182	0.845	0.351

Source: *Table prepared by the researcher based on statistical analysis data.*

Table 5: Kruskal-Wallis Test.

	x11	x12	x13	x14	x15	x16	x17	x18	x19	x20
Chi-Square	1.038	0.153	0.979	1.853	3.008	1.977	0.173	0.093	1.864	1.390
Df	2	2	2	2	2	2	2	2	2	2
Asymp. Sig.	0.595	0.926	0.613	0.396	0.222	0.372	0.917	0.955	0.394	0.499

Source: Table prepared by the researcher based on statistical analysis data.

Table 6: Kruskal-Wallis Test.

	x21	x22	x23	x24	x25	x26	x27	x28	x29	x30	x31
Chi-Square	2.988	1.666	1.332	0.051	0.966	0.404	0.091	0.250	0.308	0.437	0.743
Df	2	2	2	2	2	2	2	2	2	2	2
Asymp. Sig.	0.224	0.435	0.514	0.975	0.617	0.817	0.955	0.882	0.857	0.804	0.690

Source: Table prepared by the researcher based on statistical analysis data.

The Chi-square value refers to a statistical test used to analyze the relationship or differences between variables. The degrees of freedom indicate the number of independent values that can vary in a dataset without being affected by imposed constraints (such as total values or the number of categories). The asymptotic significance refers to the value used to determine whether the obtained result is statistically significant.

Based on the test results, it is generally observed that the null hypothesis (H_0) is accepted, as the significance level was greater than 0.05. This indicates that there are no statistically significant differences in the responses of the sample across the ministries and the Central Bank. Therefore, it is appropriate to merge the data and proceed with the analysis as a whole.

4.8. Descriptive Analysis of Responses

The responses to the questionnaire items are described by calculating the mean and standard deviation for each item representing the dimensions of both the independent and dependent variables, as presented in Table (20).

Table 7: Description of the Sample's Questionnaire Responses.

	N	Minimum	Maximum	Mean	Std. Deviation
x1	210	3.00	5.00	4.6476	0.53546
x2	210	1.00	5.00	4.4143	0.77939
x3	210	2.00	5.00	4.5000	0.66527
x4	210	1.00	5.00	4.4286	0.68276
x5	210	2.00	5.00	4.5095	0.66520
x6	210	3.00	5.00	4.5524	0.61061
x7	210	3.00	5.00	4.5714	0.54214
x8	210	2.00	5.00	4.5333	0.60408
x9	210	3.00	5.00	4.5571	0.52595
x10	210	2.00	5.00	4.5524	0.57008
x11	210	2.00	5.00	4.5667	0.69021
x12	210	1.00	5.00	4.5286	0.67181
x13	210	1.00	5.00	4.4286	0.68276
x14	210	1.00	5.00	4.3286	0.81941
x15	210	1.00	5.00	4.4143	0.87757
x16	210	2.00	5.00	4.4571	0.62681
x17	210	3.00	5.00	4.4762	0.63540
x18	210	3.00	5.00	4.5381	0.57954
x19	210	3.00	5.00	4.6524	0.58540
x20	210	3.00	5.00	4.4714	0.66465
x21	210	3.00	5.00	4.4524	0.67782
x22	210	2.00	5.00	4.4238	0.64623
x23	210	2.00	5.00	4.5143	0.54666
x24	210	2.00	5.00	4.4381	0.64776
x25	210	2.00	5.00	4.4524	0.64897
x26	210	2.00	5.00	4.5714	0.65413
x27	210	2.00	5.00	4.4571	0.70580
x28	210	3.00	5.00	4.5286	0.65741
x29	210	3.00	5.00	4.4619	0.71950
x30	210	3.00	5.00	4.4667	0.62739
x31	210	3.00	5.00	4.4476	0.64119
z1	210	3.33	5.00	4.5087	0.40570
z2	210	2.60	5.00	4.5562	0.39758
z3	210	2.80	5.00	4.4314	0.54110
z	210	3.19	5.00	4.4994	0.35413
y1	210	3.17	5.00	4.5024	0.40283
y2	210	2.40	5.00	4.4867	0.41354
y3	210	3.25	5.00	4.4762	0.47425
y	210	3.40	5.00	4.4902	0.33260
Valid N (listwise)	210				

Source: Table prepared by the researcher based on statistical analysis data.

The results of the descriptive analysis of the questionnaire responses, as presented in Table (20), indicate that the number of respondents was 210. The participants' answers ranged from a minimum of 1.00 to a maximum of 5.00, reflecting the use of a five-point Likert scale. The findings show that the mean scores of the questionnaire items ranged between 4.32 and 4.65, which are considered high values. This indicates strong positive tendencies among the participants toward the content of the items.

Furthermore, the standard deviations ranged between 0.33 and 0.87, which are low to moderate values, suggesting a relatively high consistency in responses and a limited degree of dispersion, thereby reflecting a general consensus among respondents regarding the research topic.

The following symbols are used to denote the variables:

- (z) represents the independent variable: *Clean Energy Usage*, and its dimensions are:
  - (z1) Energy Security
  - (z2) Energy Equity
  - (z3) Environmental Sustainability
- (y) represents the dependent variable: *Climate Change Management*, and its dimensions are:
  - (y1) Economic Dimension
  - (y2) Adaptation to Climate Change
  - (y3) Climate Justice

4.9. Correlation Between Variables

The following symbols are used to denote the research variables:

- (z) = Independent variable (*Clean Energy Usage*), with the sub-dimensions:
  - (z1) Energy Security
  - (z2) Energy Equity
  - (z3) Environmental Sustainability
- (y) = Dependent variable (*Climate Change Management*), with the sub-dimensions:
  - (y1) Economic Dimension
  - (y2) Adaptation to Climate Change
  - (y3) Climate Justice

4.10. Correlation

The correlation coefficients between the independent variable and its three sub-dimensions with the dependent variable were calculated. The results are shown in Table (8).

Table 8: Overall Relationships Between the Variables.

		z1	z2	z3	z	y1	y2	y3	y
z1	Pearson Correlation	1	0.436**	0.444**	0.795**	0.436**	0.269**	0.435**	0.488**
	Sig. (2-tailed)		0.000	0.000	0.000	0.000	0.000	0.000	0.000
	N	210	210	210	210	210	210	210	210
z2	Pearson Correlation	0.436**	1	0.449**	0.753**	0.385**	0.389**	0.196**	0.422**
	Sig. (2-tailed)	0.000		0.000	0.000	0.000	0.000	0.004	0.000
	N	210	210	210	210	210	210	210	210
z3	Pearson Correlation	0.444**	0.449**	1	0.826**	0.548**	0.363**	0.552**	0.626**
	Sig. (2-tailed)	0.000	0.000		0.000	0.000	0.000	0.000	0.000
	N	210	210	210	210	210	210	210	210
z	Pearson Correlation	0.795**	0.753**	0.826**	1	0.584**	0.425**	0.519**	0.657**
	Sig. (2-tailed)	0.000	0.000	0.000		0.000	0.000	0.000	0.000
	N	210	210	210	210	210	210	210	210
y1	Pearson Correlation	0.436**	0.385**	0.548**	0.584**	1	0.503**	0.401**	0.846**
	Sig. (2-tailed)	0.000	0.000	0.000	0.000		0.000	0.000	0.000
	N	210	210	210	210	210	210	210	210
y2	Pearson Correlation	0.269**	0.389**	0.363**	0.425**	0.503**	1	0.314**	0.778**
	Sig. (2-tailed)	0.000	0.000	0.000	0.000	0.000		0.000	0.000
	N	210	210	210	210	210	210	210	210
y3	Pearson Correlation	0.435**	0.196**	0.552**	0.519**	0.401**	0.314**	1	0.705**
	Sig. (2-tailed)	0.000	0.004	0.000	0.000	0.000	0.000		0.000
	N	210	210	210	210	210	210	210	210
y	Pearson Correlation	0.488**	0.422**	0.626**	0.657**	0.846**	0.778**	0.705**	1
	Sig. (2-tailed)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
	N	210	210	210	210	210	210	210	210

Note: **. Correlation is significant at the 0.01 level (2-tailed).
Source: Table prepared by the researcher based on statistical analysis data.

Table (8) shows the correlation values between the independent variable and its dimensions with the dependent variable and its dimensions. The correlation coefficient values range between (-1) and (+1), where the sign indicates the direction of the relationship (positive or negative), and the number indicates the strength of the relationship. The closer the value is to (+1), the stronger the positive correlation; conversely, values closer to (-1) indicate a strong negative correlation.

Based on this, it is observed that the relationships between the independent variable and the dependent variable are positive and statistically significant at the 1% significance level, as all correlation signs were positive and the P-values were less than 0.01. The same applies to the relationships between the dimensions of the independent and dependent variables.

Therefore, the first hypothesis is confirmed, which states:

“There is a statistically significant correlation between the use of clean energy and climate change management at the level of main variables and their sub-dimensions.”

1. Impact: The effect of the independent variable on the dependent variable was calculated, and the results are presented in the following tables.

Table 9: Adjusted R Square.

				Model Summary
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	0.657[a]	0.431	0.429	0.25139

Source: Table prepared by the researcher based on statistical analysis data.

As shown in Table (9), the value of the adjusted coefficient of determination (R^2 adjusted) was 0.429, which means that the independent variable explains approximately 43% of the variance in the dependent variable, while the remaining percentage is attributed to other variables that were not considered in this analysis.

Table 10: F(Test).

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	9.975	1	9.975	157.846	0.000[b]
	Residual	13.145	208	0.063		
	Total	23.120	209			

a. Dependent Variable: y
b. Predictors: (Constant), z

Source: Table prepared by the researcher based on statistical analysis data.

Table 11: T(Test).

Coefficients[a] Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	1.714	0.222		7.736	0.000
	z	0.617	0.049	0.657	12.564	0.000
a. Dependent Variable: y						

Source: Table prepared by the researcher based on statistical analysis data.

It is observed that there is a statistically significant effect of the independent variable on the dependent variable, as demonstrated by the following three key indicators:

- The adjusted coefficient of determination (R^2 adjusted) was 0.429, which means that the independent variable explains approximately 43% of the variance in the dependent variable. The remaining variance is due to other variables not accounted for in this analysis.
- The F-test showed statistical significance at the 0.01 level, indicating that the overall linear relationship is valid. This is confirmed by the P-value, which was less than 0.01.
- Regarding the importance of the independent variable within the model, the T-test confirmed its statistical significance at the 0.01 level. The regression coefficient (effect) was 0.617, which implies a positive influence of the independent variable on the dependent variable.

Thus, the regression equation can be written as:

$$Y = 1.714 + 0.617Z$$

Additionally, the impact of each dimension of the independent variable on the dependent variable was calculated, and all were found to be statistically significant, as detailed in the upcoming result tables. These results are analyzed based on the same three indicators discussed above for the overall relationship between the independent and dependent variables, as shown in Table (12).

Table 12: The Effect of the Indicators Measuring the Independent Variable on the Dependent Variable.

	Z1	Z2	Z3
Adjusted Coefficient of Determination	0.235	0.174	0.389
F-TEST	65.088	45.130	134.144
SIG. (OF F)	0.000	0.000	0.000
-TEST T	8.068	6.718	11.582
SIG. (OF T)	0.000	0.000	0.000
Regression Coefficient (Effect)	0.488	0.422	0.385

Source: Table prepared by the researcher based on statistical analysis data.

According to Table (12), it is observed that all dimensions of the independent variable have a statistically significant impact on the dependent variable. This is evident through the values of the three key indicators: the adjusted coefficient of determination (Adjusted R^2), the T-test, and the F-test, as analyzed in the previous tables for each of these indicators. The adjusted R^2 value for each dimension indicates the proportion of the variance in the dependent variable explained by that particular dimension. The linear relationship for all dimensions was found to be acceptable overall, as the P-value was less than (0.01) according to the F-test, which confirms statistical significance.

Regarding the importance of each dimension in the model, the T-test also indicated the significance of including each dimension, with a P-value less than (0.01). Furthermore, the regression coefficients (effects) for each of the dimensions of clean energy usage show a positive and direct (positive linear) impact on climate change management. Among the three dimensions, the environmental sustainability dimension (z3) had the strongest impact on the dependent variable, explaining approximately 38.9% (0.389) of the variance in the dependent variable, compared to the other two dimensions.

1. There is a statistically significant correlation between the independent variable (use of clean energy) and the dependent variable (climate change management). It is observed that all the relationships between the two variables are positive and statistically significant at the 1% level of significance, as all correlation coefficients were positive and the P-values were less than 0.01. This confirms the first main hypothesis and its sub-hypotheses, which state that: *"There is a statistically significant correlation between the use of clean energy and climate change management at the level of main variables and their sub-dimensions."*
2. There is a statistically significant impact of the independent variable (use of clean energy) on the dependent variable (climate change management). This is evident from the adjusted R-squared value of 0.429, meaning that the independent variable explains approximately 43% of the variance in the dependent variable. Furthermore, all sub-dimensions of the independent variable were found to have a significant effect, and none were excluded from the model. Therefore, the second main hypothesis is confirmed, which states:
3. *"There is a statistically significant effect of the use of clean energy on climate change management at the level of main variables and their sub-dimensions."*

5. RESULTS

Based on the above, the statistical analysis results indicated the following:

1. There is a statistically significant correlation between the independent variable (*use of clean energy*) and the dependent variable (*climate change management*). All correlations between the two variables were positive and statistically significant at the 1% level of significance, as indicated by the positive signs and P-values less than 0.01. This applies to the main variables as well as their sub-dimensions. Therefore, the first main hypothesis and its sub-hypotheses are confirmed:
   "There is a statistically significant correlation between the use of clean energy and climate change management at the level of main variables and sub-dimensions."

2. There is a statistically significant effect of the independent variable (*use of clean energy*) on the dependent variable (*climate change management*). This is evident from the Adjusted R-squared value of 0.429, which means that clean energy usage explains approximately 43% of the changes in climate change management. The rest is attributed to other variables not included in the study. Additionally, the effect of each sub-dimension of the independent variable on the dependent variable was also statistically significant. None of the dimensions were excluded. This confirms the second main hypothesis:
3. *"There is a statistically significant effect of the use of clean energy on climate change management at the level of main variables and sub-dimensions."*

5.1. Interpretation of the Results

Based on the findings obtained through statistical analysis, the results can be interpreted as follows:

1. The positive relationship between the use of clean energy and climate change management confirms that the expansion of clean energy sources (such as solar, wind, and hydropower) plays a significant role in mitigating the impacts of climate change. The statistical values indicate that this relationship is not random, but rather a meaningful and valid connection between adopting clean energy and improving the capacity to address climate challenges.
2. The relatively high adjusted R-squared value (0.429) suggests that clean energy use explains approximately 43% of the variations in climate change management performance. This underscores the strategic importance of investing in clean energy as a key tool for confronting the effects of global warming.
3. The regression coefficient value (0.617) shows a strong and positive effect of clean energy usage on climate change management, indicating that any increase in the implementation of clean energy policies leads to a noticeable improvement in managing climate change issues.
4. The validation of the study's main and sub-hypotheses confirms that the proposed model was appropriate and effective in explaining the relationship between the variables. The data supported the hypotheses concerning both the correlation and the causal impact between the independent and dependent variables.
5. It is also noteworthy that among the clean energy dimensions, "environmental sustainability" (z3) had the strongest influence on the dependent variable, explaining a significant portion of the variation. This implies that focusing on environmentally sustainable energy solutions not only yields ecological benefits but also contributes substantially to enhancing mitigation, adaptation, and climate justice measures.

In conclusion, the results provide strong evidence for the importance of integrating clean energy into climate change management strategies. The benefits extend beyond environmental gains, having clear economic and social impacts, especially for developing countries that face increasing pressures in dealing with climate-related risks.

6. CONCLUSION

This study concludes that adopting clean energy sources is a crucial factor in managing climate change and achieving sustainable development. The results revealed a statistically significant positive relationship between the use of clean energy and countries' ability to adapt to the impacts of climate change, confirming the importance of these sources as an effective tool for reducing harmful emissions and promoting climate justice. The study also showed that environmental sustainability is the most influential dimension within the clean energy usage factors, calling for focused policies to support the transition to a sustainable green economy.

Countries, especially developing ones, face multiple challenges in adopting clean energy policies, including economic and institutional barriers, requiring collaborative efforts at local and international levels to overcome these obstacles. Therefore, adopting comprehensive strategies that integrate mitigation, adaptation, compensation, and economic transformation based on the principles of climate justice is the optimal path to protect the environment and enhance community well-being.

In conclusion, this research recommends increasing investment in renewable energy sources, developing supportive legal and policy frameworks, and expanding international cooperation for knowledge exchange and funding to ensure a more sustainable and equitable future for all.

REFERENCES

Bazilian, M., Nussbaumer, P., Gielen, D., & Howells, M. (2019). Energy access and the SDGs: synergies and trade-offs. *Energy Policy, 129*, 400–405. https://doi.org/10.1016/j.enpol.2019.01.047

Cherp, A., & Jewell, J. (2014). The concept of energy security: beyond the four "As." *Energy Policy, 75*, 415–421. https://doi.org/10.1016/j.enpol.2014.09.005

المركز الدولي للزراعة الملحية (ICBA). (2016). *Climate change op2 final ar web* [PDF]. المركز الدولي للزراعة الملحية.

Economic and Social Commission for Western Asia (ESCWA). (2017). *Climate change statistics in the Arab region* [PDF]. Retrieved from https://www.unescwa.org/sites/default/files/pubs/pdf/climate-change-statistics-arab-region-2017-arabic.pdf

Enterpreneurship Journal for Finance and Business. (n.d.). Retrieved from https://nejfb.edu.iq/index.php/ejfb

Intergovernmental Panel on Climate Change (IPCC). (2021). *Climate change 2021: The physical science basis*. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change (pp. 123–125). Cambridge University Press. Retrieved from https://www.ipcc.ch/report/ar6/wg1/

International Energy Agency (IEA). (2022). *Energy security*. Retrieved from https://www.iea.org/topics/energy-security

International Energy Agency (IEA). (2022). *World Energy Outlook 2022*. Retrieved from https://www.iea.org/reports/world-energy-outlook-2022

International Renewable Energy Agency (IRENA), & Climate Policy Initiative (CPI). (2023). *Global landscape of renewable energy finance 2023*. International Renewable Energy Agency.

International Renewable Energy Agency. (2022). *Global Renewables Outlook 2022*. International Renewable Energy Agency.

Intergovernmental Panel on Climate Change (IPCC). (2014). *Climate change 2014: Impacts, adaptation, and vulnerability* (pp. 151–171). Cambridge University Press.

Intergovernmental Panel on Climate Change (IPCC). (2014). *Climate change 2014: Impacts, adaptation, and vulnerability* (pp.

237–241). Cambridge University Press. https://doi.org/10.1017/CBO9781107415379
Jabbour, E. (2003). *Climate disasters*. Damascus, Syria: Al-Rida Publishing and Distribution.
Jordan Ministry of Environment. (2020). *Guidelines for developing local action plans to address climate change*. Jordan Ministry of Environment. https://moenv.gov.jo/ebv4.0/root_storage/ar/eb_list_page/الدليل_الإرشادي_لتطوير_خطة_العمل_المحلية_لمواجهة_التغير_المناخي.pdf
Mohamed, A. S. (2023, November 27). Doha conference reviews the future and challenges of nuclear energy in the Arab world. *Al Jazeera Net – Economy*. https://www.aljazeera.net/ebusiness/2023/11/27/مؤتمر-بالدوحة-يستعرض-مستقبل-الطاقة-النووية
Na'mah, N. H. (2023). Climate change management: Challenges and confrontation. *Leadership Journal for Finance and Business, 4*(3).
Neama, N. H., & Abood, R. H. (2024). The role of women in Iraq in enhancing climate change mitigation: A vision and analysis. Department of Economics of Investment and Business Management, College of Business Economics, Al-Nahrain University, Baghdad, Iraq; Istanbul Okan Üniversitesi, Istanbul, Turkey.
Sovacool, B. K., Noel, L., Axsen, J., & Kempton, W. (2021). The clean energy revolution and the politics of equity. *Energy Research & Social Science, 72*, 101884. https://doi.org/10.1016/j.erss.2020.101884
United Nations. (2022). *Climate justice: Loss and damage: Summary of the report of the Special Rapporteur on the right to development, Surya Deva (A/79/168)*. United Nations General Assembly. https://undocs.org/en/A/79/168
United Nations. (2023). *Affordable and clean energy – Goal 7*. United Nations. https://sdgs.un.org/goals/goal7
United Nations. (2023). *Affordable and clean energy – Goal 7*. United Nations Sustainable Development Goals. https://sdgs.un.org/goals/goal7
United Nations. (2023). *Sustainable development goals report 2023* (pp. 34–40). United Nations. https://unstats.un.org/sdgs/report/2023/
International Renewable Energy Agency. (2022). *World energy transitions outlook*. https://www.irena.org/-/media/Files/IRENA/Agency/Publication/2022/Mar/IRENA_WETO_Summary_2022_AR.pdf