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Climate Change and Economic Growth in the Arab World

Dr. Ahmed Soliman Dr. Anwar Othman Dr. Mohamed Ismail

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Dr. Ahmed Soliman **Dr. Anwar Othman** **Dr. Mohamed Ismail**

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All correspondences should be addressed to:

Economic Department

Arab Monetary Fund

P.O. Box 2818

United Arab Emirates

Telephone No.: +9712-6171552

Fax No: +9712-6326454

Email: economic@amfad.org.ae

Website: www.amf.org.ae

Table of Contents

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Abstract

Global climate change poses a threat not only to human well-being and natural ecosystems but also to economies. The purpose of this research is to examine how climate change impacts economic growth in a selection of Arab countries. The study utilized annual panel data spanning from 2010 to 2019 for twelve countries, including Algeria, Bahrain, Comoros, Egypt, Iraq, Lebanon, Mauritania, Morocco, Oman, Saudi Arabia, Tunisia, and the United Arab Emirates. Various measures were used to assess climate change, such as changes in surface temperature, atmospheric carbon dioxide concentration, climate altering land cover index, and annual precipitation. The research employed the GMM model approach to explore the relationship between climate change and economic growth. The main findings of the study indicated that climate change has a detrimental effect on economic growth in the selected Arab countries. Consequently, addressing the adverse consequences of climate change on economic growth in the Arab region is crucial for ensuring sustainable development. As a result, this study strongly recommends the implementation of a comprehensive set of policies and strategies to mitigate the effects of climate change in the region.

1. Introduction

Climate change poses a significant obstacle to attaining global sustainable development. Its repercussions extend beyond human well-being and natural ecosystems, encompassing economic performance and overall quality of life. The economic consequences of climate change manifest in various forms, such as shifts in precipitation patterns and sea levels, impacts on crop yields, forests and ecosystems, reduced productivity of laborers facing higher temperatures, loss of biodiversity, and the destruction of property and infrastructure via events like fires and floods (Fabris, 2020). Anticipated adverse effects of climate change are particularly pronounced in climate-sensitive sectors like agriculture, forestry, fisheries, tourism, and in activities linked to natural resources, including water and energy supplies.

It's clear that the release of greenhouse gases has risen significantly, leading to heightened global warming over the past few decades. This has resulted in a global surface temperature increase of 1.1°C above the 1850-1900 baseline during the period of 2011-2020. These escalating emissions can be attributed to unsustainable practices in energy usage, land utilization, land-use changes, as well as prevailing lifestyles and consumption and production patterns. These issues transcend regions, countries, and individual behaviors. If greenhouse gas emissions persist, we can expect the global surface temperature to increase by 1.5°C in the near future, according to the most reliable estimate. Each incremental rise in global warming will exacerbate numerous simultaneous hazards (IPCC, 2023).

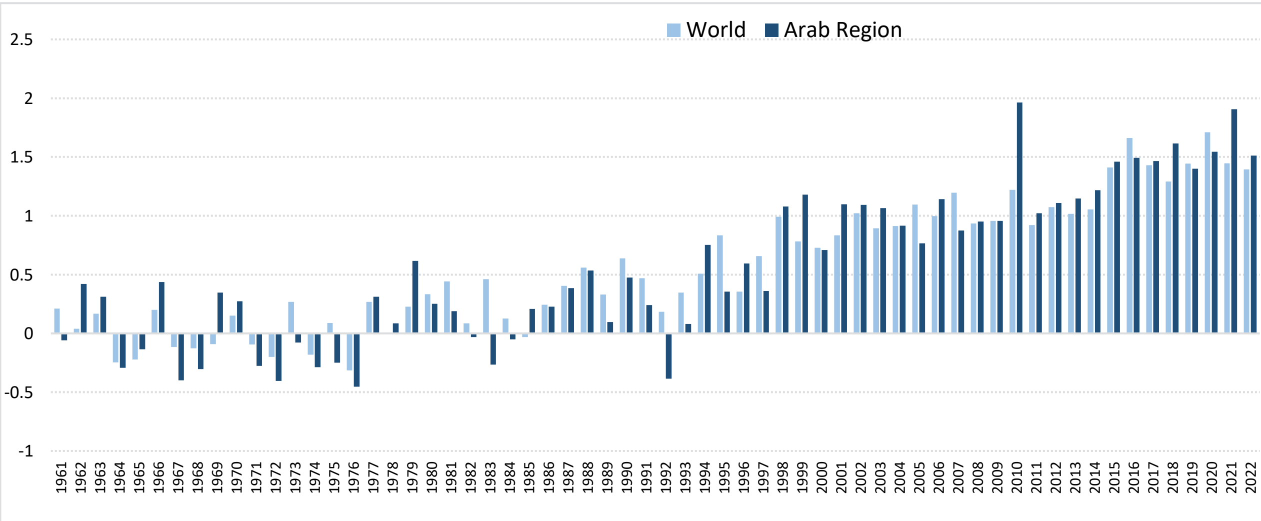
Even with minor temperature rises, climate change can lead to significant economic and social harm, intensifying poverty and disparities, particularly in developing nations with less resilience to climate-related shocks. In these regions, people with limited resources are more susceptible, residing in hotter areas where warming's effects are more pronounced compared to other countries. The consequences of climate change extend beyond these factors, as they are expected to result in substantial reductions in productivity, further increases in poverty and inequality over the long term, and various other consequences like ecosystem collapses, conflicts, and mass migrations (Bhattacharya et al, 2021).

Network for the Greening Financial System (NGFS) (2018) highlights the potential for climate change to exert significant effects on future economic growth. This could occur by shifting resources away from investments in current productive assets and innovative endeavors toward climate change adaptation. Climate change risks have the capacity to influence macroeconomic conditions from both the demand and supply perspectives. On the demand side, losses stemming from events like fires, floods, and storms could diminish household wealth and, subsequently, private consumption. Furthermore, damage to physical and financial assets could reduce business investments. On the supply side, physical climate changes may lead to a scarcity of locally or imported inputs, fluctuations in import prices, as well as harm to capital assets and infrastructure, including disruptions in transportation.

Furthermore, the adverse impacts of climate change have a detrimental effect on both the overall economic stability and fiscal health. This is primarily due to the damage to critical infrastructure and the rising demand for government subsidies to support the economy and social well-being. These factors, in turn, have repercussions on economic growth, public debt levels, the costs associated with debt financing, employment rates, inflation, and more. Additionally, these consequences lead to the escalation of prices for specific goods and services, including agricultural products, insurance, and water (Fabris, 2020). The Arab region stands out as one of the regions most heavily impacted by worldwide climate changes. The outcomes associated with climate change in this area are expected to be predominantly negative, primarily due to the already elevated temperatures that have been escalating more rapidly than the global average. Figure 1 illustrates how surface temperatures in the Arab region are rising at a pace exceeding the global average, exacerbating the difficulties confronting the agricultural sector, notably the issue of water scarcity. Furthermore, according to regional climate models using a high emission scenario, it is anticipated that the average yearly temperature may rise by nearly 5°C by the close of the current century. This change is expected to be accompanied by reduced rainfall, more frequent droughts, increased forest fires, and a higher likelihood of flash floods in specific regions (ESCWA, 2022).

There is an anticipation that by the year 2050, the Arab region may experience a reduction in water availability and agricultural productivity. This decline, which is connected to climate-related water scarcity, could result in economic losses equivalent to 14% of the region's GDP. Furthermore, approximately 45% of the total agricultural land in the area is vulnerable to issues such as salinity, soil nutrient depletion, and erosion caused by wind and water. Additionally, it is projected that climate change will lead to people's displacement due to drought and rising sea levels. About 9% of the population residing in coastal areas in the Arab region, particularly those living at altitudes not exceeding five meters above sea level, is at risk of such displacement (UNDP, 2023).

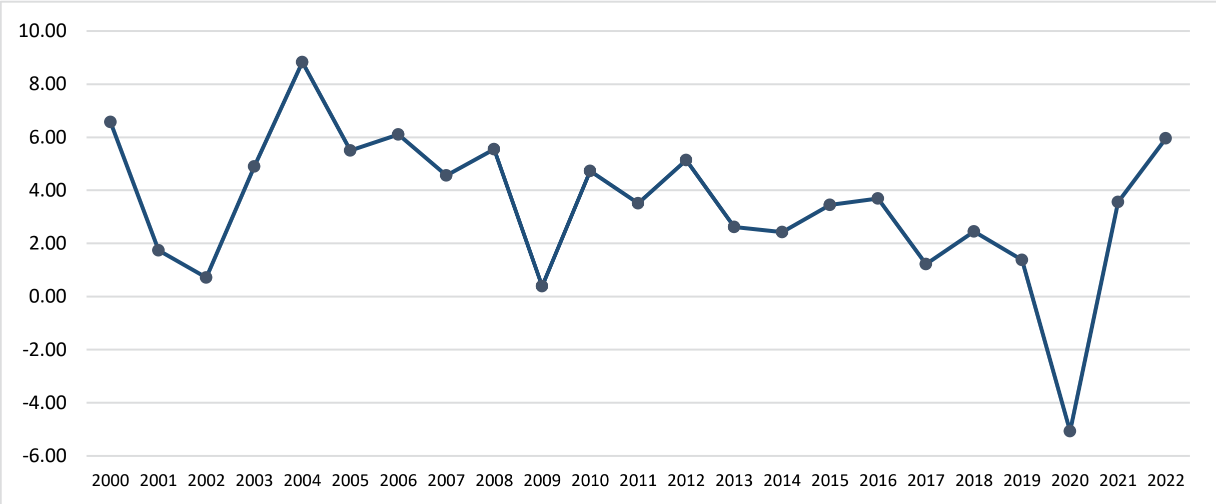
Figure 1: Mean surface temperature change during the period 1961-2022 in the Arab region.



Source: Climate Change Data | Climate Change Indicators Dashboard (imf.org).

On the other side, the real GDP of the Arab region has shown an average growth of 3.5% over the past two decades. In 2020, as a consequence of the COVID-19 pandemic, the region's economic growth sharply contracted by 5%, which was lower than the global average of -3.1%. However, in 2021 and 2022, the region quickly entered a recovery phase, achieving growth rates of approximately 3.6% and 6%, respectively (as illustrated in Figure 2). It's worth noting that this growth varies from one country to another, depending on their unique economic characteristics and structures. Despite the global economic challenges and the previous slowdown, the economic outlook for the Arab region remains positive for the years 2023 and 2024.

Figure 2: Annual GDP growth during the period 2000-2022 in the Arab region.



Source: World Bank Data: World Development Indicators.

In the Arab region, there has been a growing focus on the issue of climate change and its economic effects in recent times. This increased attention is exemplified by events like the MENA Regional Climate Week held in Dubai in March 2022, Egypt hosting COP27 in November 2022, and the United Arab Emirates preparing to host COP28 by the end of 2023. It is evident that further research is essential to better understand the diverse economic impacts of climate change in the region and to propose policies that can assist decision-makers in addressing these challenges. This study's primary objective is to investigate how climate change influences the economic growth of Arab countries and to offer policy recommendations to help these nations address climate change. The study is structured as follows: Section 2 contains a review of existing literature regarding the effects of climate change on economic growth; Section 3 outlines the methodology, encompassing data description, model specification, method of estimation and analysis; Section 4 delves into the empirical findings; and the concluding section summarizes the paper and presents key policy implications.

2. Literature review

In recent years, extensive research has been conducted regarding the connection between energy consumption and economic progress, as well as the link between economic expansion and environmental harm. For instance, Khan *et al*. (2019) explored the enduring consequences of climate change on economic activity across 174 nations by employing a panel dataset spanning from 1960 to 2014 and employing a stochastic growth model. The primary outcomes of the research indicated that persistent alterations in climate, characterized by deviations in temperature and precipitation from historical norms, have enduring adverse effects on per-capita real output growth. Furthermore, the study demonstrated that these negative long-term growth impacts are widespread, affecting all nations.

In 2017, Ogbuabor and Egwuchukwu conducted an analysis to explore how climate change affects Nigeria's overall economic growth. They used the ordinary least squares (OLS) method for their estimation, utilizing data spanning from 1981 to 2014. To assess climate change, they examined variations in annual rainfall, carbon emissions, and deforestation. The study also considered control variables such as changes in government expenditure, domestic sector investment, and currency rates. The results indicate that carbon emissions negatively impact both long-term and short-term economic growth. Additionally, the study found that the depletion of forests has an adverse effect on short-term economic growth.

Azam *et al.* (2016) conducted a study to investigate how environmental degradation, represented by per capita CO2 emissions, affects the economic growth of certain high CO2-emitting economies, namely China, the USA, India, and Japan. The research also took into account other contributing factors such as energy consumption, trade, and human capital. They analyzed annual data spanning from 1971 to 2013, and after verifying data properties through appropriate tests, they employed the panel fully modified ordinary least squares (FMOLS) method to estimate parameters. The results indicated a robust relationship among the variables, supported by the rejection of null hypotheses of non-cointegration, suggesting that all the variables under examination significantly influence economic growth in these countries.

Ejuvbekpokpo (2014) conducted a study where they assessed the impact of carbon emissions on Nigeria's economic growth by employing the ordinary least squares method of analysis. The study examined various variables over the period from 1980 to 2010, including gross domestic product and emissions originating from fossil fuels, gas fuels, liquid fuels, and solid fuels. The results revealed that carbon emissions have an adverse influence on Nigeria's economic expansion. The study recommended that measures should be taken to reduce greenhouse gas emissions, which requires collaborative efforts between the private sector, government, and oil multinational corporations with the aim of achieving a carbon emission-free country.

Ghosh et al. (2014) employed the cointegration test to examine the connection between energy consumption, CO2 emissions, and economic growth in Bangladesh. They utilized annual data for Gross Domestic Product (Y), Carbon Dioxide Emissions (CO), and Energy Consumption (EC) spanning the years 1972 to 2011. The results of their research confirm that Bangladesh can achieve economic growth without jeopardizing its environmental quality. To be more specific, the study found that energy consumption has a significant positive influence on economic growth, while carbon emissions have a relatively minor negative impact.

The study conducted by Sebri and Salha (2013) with the goal of investigating the relationship between economic growth and the use of renewable energy in the BRICS countries from 1971 to 2010. They used a multifaceted approach, employing the ARDL bounds testing methodology to explore cointegration and the vector error correction model (VECM) to analyze the long-lasting and causal connections among economic growth, renewable energy consumption, trade openness, and carbon dioxide emissions. The ARDL estimates offered empirical evidence that there are stable relationships between these variables over the long term. Additionally, the VECM findings showed bidirectional Granger causation between economic growth and renewable energy consumption. This finding supports the feedback hypothesis, which explains how renewable energy can stimulate economic growth in BRICS nations.

Borhan et. al. (2012) conducted a research study that explored the connection between carbon dioxide (CO2) emissions and economic growth in the Asean 8 region for the time span from 1965 to 2010. Their investigation involved the development of a three-equation simultaneous model to empirically analyze this relationship. The first equation was dedicated to measuring pollution, the second focused on income, and the third addressed population density. By employing a simultaneous approach, the study introduced an enhanced model to closely examine whether the data followed the Environmental Kuznets Curve (EKC) in Asean 8 countries. The main findings of the research revealed a simultaneous association between CO2 emissions and income, with CO2 emissions displaying a significant negative correlation with income.

Thurlow et al. (2009) conducted a study to investigate how variations in climate affect economic growth and poverty reduction in Zambia. To achieve this, they developed a comprehensive analytical framework that integrated multiple factors and variables. Initially, they used historical climate data and a hydro-crop model to assess how climate variability impacted crop yields over the period (1976-2007). The study focused on a crop-by-crop analysis for each of the five agroecological zones in Zambia. They further strengthened their analysis by identifying extreme weather events at the zonal level through a drought index analysis. Building on these findings, the researchers went on to create a CGE (computable general equilibrium) model to evaluate the consequences of climate-induced fluctuations in agricultural yields on both economic growth and poverty levels. Throughout their analysis, they considered not only the primary way in which yield losses occur but also various secondary pathways, including their impact on agricultural acreage, animal populations, and the devaluation of physical assets. The results of the study indicate that climate fluctuations have a significant negative effect on the rate of economic growth. The agricultural sector is particularly vulnerable to the impacts of climate variability, as it serves as the main conduit through which these effects manifest. The research reveals that climate variability leads to a reduction in the annual GDP growth rate of the agricultural sector by at least 1 percentage point. In the most severe rainfall scenarios, this reduction can be even more substantial, exceeding 2 percentage points.

Zhai et al. (2009) investigated the potential lasting impacts of climate change on trade and agricultural output within the People's Republic of China (PRC). Their research utilized a comprehensive, global computable general equilibrium model to simulate scenarios of global agricultural productivity changes resulting from climate change through the year 2080. The results suggest that the overall economic structure of the PRC may experience relatively minor effects from climate change, primarily due to the expected decrease in the agricultural sector's contribution to the GDP. It is expected that the subsectors involved in food processing will be the most adversely affected by climate-induced shifts in agricultural production. Conversely, increased demand from other regions around the world is projected to foster the expansion of certain agricultural sectors, such as wheat production.

While numerous prior research projects have delved into the global effects of climate change, there has been a notable absence of studies addressing this issue in the Arab region. Consequently, this study aims to concentrate on the repercussions of climate change in select Arab countries, offering valuable insights that could assist policymakers in mitigating its effects within the region.

3. Methodology

3.1 Data collection and time horizon

In this study, and due to data availability limitations for the Arab countries, yearly panel data covering the period of 2010 - 2019 was used to examine the impact of climate change on economic growth in the Arab selected countries. The reason behind not including the post-2019 period in the analysis is because it represents an outlier of economic growth due to the impact of COVID-19 which has led to a sharp decline in economic growth across the world. A total of twelve countries were studied, including Algeria, Bahrain, Comoros, Egypt, Iraq, Lebanon, Mauritania, Morocco, Oman, Saudi Arabia, Tunisia, and the United Arab Emirates. Over the study period, the countries were chosen based on the availability of data. The economic growth rate was represented as the dependent variable in the study.

As part of the study, data were gathered from multiple sources, specifically, climate change variables measurements include surface temperature change, global atmospheric carbon dioxide concentration, and climate altering land cover index were taken from the International Monetary Fund (IMF) database, while the data on the annual precipitation were collected from World Bank database. In addition, the data on economic growth rates and control variables measurements, including trade openness, gross fixed capital formation, general government final consumption expenditure, and labor force, were obtained from the World Bank database. It is worth noting that all variables included in the study are country specific variables, except for (CO_2) which is a global measure.

3.2 Model Specification

The model's study specifications aim to provide an assessment for the impact of climate change on the economic growth in the selected countries. The following equations represent them statistically:

$$EGR_{it} = \alpha_0 + \alpha EGR_{it-1} + \sum_k \beta_{0k} \, CCM_{kit-1} + \sum_j \beta_{1j} \, CV_{jit-1} + +\eta_i + \mu_{it} \quad (1)$$

Where: EGR represent the economic growth rate (EGR) across the selected countries. $Climate\ change\ measurments$ (CCM) refers to climate change measurements namely surface temperature change (STC), atmospheric carbon dioxide concentration (CO_2), climate altering land cover index (LC), annual precipitation (AP). Control variables including trade openness (TO), gross fixed capital formation (GFCF), general government final consumption expenditure (GGFE), and labor force (LF). The *i* refers *to* number of the cross-sectional units (countries-*1* ... *N)*, and *t* refers to time. while $\alpha_0$denotes to the constant and α , β_0 and β_1 indicate for the slop of the coefficients, η_i refers to an unobserved effect term specific to a particular country, and μ_{it} denotes for the error term.

3.3 Method of Estimation

In this investigation, a panel estimation technique known as the Generalized Methods of Moments (GMM) was employed. This method builds upon the original work presented by Holtz-Eakin et al. in 1988. Subsequent enhancements were made by Arellano and Bond in 1991, Arellano and Bover in 1995, and Blundell and Bond in 1998. The choice of this estimator over other options was motivated by the fact that it has the capability to rectify bias stemming from endogeneity issues that can arise due to explanatory variables. In particular, in this study, a system-GMM estimator was employed, which is based on the utilization of first-difference transformations in equations (1) above. This transformation serves to eliminate the influences specific to each country. The equations that depict the system-GMM estimators are as follows:

$$\begin{aligned} EGR_{it} - EGR_{it-1} &= \alpha(EGR_{it-1} - EGR_{it-2}) + \sum_k \beta_{0k} \, (CCM_{kit-1} - (CCM_{kit-2}) \\ &+ \sum_j \beta_{1j} \, (CV_{jit-1} - CV_{jit-1}) + (\mu_{it} - \mu_{it-1}) \quad (2) \end{aligned}$$

The overall reliability of a GMM estimator hinges on the soundness of both the error terms and the instruments employed. To address concerns about the estimator's reliability, Arellano and Bond propose two tests for determining the appropriateness of its specifications. Firstly, they perform the Hansen test, which evaluates whether there's an excessive identification of restrictions, assuming that the instruments are valid. Following the guideline set forth by Roodman (2009), we adhered to the principle that the number of instruments should not surpass the number of country groups in our case. In the second test, Arellano and Bond (1991) investigate the notion that there is no second-order sequential correlation within the altered error term. When both tests fail to reject the null hypothesis at a significance level of 5 percent, it indicates that the models are adequately formulated, along with the instruments chosen.

4. Findings and Analysis

Table (1) provides summary statistics that give insights into the central tendency (mean), variability (standard deviation), and range (minimum and maximum) of the variables' values under study. In particular, the economic growth rate for the selected Arab countries was approximately 3.4 percent over the period of the study with minimum and maximum value of -6.9 and 13.9 percent respectively, and the standard deviation was 2.7.

The mean of carbon dioxide (CO_2) concentration was 400.4 (Parts Per Million) across the recorded observations with minimum and maximum values of 390.1 and 411.7 (Parts Per Million) respectively. An increasing level of CO_2 globally is a significant indicator of climate change; higher levels of CO_2 in the atmosphere intensify the greenhouse effect. This results in more heat being trapped near the Earth's surface, leading to a rise in global temperatures. In addition, the mean of climate change measurement namely surface temperature change was 1.4 with minimum and maximum value of 0.5 and 2.7 respectively. This is an indication that global temperature is increasing, leading to warmer average temperatures across the planet. This can result in more frequent and intense heatwaves.

Furthermore, the mean of climate altering land cover index in the selected Arab countries was 99.7, with minimum and maximum value of 75.9 and 111.8 respectively across the countries. In addition, the mean of annual precipitation (mm per year) was 340.6 with minimum and maximum value of 10.9 and 2761.3 respectively. Regions with high annual precipitation typically experience wetter and more humid conditions, while regions with low annual precipitation are often characterized by arid or semi-arid climates.

Table 1: Descriptive Statistics for the Examined Variables

Variable	Mean	Std. Dev.	Min	Max	Obs
EGR	3.4	2.7	-6.9	13.9	119
STC	1.4	0.5	0.5	2.7	119
CO2	400.4	7.0	390.1	411.7	119
LC	99.7	5.1	75.9	111.8	119
AP	340.6	608.7	10.9	2761.3	119
TO	85.0	39.8	31.0	189.1	119
GFCF	3.05E+11	1.01E+12	90501015	5.636E+12	119
GGFE	3.19E+10	4.51E+10	89965331	1.998E+11	119
LF	7728200	8172376	164449	30927659	119

Table 2 displays the correlation matrix among the independent variables in the study. The results suggest that there is a generally satisfactory level of correlation among these variables, which confirms the absence of multicollinearity issue between the independent variables.

Table 2: Correlation Matrix Analysis for Independent Variables in the Study

	ST	CO2	LC	AP	TO	GFCF	GGFE	LF
STC	1							
CO2	0.063	1						
LC	0.251	0.412	1					
AP	-0.352	0.007	0.033	1				
TO	0.131	-0.020	0.037	-0.373	1			
GFCF	0.105	0.027	-0.006	-0.079	-0.124	1		
GGFE	0.079	0.054	-0.058	-0.263	-0.095	0.086	1	
LF	0.024	0.043	0.004	-0.332	-0.423	0.073	0.407	1

To assess the potential issue of multicollinearity, an additional test called the Variance Inflationary Vector (VIF) was conducted. The results, as presented in Table 3, reveal that there is no evidence of multicollinearity among the independent variables, as all VIF values fall below the predefined threshold of 5.

Table (3): VIF test result

Variable	VIF	1/VIF
AP	2.10	0.476129
LF	2.08	0.479864
TO	2.00	0.500293
LC	1.34	0.748170
STC	1.28	0.778303
GGFE	1.24	0.804094
CO2	1.22	0.820342
GFCF	1.05	0.952633
Mean VIF	1.54	

Table 4 presents the practical outcomes derived from a system-GMM estimator employed to investigate the influence of climate change effects on the economic growth rate within the Arab region. Generally, climate change measurement indices exhibit an adverse impact on the economic growth rate in the Arab region. However, the impacts of surface temperature change and annual precipitation have the expected sign but are not statistically significant.

In particular, high levels of global CO_2 emissions, often associated with industrialization and fossil fuel consumption, can lead to environmental problems such as air pollution and climate change. These environmental issues can have adverse effects on ecosystems and agriculture, potentially hampering economic growth. This result aligns with the research conducted by Azam, Khan, Abdullah, and Qureshi (2016), which explored the impact of environmental degradation, represented by CO_2 emissions per capita, on the economic growth of four prominent economies: China, the USA, India, and Japan. Their results suggest that, overall, CO_2 emissions are associated with a significantly negative effect on economic growth. Nevertheless, when examining each country individually, their study reveals that CO_2 emissions exhibit a noteworthy positive association with economic growth in China, Japan, and the USA, while displaying a substantial negative association in the case of India. The findings demonstrate that changes in climate altering land cover index intend to negatively affect economic growth. Changes in land cover alter the flow of greenhouse gases between the land and the atmosphere and increase the concentration of small particles in the atmosphere.

In addition, table 4 shows negative effect of surface temperature changes (STC) on the economic growth rates of the chosen Arab countries. This is indicative of the broad environmental repercussions of increased surface temperatures, which encompass severe weather events and rising sea levels, with the potential to impact sectors such as agriculture, tourism, and insurance, ultimately affecting economic growth. Nonetheless, the insignificant impact can be attributed to the fact that most of the countries included in this study are characterized by semi-arid to arid climate conditions with generally dry and hot summers and mild winters.

In the same vein, the study's results indicate that annual precipitation (AP) exerts a positive yet insignificant impact on economic growth in the Arab region. This observation may be attributed to the fact that the majority of the countries included in the study sample have economies that are not heavily reliant on the agricultural sector, such as the countries in the GCC region. Therefore, the decline in annual precipitation levels does not appear to significantly affect their economic growth in the model of the study.

Table (4): A system -GMM estimator results

	Coef.	Std. Err.	z	P>z	[95% Conf. Interval]	
EGR L1.	-0.34955***	0.043677	-8.00	0.000	-0.43515	-0.26394
STC	-0.17351	0.190632	-0.91	0.363	-0.54714	0.200123
CO2	-0.12551**	0.054779	-2.29	0.022	-0.23287	-0.01814
LC	-0.04755*	0.027676	-1.72	0.086	-0.10179	0.006697
AP	-0.00011	0.000622	-0.17	0.863	-0.00133	0.001112
TO	0.016762**	0.006811	2.46	0.014	0.003412	0.030112
GFCF	4.27E-13***	9.33E-14	4.57	0.000	2.44E-13	6.10E-13
GGFE	5.74E-12*	2.98E-12	1.92	0.054	-1.09E-13	1.16E-11
LF	5.79E-08	3.95E-08	1.47	0.142	-1.94E-08	1.35E-07
_cons	57.37958***	20.26484	2.83	0.005	17.66122	97.09793
Number of instruments		= 12				
Number of groups		= 12				
Wald chi2(8)		= 213.9	Prob > chi2	= 0.000		
Arellano-Bond test		AR (1)	z = -1.27	P > z =	0.206	
		AR (2)	z = -1.24	P > z =	0.215	
Hansen test	chi2(2)	= 2.68	Prob > chi2	= 0.262		

*Notes: '***', '**', and '*' are significant at the 1%, 5%, and 10% levels, respectively. Generated by Stata software.*

Furthermore, Table 4 indicates that control variables such as trade openness (TO), gross fixed capital formation (GFCF) and General Government Final Expenditure (GGFE) have shown significant positive impact on economic growth of the selected countries. Trade openness can boost economic growth by increasing efficient allocation of resources through economies of both scale and scope as well as increased competition and improving total factor productivity through knowledge diffusion and technology transfer.

The reason for the substantial influence of GFCF on economic growth can be attributed to its encompassing investments in tangible assets like machinery, infrastructure, and technology, all of which play a pivotal role. These investments drive productivity, facilitate employment, promote technological advancement, and lay the foundation for sustained growth. Moreover, GFCF enhances competitiveness, initiates a ripple effect in economic activity, attracts foreign investment, nurtures the development of human capital, and aligns with sustainability and environmental objectives in the Arab region.

This positive impact may be further underscored by recent technological advancements witnessed in the capital investments within the Arab region. This finding aligns with the research conducted by Abbas et al (2020), where they observed that investing in capital fixed formation can boost economic growth and contribute to the maintenance of sustainable environmental conditions. The positive impact of the general government final expenditure on economic growth in the examined Arab countries refers to the important role that the government expenditure can play to boost economic growth through increasing demand and creating job opportunities; these results agree with finding of some studies such as Borhan et al. (2012) and Ogbuabor and Egwuchukwu (2017). Furthermore, LF was observed to have no statistically significant association with economic growth.

5. Conclusion and Recommendations

The study was conducted to examine the impact of climate changes on economic growth in the selected Arab countries using yearly panel data covering the period of 2010 to 2019. The study applied the GMM model to investigate this relationship. The findings of the study showed that climate changes have negative influences on economic growth in the Arab selected countries, particularly with atmospheric carbon dioxide concentration (CO_2) and climate altering land cover index (LC) measurements, while the impact of surface temperature change (STC) and annual precipitation (AP) appeared to be insignificant. Moreover, the study found that control variables such as trade openness (TO), gross fixed capital formation (GFCF) and General Government Final Expenditure (GGFE) had a positive impact on the growth of the Arab economy. Thus, addressing the negative impact of climate change on economic growth in the Arab region is important for sustainable development.

Policymakers in the region can consider implementing policies and strategies that may help mitigate climate change’s effects in the region. This includes investing in renewable energy sources like solar and wind power to reduce the region's dependency on fossil fuels, mitigate greenhouse gas emissions, and create a more sustainable energy infrastructure. Encourage the use of eco-friendly transportation methods. Launch initiatives to increase green cover through afforestation and reforestation programs. Enforce green building standards that prioritize energy-efficient construction and design. Further, encourage sustainable farming practices that conserve water, reduce soil erosion, and promote responsible land use.

One limitation of this study arises from the constrained timeframe of available data for countries in the region. Hence, for future research, it is advisable to extend the study's temporal scope and categorize selected countries within the model into distinct groups, such as distinguishing between oil-importing and oil-exporting nations in the region. This approach could yield more comprehensive results and offer a clearer assessment of the region's susceptibility to the impact of climate change.

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