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Climate Change and Sustainable Development in the Arab States

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Forward

As we enter a new era of unprecedented global challenges, this report provides a snapshot of the climate change challenges facing the Arab region. The interrelationship between climate change and sustainable development has become an important topic in our modern era. This relationship holds the keys to future challenges, and it compels us to act urgently and in an integrated manner. The seventh edition of the Arab Development Report provides a comprehensive study of the complex and multifaceted relationship between climate change and sustainable development, which is transboundary and interdisciplinary in nature, and touches the lives of everyone in the Arab region and the well-being of future generations.

Driven by the continued accumulation of greenhouse gases, climate change poses an existential threat to ecological, economic, and social systems. Its consequences have become evident in the form of extreme weather events, rising sea levels, impact on crop productivity, and compounding the negative effects of poverty and forced displacement. The luxury of ignoring it can no longer be afforded. Sustainable development, on the other hand, represents the aspiration of societies to a better world — a world in which everyone enjoys an adequate standard of living, where economic progress is in harmony with social justice and a sustainable environment, leading to the realization of the vision of a just and prosperous society.

This report seeks to provide an analytical picture of the current situation and calls for climate action, considering the challenges of knowledge, technology, and resilience. The report stresses the importance of innovation, cooperation and integration of efforts as well as the provision of the necessary financial and human resources. It highlights the need to align the climate action and sustainable development agendas, with climate action as an opportunity rather than a burden towards accelerating the sustainable development agenda in order to achieve prosperity and enhance well-being in the Arab region. But let's be realistic, the road ahead is still fraught with difficulties and challenges, because supporting adaptation and mitigation requires strengthening regional cooperation and working closely with the international community to take advantage of opportunities for climate finance and the transfer of environmentally friendly technology. It also requires concerted efforts between the public and private sectors and civil society.

This report provides a roadmap to overcome this critical historical juncture. It provides insights, evidence, and recommendations that can inform supportive policies to ensure the effective implementation of adaptation and mitigation strategies in Arab States with the required investments. Let us remember that the choices we make today will determine the world we will bequeath to future generations, requiring the need to address the challenges of our times more efficiently and effectively.

In conclusion, we would like to express our great gratitude to all who contributed to the completion of this report, and the dedication of the Editorial Board inspires us all. We hope that this report will serve as a catalyst for the transformative actions needed in the Arab region, a collective effort to usher a future where climate change is confronted, and sustainable development is achieved.

Abbreviations

CO2	Carbon Dioxide
COP	Conference of the parties
°C	degree Celsius
GCC	Gulf Cooperation Council
GDP	Gross Domestic Product
GHG	Greenhouse Gas
GW	Gega Watt
IPCC	Intergovernmental Panel on Climate Change
m3/year	Cubic meter per year
NDCs	Nationally Determined Contributions
OECD	Organization for Economic Cooperation and Development
PPP	Public Private Partnership
RE	Renewable Energy
UAE	United Arab Emirates
UNCTAD	United Nations Conference on Trade and Development
ESCWA	United Nations Economic and Social Commission for Western Asia

Executive Summary

Climate change presents significant challenges to sustainable development in the Arab region. Countries in this region must urgently integrate efforts to reduce greenhouse gas emissions and invest in adaptation into their development strategies. Such climate action is essential for mitigating risks and damages associated with shifting weather patterns, thus supporting development goals like poverty reduction and sustainable growth. Most countries have climate strategies in their Nationally Determined Contributions (NDCs), but there is a need for clear pathways to reduce emissions that align with sustainable development objectives. This report delves into critical issues such as eradicating poverty and achieving development goals while addressing climate change threats in the Arab region. It explores the resilience of Arab economies in the face of declining fossil fuel demand, emphasizes the importance of prioritizing policy changes and investments for a green transition, and highlights financing sources for climate-related investments. Additionally, structural reforms are discussed in terms of their contributions to mitigating the negative effects of climate change. The report reviews the current and anticipated impacts of climate change on sustainable development in the Arab region, summarizing them as follows:

- The Arab region contributes only a small fraction of global carbon dioxide emissions (less than 5%) yet faces over 30% of the negative consequences of climate change in terms of damage and fatalities.
- The region has experienced a significant increase in average annual temperatures, about 1.5°C in the past three decades, which is roughly twice the global average temperature rise over the same period.
- Rainfall patterns have become erratic, with significant declines in countries like Jordan, Iraq, Syria, and Oman.
- High population growth, rapid urbanization, and environmental pollution exacerbate the impact of climate change.
- Eighteen Arab countries are categorized as water-poor, with limited per capita water supply and quality constraints, exacerbated by excessive water use and non-renewable groundwater extraction.
- Most water is consumed inefficiently, with traditional irrigation methods still prevalent.
- The region has witnessed an increase in climate disasters, including flash floods and extended periods of high temperatures.
- There is a relative disparity in adaptive capacity between rich and poor Arab countries. Rich nations are better equipped to mitigate economic impacts through adaptation strategies, while

poorer economies in the region have fewer resources and weaker capabilities.

- Climate adaptation and mitigation have not received sufficient attention at the national and international levels, posing challenges for non-oil countries in financing adaptation programs.
- Intensified climatic pressures are expected to worsen the human and material damages from climate change, increasing land degradation, water scarcity, and sea-level rise.
- Climate disasters are likely to lead to social and political instability, economic imbalances, and declines in income, employment, and growth.
- The International Monetary Fund estimates the cost of adaptation in the Arab region at 2% of GDP, which is significantly lower than the cost of inaction.
- Adaptation programs not only mitigate risks and costs but also drive growth and job opportunities.
- Fossil fuels may become stranded assets, with Saudi Arabia potentially losing about $2 trillion, although this estimation does not account for the region's low production and extraction costs and its potential to repurpose oil and gas assets.
- The Arab region offers great potential for renewable energy due to its abundant solar radiation.

This report emphasizes the pivotal **role of water in adapting to climate change within the agricultural sector**, where the interplay between climate variables like rainfall and temperature significantly impacts agricultural production. The effects of climate change manifest through factors such as crop water requirements, water availability, quality, and the increasing frequency of extreme events like floods and droughts. As climate change accelerates, the Arab region, already one of the world's most water-scarce regions, faces heightened vulnerability due to its limited adaptability and resilience. This makes it crucial to cooperate on transboundary water resources for effective water resource management and conflict prevention. While Arab communities have historically adapted to this challenging environment, rapid climate change renders existing mechanisms obsolete.

Climate change poses unique social and economic threats to each country, depending on its adaptability and development level. Arab countries must build national capacities to confront climate change threats comprehensively, strengthen regional collaboration to address climate risks, and engage with the international community to access climate financing and climate-friendly technology transfer. In recent years, the Arab region has launched initiatives to tackle disaster risk reduction and climate change adaptation. Countries have also assessed climate change's impacts on national resources, supporting

adaptation plans and UNFCCC commitments. Most Arab countries recognize the **urgency of climate adaptation** and have initiated measures to address climate challenges. The focus should be on strategies offering maximum benefits across various climate change scenarios while enhancing resilience to future challenges. While there's no one-size-fits-all solution due to unique challenges in each country, **integrating adaptation policies into national economic strategies is essential**. Developing macroeconomic frameworks that incorporate climate risks is crucial for formulating effective policy responses.

Arab countries must continue strengthening their national capabilities to address climate change and **foster regional cooperation to combat climate risks**. Moreover, they should work closely with the international community to tap into climate financing opportunities and access environmentally friendly technologies that support adaptation and mitigate climate change effects. Most Arab countries already have established adaptation programs and policies, but the focus should now shift toward **translating policies into concrete action plans** and implementation programs. The Arab region, significantly impacted by extreme climate changes, may face substantial economic and social losses. Although it's challenging to comprehensively address climate change's root causes, the priority is adapting to its consequences. Concurrently, efforts to mitigate global warming's causes must accelerate to prevent a future where adaptation becomes unfeasible.

Considering these challenges, Arab countries should continue **building national capacities** at central and local levels to address climate change threats, enhance regional cooperation, and engage with the international community to access climate financing and environmentally friendly technologies. It's crucial to prioritize measures with the greatest benefits under diverse climate scenarios and to integrate adaptation policies into major national economic strategies. Establishing effective macroeconomic policy frameworks that account for climate risks and respond to them through targeted actions is fundamental. Adapting to climate change is a shared responsibility that transcends borders, and it demands collective efforts and coordinated actions at regional and international levels. A comprehensive set of recommendations can be outlined as follows:

- **Stakeholder Coordination:** Effective adaptation often involves cross-ministerial and cross-sectoral activities, underscoring the need for close coordination among relevant stakeholders.
- **Regional Cooperation:** Collaboration among Arab governments is essential to implement effective adaptation and mitigation strategies, explore financial avenues to combat climate change, and lay the groundwork for climate change adaptation.

- **Integration into National Development Plans:** The integration of climate action plans, such as national adaptation programs, into broader national development plans is crucial. This prevents climate action from becoming an additional layer of planning and ensures alignment with core development processes.
- **Immediate Implementation of Key Measures:** Despite uncertainties surrounding climate change impacts, important adaptation and mitigation measures should be implemented promptly. Reducing uncertainty requires further spatial analysis to pinpoint areas most susceptible to climate change impacts.
- **Carbon Markets:** Pursue carbon offset initiatives that support projects in other regions to compensate for emissions that can't be immediately reduced.
- **Financial Resources:** Adequate funding and financial resources are essential for adaptation and mitigation programs, particularly in regions most exposed to climate change repercussions. The involvement of the private sector and civil society in financing is crucial, as is addressing the needs of the groups most affected by climate change's impacts.
- **Role of Regional and International Organizations:** Encourage official regional and international organizations in the Arab region to play active roles in implementing adaptation and mitigation plans, building capacities, raising awareness, collecting data, and monitoring and evaluation processes. These organizations can significantly contribute to addressing climate change challenges.

Climate change is posing a serious threat to mankind. It does not only encompass rising average temperatures but also climate related loss and damage including rising sea levels and consequent coastal erosion, extreme weather events and variations, shifting wildlife populations and habitats, desertification, loss of soil fertility leading to food and water insecurity. The world continues to experience extreme weather conditions as well as increasing concentrations of greenhouse gases (IPCC, 2018). Greenhouse gases warm the earth's climate through creating what is known as the greenhouse effect. These gases, including carbon dioxide (CO2), nitrous oxide, methane, and others, are essential in sustaining a suitable temperature for the planet. However, since the Industrial Revolution, these greenhouse gas emissions have rapidly increased simultaneously with economic activities leading to climate change. It is apparent that the rising anthropogenic greenhouse gases' emissions are mainly the responsibility of industrialized countries, the impacts of climate change will be more severe in developing countries and countries on their growth pathways.

The Arab region is becoming one of the heavily affected regions by extreme weather patterns (Sieghart, Betre and Mizener, 2018). Excessive global temperatures would cause fewer and more irregular precipitations, changing rainfall patterns, a continued rise in the sea levels, and changes in the water supply. This is all going to happen in a region that already experiences desertification, frequent drought, and water shortages. Heatwaves can have adverse impacts on many spheres in the Arab countries, influencing water supplies, sea levels, biodiversity, public health, food security, land use and urban development, and tourism. Each of these threats exhibits unprecedented challenges to macroeconomic variables such as economic growth and governance which calls for significant initiatives to minimize their adverse and dangerous effects. It will cause hot temperatures to expand over more land for extended periods, rendering some regions inhabitable and limiting cultivated agricultural areas. Cities will feel an excessive heat effect on the mainland, and most of the capital cities in the Arab region could confront four months of scorching days every year. Increasing temperatures will place incredible pressure on crops and already scarce water resources (Alboghdady and El-Hendawy, 2016; Ali, 2016; Gilmont, 2016; and Nazemi et al., 2020), potentially increasing migration (Balsari et al., 2020; Black, 2011; Burrows and Kinney, 2016 and Waha et al. 2017) and conflict risk (Scheffran and

Brauch, 2014; Sofuoğlu and Ay, 2020; and Woertz, 2014). Higher average temperatures will have a negative influence on GDP growth, while the concurrently increasing economic activities around the region contribute considerably to increasing CO2 emissions and hence higher temperature levels (Elayouty and Abou-Ali, 2022). This demand that policymakers take quick steps to mitigate and adapt to the effects of climate change.

ARAB DEVELOPMENT CHALLENGES AND CLIMATE CHANGE

The Arab region struggles with a spectrum of challenges, notably stark economic disparities. Economically, the annual per capita GDP in constant prices spans a vast range, from a mere US$445 in Somalia to an affluent US$63,700 in Qatar (in constant 2015 dollars according to World Development Indicators). Consequently, the ability to adapt to and address climate change risks varies significantly across the region. Against the backdrop of global agreements such as the Paris Agreement and the United Nations Framework Convention on Climate Change, ratified by 195 countries, including Arab nations, the imperative to strike a balance between economic growth and climate action becomes evident. This underscores the pressing need for enhanced coordination among stakeholders and heightened public awareness of climate change across all segments of society.

Arab countries are among those most vulnerable to the potential ramifications of climate change due to several factors, with water scarcity and frequent drought standing out prominently. Most nations in the Arab region grapple with arid to semi-arid climates, while the vast Sahara Desert stretches across North Africa, encompassing Mauritania, southern Morocco, and extensive areas of Algeria, Libya, Egypt, and Sudan. Coastal regions, vulnerable to sea-level rise, bear immense significance as the Arab world's shores extend along the Atlantic Ocean, Indian Ocean, Mediterranean Sea, Red Sea, and the Arabian Gulf. These coastal areas, spanning approximately 34,000 km, with around 18,000 km inhabited, are home to most of the Arab population. More than 90 percent of the populations of some Arab countries, such as Kuwait, Bahrain, the United Arab Emirates, Palestine, Lebanon, Djibouti, and Morocco, reside along these coasts. Moreover, major cities and economic hubs are concentrated in these coastal areas. Fertile agricultural lands, like the Nile Delta, are also situated in low-lying coastal regions, while tourism thrives on marine and coastal assets, including coral reefs and associated fauna.

The projected impacts of climate change are exacerbating the strain on already limited freshwater resources, with roughly 85 percent of available freshwater dedicated to agriculture. However, food security has long been susceptible to environmental, social, and economic pressures. The climate change-

related challenges facing the Arab region encompass rising temperatures, surging sea levels, freshwater scarcity, escalating desertification, prolonged droughts, salinity-induced soil degradation, and a discernible uptick in the frequency and intensity of climate-related phenomena and disasters.

Over the past two decades, the frequency of natural hazards resulting from climate change has surged, with these disasters posing a grave menace to the Arab region. The United Nations Office for Disaster Risk Reduction reports that the region has witnessed over 270 natural disasters, caused more than 150,000 fatalities, and affected approximately 10 million people. Climate change further compounds challenges faced by Arab cities, including heightened temperatures, heatwaves, and associated health risks, as well as inadequate infrastructure to cope with floods and heavy rainfall. The extensive coastal population is also at risk due to sea-level rise and coastal erosion. Environmental studies suggest that these effects will disrupt biological systems and jeopardize the diversity of flora and fauna. For instance, climate models indicate that drier regions will experience increased evaporation and decreased soil moisture, rendering some arable lands unsuitable for agriculture and grasslands progressively arid. This directly exacerbates the negative consequences of poverty and can lead to forced displacement, and climate migration. The interplay of these factors reshapes the risk landscape for the region, rendering its natural resource base increasingly fragile and susceptible to diverse internal and external pressures. A brief overview of some of the threats anticipated to confront the Arab region are:

Temperature: Average annual temperatures in East and North Africa are likely to exceed 2°C with maximum projected increases of up to 6°C by 2100. Rising temperatures are expected to have dual effects, (1) accelerated melting: rising temperature expedite the melting of glaciers, ice sheets, and land permafrost, which contributes 30 to 50 percent of sea level rise; and (2) thermal expansion of seas and oceans, causing sea levels to rise by about 15 to 35 percent.

Precipitation: The dynamics of precipitation will undergo transformation as a direct consequence of rising temperatures. Increased temperatures lead to greater evaporation, which, in turn, introduces more moisture into the atmosphere. This surplus moisture cannot be contained indefinitely, resulting in the increased frequency of rainfall. This acceleration of the water cycle will have two primary consequences: increased rainfall rates and increased variability at the global level. A decrease in precipitation of up to 40 percent is likely to occur over North Africa by the end of the twenty-first century.

Sea level rise: By the end of the century, climate change will likely cause average global sea levels to rise by 32 to 82 cm. Coupled with heightened incidence of storm surges and saltwater intrusion into rivers and

groundwater, this is likely to affect water quality and agricultural productivity in low-lying coastal areas. Projections have identified Egypt, Libya, Morocco and Tunisia as the most vulnerable African countries in terms of the total population that will be affected by sea level rise.

Natural Disasters: The frequency and intensity of natural disasters are anticipated to escalate as temperatures continue to reach record levels. The Arab region has already witnessed severe heatwaves, and droughts, once occurring every six to eight years, now strike every one to two years. Tropical cyclone events, which struck the Arabian Peninsula in 2007 and 2010, are expected to proliferate due to increased humidity and temperature levels. These events will bring heavy rainfall, potentially skewing annual precipitation averages.

Desertification: the process by which land in arid, semi-arid, and dry sub-humid areas deteriorates due to various factors, including climate change and human activities, poses a significant threat. It results in the loss of plant life and biodiversity, topsoil depletion, and a decline in land's ability to support agricultural production and sustain animal and human life.

These multifaceted challenges necessitate concerted efforts at both regional and global levels to adapt and mitigate their impacts and build resilience within the Arab region.

GREEN TRANSITION

The transition to a green economy is a new approach aimed at helping countries build low-carbon economies. The shift towards a green economy is defined as a vision that aims to promote economic development and achieve social well-being while preserving environmental quality. This objective is accomplished through the adoption of environmentally friendly technologies, and policy implementation (Schechla, 2022). The concept of the green transition is intricately linked with other concepts, notably the green economy and green growth. According to the United Nations Environment Program a green economy is defined as “an economy that improves human well-being, achieves social equity, and contributes to reducing risks and damage to ecosystems and ecological resources.” In parallel, the Organization for Economic Cooperation and Development (OECD) defines green growth as “economic growth that safeguards the natural wealth required to sustain the environmental resources and services necessary for human well-being.” The Economic and Social Commission for Western Asia (ESCWA) also defines green growth as “economic growth that supports environmentally sustainable development (i.e., low-carbon economic development)” (ESCWA, 2013). Over the past decade, and particularly since the United Nations Conference on Environment and Development (Rio+20), the vision of transitioning

towards a green economy has emerged in response to the urgent need to restructure traditional economic and social models. This restructuring is driven by considerations encompassing climate change, biodiversity loss, water scarcity, and the depletion of finite resources. The global financial crisis of 2008 and the subsequent Covid-19 crisis emphasized the necessity of translating these concerns into a vision for transitioning towards a green economy.

In 2015, the United Nations adopted the Sustainable Development Goals for 2030, a set of seventeen objectives aimed at achieving economic growth and eradicating poverty. These goals take into account vital social aspects such as education, health, social protection, access to adequate housing, and the creation of decent job opportunities. Importantly, these goals also emphasize the imperative of reducing environmental pollution and addressing the challenge of climate change. Consequently, the twelfth and thirteenth Sustainable Development Goals underline the intrinsic connection between the environmental ecosystem and economic activities. They stress the necessity of transitioning to a green economy, achieved by relying on clean and sustainable energy sources for production and consumption, and by shifting towards a circular economy.

In 2016, the United Nations launched the New Urban Plan, which focused on the economic and social function of urbanization while integrating environmental considerations. This plan emphasized the government's role in ensuring citizens' access to adequate housing, urban flexibility, and sustainability. Sustainability, in this context, entails the capacity of urban systems to withstand pressures or shocks while promoting the adoption of clean, renewable energy sources to advance economic growth (Schechla, 2022).

To facilitate the transition to a green economy, OECD recommends that countries adopt modern environmentally friendly technologies. These technologies can help transform traditional sectors into green ones while addressing the resulting redistribution in labor and capital allocation both within and between sectors. Moreover, the organization underscores the necessity of enhancing investments in renewable and clean energy sources. These sources are recognized as reliable and profitable alternatives, especially in the Arab region given the igh levels of solar radiation, thus serving as engines for economic growth. The shift towards a green economy represents a groundbreaking approach aimed at helping countries build low-carbon economies.

ADAPTATION TO CLIMATE CHANGE IN THE ARAB REGION

Adaptation is a pivotal process that needs continuous adjustment to keep pace with climate change, by managing and integrating climate risks and opportunities into all activities. In order to build resilience to climate change, Arab countries must include climate adaptation in all decisions, whether at the regional, national or local levels. The steps for preparing adaptation plans and policies are summarized in assessing vulnerability to climate change, with a focus on the potential impacts of rising temperatures, increased frequency of storms, sea level rise, and others. The assessment of the current situation aims to support decision-makers in developing adaptation strategies and developing management and investment policies based on identifying the potential impacts of climate change on water resources, agricultural systems, infrastructure, cities, and the tourism sector. Climate change monitoring data plays a pivotal role, offering crucial insights into ongoing developments. These data sources utilize advanced modeling tools to investigate the hydrological environment and regional climate. Their primary objective is to create technology solutions that are environmentally conscious, with a focus on enhancing water management and cultivating crops that can thrive in saline and arid conditions. Efforts to combat climate change extend to promoting public investment in climate-resilient infrastructure and encouraging a more substantial role for the private sector in adaptation initiatives. This inclusive approach extends to adapting growth strategies and sustainable development plans to accommodate potential climate risks. For instance, providing support to businesses struggling with the impacts of climate change, such as those in the tourism sector, and fortifying social protection systems for vulnerable groups.

Climate change impact includes extreme weather events and slow onset events. Traditional strategies and actions designed for gradual adaptation may not suffice when confronting significant, rapid challenges. Hence, it becomes imperative for adaptation strategies in Arab countries to adopt periodic adaptation frameworks. These frameworks establish adaptation as a continuous, dynamic process, subject to periodic review and adjustment to accommodate new knowledge and challenges arising from the expected impacts of climate change. This approach ensures that plans remain responsive to climate shocks, both present and future, considering updated climate data. This adaptive strategy equips countries and societies to effectively build their capacity to withstand the challenges of future climate change. It is crucial to recognize that adaptation activities become progressively more complex and expensive as global temperatures rise beyond a certain threshold, especially when average global temperatures exceed a 2°C degree Celsius increase. This necessitates exploring and tapping into new financial instruments and sources of funding to support adaptation efforts. Among these instruments are insurance products and

green bonds, along with budgetary allocations. The private sector is a crucial stakeholder in the adaptation journey and can contribute significantly to enhancing resilience. The private sector plays two pivotal roles. Firstly, as a "shareholder," it can invest in cutting-edge technology, construct climate-responsive infrastructure, adopt sustainable business practices, and offer adaptation services such as digital climate services, climate-responsive engineering solutions, and eco-friendly products and services. This encompasses services related to the industrial sector, financial sector, and insurance services. The second role the private sector can fulfill is that of a "buyer" of adaptation services. In some sectors, companies need to invest in adaptive areas, such as production systems, delivery and logistics systems, and infrastructure services. These investments have the potential to open new markets in agriculture, infrastructure, and urban development.

The International Monetary Fund estimates that adaptation costs amount to about 2 percent of GDP. In the case of Egypt, this translates to $6.1 billion of its 2019 GDP, which stood at an estimated $303 billion. For Tunisia, the cost is approximately $800 million, and for Sudan, it is around $640 million (World Bank, 2020). Sea-level rise alone entails significant costs, with Egypt facing about $27.3 billion and Tunisia approximately $1.96 billion. The value of costs avoided through adaptation measures to mitigate the effects of sea-level rise is substantial, exceeding $21 billion in Egypt and $1.2 billion in Tunisia. Adaptation programs not only avert costs but also create opportunities for growth and employment, fostering a sustainable, resilient future.

MITIGATING THE EFFECTS OF CLIMATE CHANGE

The Arab region's greenhouse gas emissions account for less than five percent of the global total. This proportion, albeit modest, is disproportionate to the region's vulnerability to the damaging effects of climate change, which exceed 30 percent. While some countries have managed to decouple GDP growth from greenhouse gas emissions, these two factors remain closely linked. Over the past three decades, emissions in the energy sector's value chain have seen continued growth, with the production and use of natural gas and crude oil remaining the primary sources of greenhouse gas emissions in the region. The transition to a low-carbon economy holds the potential to enhance competitiveness and economic growth in select countries, especially as global preferences shift towards greener products and policies. Vulnerability to the adverse effects of climate change extends beyond coastal regions, agriculture, food security, and water resources. It extends across aspects such as poverty, inequality, public health, demographics, and infrastructure. Consequently, it is imperative for the Arab region to prioritize mitigation efforts to address climate change and its ramifications on key macroeconomic performance indicators such as GDP growth, inflation, and public finances.

The Arab countries constitute a vast and diverse region where climate change-induced damages manifest variably based on geography, sector, and income groups. This diversity presents a unique opportunity for the region to capitalize on the transition toward more sustainable, inclusive, and resilient economies. Achieving this necessitates significant enhancements in data infrastructure and systems in both the public and private sectors. Comprehensive and accessible data are indispensable for monitoring progress and informed decision-making. Access to reliable data empowers governments, individuals, and businesses to grapple with the uncertainties surrounding climate change and navigate current global complexities. In the pursuit of the green transition, governments and societies must work together to develop and utilize innovative solutions. Recent years have witnessed remarkable strides in innovation, technology, and artificial intelligence to combat climate change's effects. While innovation brings about improved service delivery, it is not without its drawbacks, as it can exacerbate social inequality and reliance on foreign knowledge. However, these inequalities can be mitigated through effective policies and governance. Governments must harness innovation and technological progress, fostering scientific research in the realm of climate action. This endeavor demands the development of local expertise, encompassing experienced engineers and scientists. Furthermore, raising public awareness about climate change and its repercussions is paramount. Climate change education should be a cornerstone of the region's efforts. Policymakers must introduce climate policies, enact legislation, and establish carbon pricing mechanisms that incentivize emissions reductions and the adoption of environmentally responsible practices. These efforts should coincide with investments in research and innovation aimed at developing technologies that bolster climate action. Collaboration on an international scale is also crucial. Arab countries should engage in cooperative partnerships, exchanging knowledge, resources, and best practices in the realm of mitigation. Such collaboration will enable the region to build a more sustainable and resilient future in the face of climate change, leveraging the collective power of shared expertise and experiences.

REPORT CONTENT

This report comprises six comprehensive chapters, each delving into crucial aspects of climate change relevant to the Arab region. The first chapter, titled "Climate Change and Sustainable Development," delves into the stance of Arab nations regarding the implementation of the United Nations Sustainable Development Goals for 2030. It explores the impact of climate change on the attainment of these goals and presents actionable proposals aimed at propelling Arab countries towards realizing sustainable development. This chapter serves as a blueprint for advancing sustainable development

objectives while simultaneously addressing the challenges posed by climate change. Chapter two takes a closer look at the repercussions of climate change on the agricultural and irrigation sectors within the Arab world. These sectors represent the frontline of climate adaptation efforts and are thoroughly examined. The chapter provides insights into the current state of these repercussions and their implications for food security. Additionally, it offers an in-depth analysis of the initiatives embraced by Arab countries to tackle this critical issue, which has a profound impact on the lives of citizens, particularly those in low-income brackets.

The third chapter focuses on mitigation strategies within the energy sector and its adaptability. Given its immense potential to drive the green transformation within Arab countries, the energy sector is placed under the microscope. Chapter four explores various approaches to reduce or eliminate carbon emissions from industrial activities in the Arab region, with a specific emphasis on manufacturing industries. The overarching goal is to accelerate the pace of structural transformation within Arab nations. Chapter five is dedicated to financing, investment, and the involvement of the private sector. It dissects the crucial role these components play in driving the green transition. The chapter provides insights into strategies and mechanisms that facilitate the mobilization of resources, foster investments in climate-resilient projects, and encourage private sector participation in initiatives geared towards sustainability and climate action. The final chapter addresses the vital issue of governance. In the context of the transition to a green economy, governance takes center stage as a key driver of efficiency and effectiveness. This chapter underscores the importance of sound governance practices in managing the transition process efficiently, ensuring accountability, and promoting transparency and equity. These chapters collectively provide a comprehensive framework for addressing climate change challenges and advancing the green transition agenda in the Arab region.

Chapter One

Climate Change and Sustainable Development

1.1 Introduction

Sustainable development and climate change are among the most important challenges facing all countries, and the Arab region in particular, given the challenges that some countries in the region are exposed to in achieving the sustainable development goals (SDGs). These challenges relate to providing the necessary funding, institutional and human capacities, and sometimes the legislative and regulatory frameworks, as well as the coordination between multiple relevant stakeholders, raising awareness and supporting the change required by implementing the United Nations Sustainable Development Agenda. The challenges that the Arab countries are witnessing due to the economic and geopolitical circumstances in some countries, increase the difficulty of achieving sustainable development. The repercussions of climate change increase these challenges.

This link between climate change and sustainable development requires the formulation of strategies that address both problems simultaneously, as climate change affects development prospects, and development paths determine the direction and degree of the future impact on climate. At the global and regional levels, countries need to coordinate and integrate their work within the framework of the 1992 United Nations Framework Convention on Climate Change (UNFCCC). However, the climate developments indicate a slowdown in the commitment of developed countries to their pledges, as well as a deficiency in achieving a balance between the right of countries to promote development, achieve sustainable development, and meet their commitments to mitigation and adaptation measures to reduce the negative repercussions of climate change. Although there are many challenges facing climate action worldwide, opportunities to integrate measures to deal with climate change into sustainable development strategies at the national level are possible. In practice, countries can consider the repercussions of climate change, by directing resources to deal with the most pressing development issues that include growth, poverty, education, health, food security, unemployment, inflation, energy, economic diversification, justice, equality, and other development issues of relevance and importance to the Arab region. Climate justice is one of the most important issues that must be dealt with when estimating the burdens of adaptation and mitigation. It is known that developed countries are responsible for the bulk of greenhouse gases, or carbon dioxide, resulting from burning fossil fuels and deforestation, as the average per capita greenhouse gas emissions in industrialized countries are estimated to be four times those in developing countries in 2021. While Poor countries are the most affected by climate change, and therefore they must take the necessary measures to focus on adaptation as a priority, especially to protect the poor and most vulnerable groups, and at the same time they need to strengthen development efforts to reduce poverty rates and improve the living standards of their citizens. More developed countries, better financially and technically resourced, should lead mitigation efforts and also assist the developing and poor countries with adaptation and mitigation efforts.

In order to achieve a balance between climate change and the sustainability of development efforts in the Arab countries, in light of the current circumstances, the importance of the trade-off between economic, environmental and social goals appears. At the level of macro policies that stimulate economic growth and contribute to the success of adaptation and mitigation efforts, the importance of working to implement a set of structural reforms to ensure the efficient and effective performance of market

mechanisms, giving a big push to institutional reforms, and adopting a set of innovative measures that would address the repercussions of climate change and improve prospects for mitigation and adaptation. In order to advance the implementation of the SDGs, urgent policies and actions must be adopted dedicated to climate action and the loss of ecosystems and biodiversity, which threaten the well-being of citizens and negatively impact sustainable growth prospects. It all depends on the availability of financing and investments necessary for climate action.

This chapter reviews the status of implementing the SDGs in Arab countries. It provides an analysis of the interrelationship and expected impacts of climate change on the implementation of the SDGs. It sheds light on the most important practices that achieve a balance between climate action and stimulating sustainable development. The chapter concludes with the main results and some recommendations.

1.2 A brief review of the status of implementing the SDGs

The Arab region is currently facing many challenges in achieving the SDGs as an inevitable result of the repercussions of both the COVID-19 pandemic and the Russian-Ukrainian war, which negatively affected the development efforts in many Arab countries. The differences between Arab countries reflect the large differences in performance regarding many social and economic indicators. SDG 5 (gender equality) remains the most important challenge in the region, followed by SDG 2 (Zero Hunger) and SDG 8 (Decent Work and Economic Growth). Other SDGs show more variation, which in turn requires country-specific policy recommendations and solutions. It is also worth noting that assessing the extent of progress towards achieving the SDGs at the local level is expected to indicate differences in the level of achievement, which entails the necessity of developing plans to stimulate progress towards achieving the SDGs not only at the level of each country in the region, but also at the local level, within each country. There are certainly some successful initiatives in Arab countries, which can be scaled-up and applied in other countries but tailored to the circumstances of each country.

It is clear from extrapolating the indicators for monitoring the implementation of the SDGs in the Arab region for the year 2022 (Apendix 1) that:

- Several Arab countries are still facing important challenges in achieving the SDGs, especially SDG 5 related to gender equality, as it represents the greatest challenge in the Arab region, then the goals related to the complete elimination of hunger (SDG 2), and the goal of health and well-being (SDG 3), decent work and economic growth (SDG 8), life below water (SDG 14), and peace, justice and strong institutions (SDG 16), in which more than two-thirds of the Arab countries received a low score, represented in red, meaning that they are still facing challenges in achieving these goals.
- Many countries are on track to achieve quality education (SDG 4) and climate action (SDG 13), while showing moderate increases in performance in other SDGs, including SDG 6 (clean water and hygiene) and SDG 7 (clean, affordable energy). reasonable). While most countries show a declining or stagnating trend on SDG 11 (sustainable cities and communities).
- It is worth noting that statistical systems in Arab countries are not able to cover the computation of all indicators, which may affect some of the indicators used to monitor the implementation of the SDGs.

1.3 Analysis of the interrelationship and expected impacts of climate change on the SDGs implementation

The taxonomy of the 17 SDGs into 5 main groups, as presented in the following table, reveals the following:

Group	First	Second	Third	Fourth	Fifth
Dimension	Multidimensional poverty	Infrastructure, growth and employment	Justice, fairness and efficiency	Environmental infrastructure	Institutional Efficiency
SDGs	1 – 5	6 – 9	10 – 12	13 – 15	16 – 17

The first group (SDG 1 to SDG 5) addresses the multiple dimensions of poverty, which include food, income, health, education, and gender. Climate change is a comprehensive development issue that affects all aspects of the sustainable development agenda 2030, through various pillars. In terms of multidimensional poverty, climate change worsens the existing poverty situation, causing more citizens to be at risk of falling into extreme poverty. According to the Second Multidimensional Poverty Report released this year, the multidimensional poverty rate as measured by the number of individuals suffering from multidimensional poverty is high but declining. This is due to conflict conditions, climate changes, and the repercussions of the COVID-19 pandemic. Climate change can exacerbate poverty by affecting agricultural productivity, causing loss of livelihoods, and increasing the frequency of extreme weather events that disproportionately affect marginalized groups of the population. Climate change also poses a major threat to food security due to changing weather patterns, changing growing and harvesting seasons, and increasing risks of drought and floods, as the incidence of flash floods has increased and become more frequent in Egypt, Iraq, Saudi Arabia, the United Arab Emirates, Morocco, and Tunisia. This led to a decline in agricultural productivity and the possibility of food shortages, especially in Egypt, North African countries, Syria, and Iraq. Some estimates indicate that regional agricultural production will decline by 21 percent by 2080 because of climate change. The production of some agricultural crops could decline by 30 to 60 percent in some areas if no action is taken to confront rising temperatures and changes in rainfall patterns (ESCWA, 2020).

The degree of desertification, high temperatures, water scarcity, and the negative impact of climate change affect the ability of agricultural production in Arab countries to withstand. Despite the existence of strategies for agricultural development and food security in most countries in the region, agricultural productivity has declined, as has the nutritional value of crops, in addition to diminished return on investment in agriculture. The lack of public and private investment in new technologies necessary to develop agricultural production and its ability to confront the repercussions of climate change has led to the depletion of natural resources, poor rural development, and increasing waves of climate migration to urban areas. Increasing urbanization, in turn, leads to expanding the scope of encroachment on

agricultural lands, increasing demand on food products, and continuing dependence on food imports, especially with the population of the Arab region expected to rise to 520 and 676 million people by 2030 and 2050, respectively.

Most Arab countries also suffer from the negative impact of climate change on human health through an increase in heat-related diseases, air pollution caused by burning fossil fuels, and the disruption of health care systems due to extreme weather events. Arab countries in general, especially in poor and remote areas, also suffer from a low degree of awareness about environmental issues, sustainable practices, and the repercussions of climate change. Recent studies and reports indicate that women in Arab countries, especially the poor, are relatively more affected by climate change due to their roles as caregivers, their dependence on natural resources, and limited access to these resources. The 2020 Arab States Sustainable Development Report also shows the region's declining performance on several SDGs, including those related to gender equality, income poverty, health care coverage, and social protection.

The second group (SDG 6 to SDG 9) is linked to infrastructure development (water and energy), growth and employment. The scarcity of fresh water represents a major challenge in the Arab countries, and this crisis is intensified considering conflict, successive internal and external crises, population growth and increasing urbanization in the region. It should be noted that the use of fresh water in the region has exceeded 400 percent of the available renewable fresh water. Arab countries face additional pressures on their water resources due to rising temperatures and a general decrease in rainfall resulting from climate change, as rainfall amounts are declining significantly in the region, especially in Jordan, Iraq, Syria, and Oman. Average annual rainfall is expected to decrease by 10 percent over the next 50 years. Rising temperatures affect evaporation rates, leading to increased frequency of droughts and flash floods.

Achieving the infrastructure goals (particularly related to water and energy) requires developing the institutional and human capacities of Arab countries to adopt a human rights-based approach to water, sanitation, and energy. This also requires increasing public investments to deliver public utilities and infrastructure, as well as creating new mechanisms for private sector participation in these areas. These utilities also need to develop strong water and energy management structures in the Arab countries to raise their efficiency, apply good governance principles, and expand the uses of modern technologies and artificial intelligence applications to rationalize the use, preservation, and maintenance of these facilities, improve their productivity and efficiency, achieve sustainability, and ensure that the services of these facilities reach all members of the society without discrimination.

The Sustainable Development Report in the Arab Countries for 2020 confirms that all Arab countries, except for the Comoros, share one or more of the region's more than 40 common groundwater aquifers, many of which share surface water and water basins as well. It should be noted that 50 percent of the water in the region is shared water, but in Egypt, Bahrain, and Kuwait this percentage exceeds 97 percent. This affects the management, regulation, distribution, and use of water resources, and requires coordination and a participatory methodology to address water scarcity and the impacts of climate change and its implications for water in the region. About 60 percent of surface water comes from outside the Arab region, which requires cooperation and integration to develop the water management system, raise its efficiency, increase its productivity, and achieve justice in its distribution. Considering these

challenges, Arab countries need to develop and adapt appropriate technologies for water supply, expand water desalination, wastewater treatment and reuse, provide resources, stimulate investment, draw up the necessary plans to confront the repercussions of climate change and the associated and resulting risks, and take the necessary measures to rationalize water consumption.

The energy sector in the Arab countries also faces many distortions and imbalances, which emphasizes the importance of adopting the necessary policies to achieve the sustainability of energy sources and transition to new and clean energy. These policies include close coordination and integration between the policies and the programs adopted by the various ministries, enhancing the institutional capacity to integrate energy policies with the policies necessary to confront the repercussions of climate change, stimulating the water, energy and food nexus, and strengthening the public-private-partnership (PPP) in infrastructure development, to raise the efficiency of clean energy and increase its productivity, and meet the climate change challenges.

The third group (SDG 10 to SDG 12), which are related to achieving a balance between justice, equity, and efficiency. The 2020 Arab States Sustainable Development Report indicates a decline in the region's performance on several SDGs, including those related to sustainable management of natural resources, and sustainable consumption and production. Arab economies suffer from major challenges, especially about modest levels of employment, high unemployment rates, inefficient macroeconomic environment, and lack of harmonization of financial and monetary policies to face current challenges. With the excessive dependence on oil and rent activities in several Arab countries, investment rates are modest, and most investments are concentrated primarily in the real estate and services sectors. With the continued depletion of natural resources, the failure of economic diversification efforts, and the exposure of some Arab countries to extreme temperatures for more than 100 days, especially in Bahrain, Oman, Mauritania, and Sudan, which greatly affects economic activity in general, and the creation of decent and productive job opportunities. The continued concentration of wealth in a small number of non-productive sectors has led to a widening of the gap between different income groups, and an increase in the disparity in the distribution of income between geographical regions as well. These challenges have resulted in weak financial space to provide adaptation and mitigation programs to confront the repercussions of climate change in Arab countries. It is known that the Arab countries already suffer from a relative imbalance in the ability to adapt between rich countries and poor countries. Rich Arab countries are in a better position to mitigate the economic impacts of climate change through policies and adaptation strategies, compared to lower-income Arab countries. Poor, agricultural, and raw material-dependent economies in the region are also more vulnerable to climate shocks, have less adaptive capacity, fewer resources, weaker economic and institutional capacity bases, and are unable to finance the development of appropriate adaptation programs.

Innovation, scientific research, and the expansion of the use of advanced technologies and applications of the Fourth Industrial Revolution and the Artificial Intelligence (AI) are a necessary condition for bringing about the structural change to shift towards deepening industrialization and developing it to become more dependent on local added value of medium and high technological content. Moreover, the efforts made by Arab countries to achieve the transition to a knowledge-based economy are still fragmented, insufficient, and do not meet expectations. Relying on innovation, research and

development is a necessary condition to confront the repercussions of climate change on production chains and to increase the ability of Arab economies to withstand these repercussions.

Arab countries suffer from high rates of unplanned urbanization, largely due to increasing poverty rates, the repercussions of climate change, the consequences of geopolitical conflict, and successive economic crises. Migration from rural, remote, dilapidated, or marginalized areas to urban centers in the Arab region has led to the phenomenon of unplanned urban expansion, which results in a decline in the quality of life, modest economic activity, scarcity of productive and decent job opportunities, increased pollution, and the inability of public utilities and infrastructure to meet the needs of the population. These phenomena are exacerbated by the repercussions of climate change, in addition to the scarcity of water and the low productivity of various economic sectors, most notably the agricultural sector, and then more informal migration, unsustainable energy sources, and deteriorating food security. Poverty rates and the degree of disparity in income distribution and access to land, housing, high-quality services and infrastructure, and access to public places and a clean environment also increase. To accelerate progress towards achieving SDG 11, Arab countries must confront the challenges of urbanization through planning that focuses on the needs of the population and on integrated spatial policies.

The fourth group (SDG 13 to SDG 15) focuses on environmental infrastructure. An increase in disasters and extreme weather events leads to loss of lives and economic damage. The Arab region has witnessed an increase of about 1.5 degrees Celsius on average in the past three decades, that is, about double the average global increase in temperature (0.70 degrees Celsius) during the same period. By 2030, climate change is expected to reduce the volume of renewable water resources by 20 percent because of decreased rainfall, which has become more unpredictable compared to other regions of the world, as well as an expansion in demand for water with rising temperatures and increased saltwater intrusion into coastal aquifers due to over pumping of fresh groundwater and rising sea levels. Per capita carbon dioxide emissions are increasing at the regional level and were like the global average in 2013. In the Gulf Cooperation Council (GCC) region, per capita emissions are nearly four times the global average. Egypt and Saudi Arabia also suffer from the highest cumulative emissions in the world. In 2014, the Arab region's share of global carbon dioxide emissions was less than 5 percent, but it will face more than 30 percent of its negative consequences, whether in climate-related damage or deaths. From 1990 to 2019, the economic damage caused by climate disasters was estimated at more than $19.7 billion.

The coastal areas in the Arab region are witnessing increasing rates of urbanization, high rates of pollution, and poor handling of waste and waste. Coastal areas are also greatly affected by the consequences of climate change. This has resulted in a decrease in fish wealth, which has been exacerbated by unregulated and illegal fishing activities, overfishing, and the failure of sea and water transport to respect environmental obligations and the rules of safe waste disposal. The high rates of urbanization and unplanned urban expansion also resulted in the discharge of untreated wastewater into the sea. In addition to this, there is a rise in diseases and biological and chemical pollution, which has had a negative impact on the safety of seafood, and thus on food security.

Climate changes also pose a threat to marine life in the oceans and seas, causing ocean temperatures to rise and acidity to increase, leading to the destruction of coral reefs. Expectations indicate that a third

of marine species in the Arabian Gulf alone may become extinct by 2090 due to rising water temperatures and changes in salinity and oxygen levels. Human practices and overfishing lead to the migration of marine organisms and affect the integrity of ecosystems and protection measures, as well as biodiversity and ecosystems in the coastal areas of Arab countries.

While many Arab countries are investing in making the necessary efforts to adapt to climate change and diversify their economies, adopt national strategies to reduce disaster risks, and stimulate the participation of various relevant stakeholders. However, the Arab region still suffers from weak integration between climate change policies and other development policies. It also needs to make more efforts to enhance the interaction between research and development and the policies and programs it adopts to deal with the repercussions of climate change, especially in the priority regions and sectors of each country, and to improve the integration of climate change impacts and risk assessments into the planning framework. It also requires strengthening the efforts made to address the issue of data deficiency, which negatively affects the ability of Arab countries to monitor the repercussions of climate change, follow the development of these effects, and evaluate the results of the mitigation and adaptation measures.

The fifth group (SDG 16 and SDG 17) focuses on the efficiency of institutions. Arab countries suffer from the failure of developed countries to fulfill their commitment to providing official development assistance, technology transfer, and assistance in building institutional and human capacities, which affects the ability of countries in the region and enabling them to achieve SDGs. There are specific areas such as food security, intra-trade and environmental work that require strengthening institutional cooperation and benefit greatly from national cooperation, restructuring work methods and coordination, and unleashing the enormous potential of human and non-human resources. Economic integration, harmonization of standards and capacities in the fields of transportation, connectivity, and cross-border water management, and ending conflict, and crises in Arab countries also contribute to stimulating the SDGs implementation in Arab countries. It also requires encouraging the international community to fulfill its obligations towards developing countries. In addition, there is a need to mobilize efforts and unify collective will and negotiation capacities, and largely benefit from the international cooperation during the few years remaining until 2030.

1.4 The repercussions of climate change on the implementation of the seventeen SDGs

Climate change is one of the most significant challenges facing the Arab region in achieving the 17 SDGs. These challenges are intensified considering the financial, human and natural repercussions facing all countries in general, and Arab countries in particular, due to climate change, and under the geopolitical circumstances in some countries. This section reviews the repercussions of climate change on achieving each of the seventeen SDGs in Arab countries.

SDG 1: End poverty in all its forms everywhere

According to the poverty line of (1.9) US dollars one and nine out of ten per day ($/day), the poverty rate in the Arab region in 2015 was about 5.6 percent, compared to nearly 4 percent in 2010. The Arab countries and Africa are Sub-Saharan Africa is the only region not on track to eliminate extreme poverty by 2030 if 2010 is taken as the base year. The data indicates that the percentage of the population living on $1.9/day is low, while this percentage increases for the population in the Arab region who receive a daily income between $1.9/day and $3.5/day, which indicates that extreme poverty is low, but There is a larger percentage of the population that is more likely to be classified into extreme poverty as a result of any change in circumstances, the occurrence of natural or human disasters, or the adoption of reform policies that have a high social cost. Of course, the Arab region is characterized by a large disparity at the country level in terms of average per capita income, between oil and non-oil countries, and between countries that suffer from the repercussions of strife, conflict, and political or economic instability. It should be noted that the COVID-19 pandemic, and then the Russian-Ukrainian war and its consequences, have negatively affected poverty rates in Arab countries, especially if we consider multidimensional poverty (World Bank, 2022). Climate change is expected to increase poverty rates worldwide, and in the Arab region. It should be noted that the impact will be more severe in terms of increasing the income gap between countries, and deepening inequality within the country, as a result of the disparity in the distribution of income between different regions within the same country, according to the degree of damage resulting from the results of climate change and its effects, and the resulting displacement and forced migration, as well as the decline of economic activity, and the loss of assets, wealth, and infrastructure.

SDG 2: Zero hunger

The report assessing climate change in the Arab region, issued by the Regional Initiative to Assess the Impact of Climate Change on Water Resources and the Vulnerability of Social and Economic Sectors in the Arab Region (RICARD, 2018), expects that the region will witness a rise in temperatures and negative impacts of climate change on freshwater resources. Used in various strategic sectors, which has negative effects on the social, economic, and environmental conditions in Arab countries, especially in water-dependent sectors. It should be noted that several Arab countries already suffer from dwindling water resources, regardless of climate change. Water scarcity in the Arab world is expected to reach severe levels by 2025.

Around 84 percent of agricultural lands in the Arab region are exposed to risks associated with the lack of water resources in light of climate change. Hence, climate changes negatively affect food security because of the decline in agricultural crop productivity, the increase in water needs of agricultural crops, and the spread of weeds, insects, and harmful pests, as well as the negative effects on animal and fish production. In light of these negative developments, the prices of agricultural and food crops are expected to rise, especially if we add the continued dependence of Arab countries on food imports, and the associated weakness of food systems due to supply chains being exposed to fluctuations due to different political and economic conditions, which led to a gap in major food commodities reaching 13.7

percent. It is estimated that the number of people in the Arab region suffering from malnutrition due to weak food systems, because of political and economic instability, and as a result of climate change, will increase, reaching approximately 75 million people by 2030 (Arab Organization for Agricultural Development, 2022).

SDG 3: Good health and well-being

The Arab region is one of the most vulnerable regions to climate change because of its arid nature, and because of the endemic nature of many diseases and health problems that are sensitive to poverty and climate change (Tolba and Saab, 2009). Most Arab countries also published national reports on the harmful effects of climate change in response to the request of the UNFCCC. These reports have shown that there are direct effects of climate change on health, such as increased physiological disorders, skin cancer, and cataracts, and there are indirect effects that include factors such as demographic displacement, social, economic, and environmental impacts, and air pollution. Decreased rainfall and increased temperature may lead to increased air pollution; thus, increasing respiratory diseases among urban residents. High temperatures can lead to increased thermal stresses and extreme weather disasters, leading to increased rates of death and injury. The expected increase in desertification rates in the northern parts of Sudan, Morocco, and Saudi Arabia, and the increase in sandstorms, will have negative effects on health. Heat waves affect public health, especially in Arab countries with hot summer climates, especially since heat waves are expected to become more severe. more frequent and relatively longer (World Health Organization (WHO) and WHO Regional Office for the Eastern Mediterranean (AMRO), various reports).

SDG 4: Quality education

Climate change poses major threats to the health of children and youth in the Arab region and affect their nutrition, education, survival, and future. The effects of climate change appear to hinder the education process, as periods of extreme heat and severe sandstorms prevent children from going to school in some areas. Floods block roads, preventing students from reaching schools. These phenomena may also result in power outages, forcing schools to suspend their activities. In some extreme cases, the repercussions of climate change can lead to the destruction of infrastructure and difficulty in accessing educational services. In the longer term, climate change is expected to result in other developments directly and indirectly related to education, as school-age children suffer from malnutrition, have less ability to learn than healthy and well-nourished children, and are more likely to drop out of education early. Or to fail to learn properly due to poor concentration and perception (UNICEF, 2021). It is expected that climate change will increase the rates of forced migration of many children and youth from Arab countries that suffer from political and security instability. Displaced children and youth, internally or externally, are likely to be exposed to major challenges that contribute to the deterioration of human capital in this region, due to the difficulty of continuing their education, diversifying their skills, and providing them with better job opportunities (Tolba, 2009).

To address these negative impacts of climate change on education, countries are adopting “climate-sensitive education systems,” which include reviewing existing school infrastructure to ensure its safety

and developing a plan to manage disaster risks resulting from climate change. As for new schools, the criteria for determining their accommodation and the specifications of educational facilities must be reviewed to ensure that they are appropriate and designed to withstand severe climatic events. There is also reliance on clean energy, storing rainwater for reuse, and other measures that make educational infrastructure systems more capable of dealing with the repercussions of climate change. It is worth noting the important role that education plays in training and raising public awareness to confront climate change, by adding lessons to the curricula in the pre-university education stages, to introduce the concepts of sustainable development, confronting climate change, and developing education systems that provide students with the required skills and knowledge necessary to deal with it. With future challenges and adopting appropriate behavior, such as recycling waste, conserving energy, reducing the individual carbon footprint, or by encouraging citizens to develop their skills in confronting rapid climate change and respecting the environment.

SDG 5: Gender equality

The World Bank estimated the number of migrants due to the repercussions of climate change at approximately 19.3 million migrants by 2050 in the Arab region, in addition to those who have already been displaced due to political and security instability. Women are among the groups most affected by climate migration, especially since Arab women's participation in the labor market suffers from various challenges for cultural, social, and structural reasons, and their role in decision-making and climate-related policies is often limited. The negative impacts of climate change on women include increased maternal mortality linked to heat stress, and gender-based violence following natural disasters or conflicts. Forced migration due to climate change in the region, if limited to men moving from rural areas in search of paid work opportunities, is expected to increase the pressures imposed on rural women to take over their husbands' activities in addition to their daily activities. For example, in Yemen and Sudan, the daily activities of women and children require them to travel long distances to fetch safe water. Forced migrations also result in increased school dropout rates, especially among girls. The health of women and girls is also at risk due to climate change and disasters by negatively affecting their access to health services and care. It also increases the risks related to the health of the mother and child, as many studies indicate that extreme heat increases the spread of vector-borne diseases such as malaria and others, as previously mentioned, which affect mothers and newborns to a greater extent.

SDG 6: Clean water and sanitation

Studies and forecasts indicate that there are large variations in the maximum trends of rainfall in the Arab region until the end of the century, with a general trend towards drought, as the number of days witnessing heavy rainfall decreases annually, except for the headwaters of the Euphrates River and the Senegal River. It should be noted that eighteen countries in the Arab region are classified as water poor, with a per capita water supply of less than 1,000 cubic meter, with severe restrictions on its quality and accessibility. Rising temperatures and increased evaporation rates associated with climate change are expected to increase the severity of the crisis in countries that rely more on rainfall or rivers. It is also expected to be affected by the Arabian Peninsula region, which suffers from scarcity of fresh water and

dependence on water desalination, which becomes increasingly difficult with rising levels of salinity resulting from climate change. The past years have also witnessed a decline in groundwater levels in the Arab region by one to two meters annually. It is clear that the Arab region is suffering from water scarcity due to climate change.

The impact on water availability depends on the success of adaptation efforts, and areas that are expected to suffer from a lack of water include the Upper Nile Valley, the southwestern Arabian Peninsula, and the northern Horn of Africa, due to the weak ability of these areas to adapt. While the Tigris and Euphrates Basin and the lower Nile Valley, including the Nile Delta, are among the areas where the impact of climate change on water availability is expected to be low, due to their increased ability to adapt. The Arab region is also moderately affected by internal floods, and if adaptation efforts are not successful, the degree of vulnerability to internal floods increases from north to south, and the degree of exposure to them decreases relatively in coastal areas.

SDG 7: Affordable and clean energy

Climate change is expected to have significant negative effects on energy production and consumption in the Arab region. On the one hand, countries may have to rely more on energy-intensive methods to provide adequate water supplies, through desalination and groundwater pumping. Farmers are becoming more dependent on more energy-intensive methods due to higher demand for fertilizers, using advanced irrigation methods, and more diverse harvesting patterns to maintain productivity levels. High temperatures also limit workers' ability to work in a healthy manner, and this may result in changing working hours for some activities, which leads to increased energy consumption due to the increasing reliance on air conditioning to cope with high temperatures. The ability to produce electricity from hydropower and other water-intensive generation technologies may decline. Reduced water availability also negatively impacts the cooling and cleaning systems required for concentrated solar power, nuclear power, and many other thermal generation technologies. Changing patterns of supply and demand for energy result in higher energy prices in the region. It should be noted that there are also some opportunities in some parts of the Arab region, where the increase in the number of sunny days more than before results in higher production rates of solar farms and the development of their productivity.

Various challenges appear in terms of the efficiency of the current infrastructure of the energy sector, and the need to develop it to meet the challenges resulting from climate change, and to meet the steady increase in demand for energy in a number of countries in the region. This requires a significant amount of time, in addition to the high cost of developing the infrastructure of the energy sector. For example, nuclear power plants take several years or even decades to be built. The transition to low-carbon energy technologies takes several years and is expensive. Most countries in the region are taking the necessary measures to adapt to the repercussions of climate change, which increases pressure on the public budgets of these countries. In Egypt, for example, the government faces the costs of transitioning toward clean energy and gradually reducing fossil fuel subsidies. Dealing with the repercussions of climate change in the Arab region will entail taking the necessary measures to develop manufacturing activities to become less consuming of energy in general, and of unclean energy in particular.

Goal 8: Decent work and economic growth

Experts estimate that the GCC economy could decline by 20 percent by 2050 if temperatures rise by more than 2 degrees, compared to pre-industrial levels. As part of the trend towards clean energy, demand for oil is expected to decline, and the GDP of the Gulf Cooperation Council countries will become vulnerable to contraction. The negative impact on the economy of the Arab region is increasing since most industries, such as chemicals, metals, refining and energy production sectors, have established and expanded to benefit from the low cost of gas and oil. The policies implemented to deal with the repercussions of climate change, such as reducing carbon emissions and imposing carbon taxes, will have a significant impact on the region's economies. The ideal solution to deal with these challenges is to adopt strategies for economic diversification based on green and sustainable activities. In addition, urban areas face population pressures resulting from rural and remote-to-urban migration, and their ability to provide public services and facilities and to provide opportunities for economic growth and decent work is declining. Agricultural workers face a decrease in job opportunities in this sector. Cultivated land also becomes scarcer and less productive, agricultural income declines, and thus economic activity and employment opportunities in rural areas generally decline. This also results in more young people being stimulated to migrate to urban centres, increased competition for jobs and resources, a rising low-income population, and greater inequality of income and wealth, which is reflected in growing inequality and economic exclusion.

Despite these challenges that affect decent employment in the Arab region, climate change and environmental degradation will stimulate the transition to green energy and increase the demand for labor in the clean energy, circular economy, and knowledge economy sectors. This, of course, requires requalifying young people in Arab countries for new jobs. International Labor Organization (ILO) forecasts indicate that the shift to green economic activities could achieve net gains of 18 million jobs by 2030. Climate change mitigation measures alone will require a lot of labor, and economic diversification efforts, especially in the Gulf region, provide more employment opportunities. Productive and decent work. Hence the importance of developing education, training, and qualification systems to keep pace with the requirements of new jobs and future job opportunities. Continuing learning must become a priority in the Arab region, as change is coming more quickly than formal education systems can respond to it (ILO, 2023).

SDG 9: Industry, innovation and infrastructure

According to 2019 data, the industrial sector is responsible for about 25% of fossil fuel-related CO2 emissions globally. The manufacturing industry is also one of the productive sectors that contribute most to greenhouse gas emissions in the Arab region. In achieving high rates of growth in the manufacturing sector, most Arab countries have also relied on increasing production in energy-intensive industries such as cement, iron, steel, fertilisers, pharmaceuticals, chemical industries, and glass. Fossil fuels have also dominated the energy mix in the manufacturing sector over the past decades. Although the Arab countries are trying to adopt some initiatives to improve the efficiency of energy use in the manufacturing sector, with the aim of reducing emissions in the sector, through the development of furnaces, industrial engines

and boilers, there is a need to provide other large investments to develop the capacity of the manufacturing industries in the Arab countries to move towards... More intensive use of clean energy, improving energy efficiency, working to capture and store carbon, paying attention to maintenance, replacement, and renewal, resetting equipment, and replacing obsolete ones, modernizing production lines, reducing wasted energy, reusing, and recycling products and materials, and increasing productivity. Technological developments and innovations are expected to play a role in reducing energy consumption in the manufacturing sector, especially in the field of developing production and supply chains for the carbon dioxide capture and storage industry. This also requires strengthening international cooperation and partnerships in the areas of research, development, and operation.

SDG 10: Reduced inequalities

The issues of climate change and its repercussions have embodied the issue of inequality for the Arab region, and this is shown by the developing and poorest countries, especially the Arab countries, bearing the consequences of the practices of the developed and rich countries. Poor children are among the groups most vulnerable to the negative consequences of climate change. The Save the Children report indicates that children born in the Arab region are more vulnerable to climate threats, compared to children in other regions and countries, due to river flooding, damage to agricultural crops, and drought. Children born in 2020 will be exposed to approximately 4.5 times the risk of river floods, approximately 4.4 times the risk of damage to agricultural crops, 3 times the risk of drought, and 7.2 times the risk of exposure to heat waves compared to those born in 1960 (UNFPA, 2022).

SDG 11: Sustainable cities and communities

Studies indicate that the Arab region, which is currently inhabited by approximately 547 million people, and whose population is expected to rise to 724 million people by 2050, will become uninhabitable, especially as temperatures continue to rise to unprecedented levels, and the resulting consequences. From severe droughts, the outbreak of fires in some forests, and causing power outages for long periods. The northern Sultanate of Oman was also struck last summer by Cyclone Shaheen, which was reported to be the first tropical cyclone to reach the far west of the Gulf. In recent years, some Gulf cities have suffered flash floods. Migrations have also increased due to the decline in agricultural activities and the increase in conflict in different parts of the Arab region. Health risks associated with air pollution and unusually high temperatures have also increased. Evidence indicates that the city of Alexandria in Egypt may be negatively affected by a sea level rise of 11.3 cm in just 100 years. This increase greatly affects the northern Nile Delta region, and three other major cities, including Rosetta, Burullus, and Port Said. Alexandria has also been exposed to heavy floods in recent years, which has increased concerns about flooding and erosion (World Bank, 2016).

Syria has been exposed to long periods of drought, the last of which was in 2006-2010, which experts considered the longest drought period in 900 years, which coincided with heat waves and scarcity of rain, which led to desertification, causing the suffering of 75 percent of Syria's farmers and a significant deterioration in Cultivation of basic crops, and the death of 85 percent of livestock. These difficult conditions resulted in the significant destruction of agricultural lands and caused the

displacement of 1.5 million people inside Syria before the outbreak of war. On the other hand, we find that Arab countries such as Somalia suffered from long years of drought, which resulted in the displacement of about 4 million citizens. Data indicate that more than half of the world's refugees come from the Arab region, due to the repercussions of climate change. It is expected that more than 43 cities will be affected by sea level rise, which will negatively affect maritime transport, related economic activities, tourism, fish resources, and the displacement of at least 37 million people throughout the Arab region (World Bank, 2016).

SDG 12: Responsible consumption and production

The demand for housing, transportation, and food services is responsible for about 75-80 percent of consumption in the Arab region. These three areas of consumption are greatly affected by climate change. Mitigation measures require reducing demand for these goods and services and changing the consumption pattern to become more sustainable. Economic growth trends in Arab countries contribute to relying on stimulating consumption, and every increase in the level of income turns into an increase in the purchasing power of individuals and the pursuit of material well-being. The challenge of applying governance rules, especially in government institutions, has also led to high consumption rates, especially with regard to increased demand for energy sources and wasted consumption of various resources and final products as well. Consumption policies focus on protecting the consumer, monitoring health and safety, and providing information to the consumer about products, through environmental labeling and others. However, awareness of the extent of the mutual influence between consumption patterns and climate change is modest in the Arab region. Many factors have contributed to relying on unsustainable consumption patterns for a long period of time, especially considering increasing urbanization rates, increasing reliance on private transportation, and so on. Technological developments are also expected to contribute to changing consumption patterns on several fronts. Technological developments lead to the provision of more efficient products in the use of energy and raw materials, especially in the areas of housing and transportation, and the shift to the use of alternative fuels, for example, electricity, ethanol, biodiesel, or gas. The expansion of sharing economy services in the Arab region may contribute to the shift towards more sustainable consumption patterns.

SDG 13: Climate action

Sustainable environmental management is one of the most important challenges facing long-term development efforts in the region. SDG 13 includes six sub-goals, which include three implementation goals aimed at providing support, technology, and capacity-building that enhance the achievement of the SDGs. The remaining sub-goals aim to build human and institutional capacities and mainstream climate policies. All of these goals can be achieved through a set of policies represented in 1) enhancing the ability and flexibility of countries to adapt to risks and natural disasters associated with climate change in all countries, 2) integrating measures and policies related to climate change into the plans and strategies that are formulated at the national level. 3) Improving education and increasing individuals' awareness of the risks associated with climate change, and how to adapt to and reduce those changes, in addition to supporting institutional capacities in various countries to confront climate change. 4) Implementing the

commitment made by developed countries to the United Nations Framework Convention on Climate Change, By mobilizing $100 billion annually starting in 2020 to meet the needs of developing countries to address climate change, and providing support to developing countries that take purposeful and transparent measures and policies to address climate change, in addition to fully activating the role of the Green Climate Fund by providing appropriate capital for it, as The Green Climate Fund plays an important role in providing appropriate support to developing countries with the aim of helping those countries adapt to climate change, and 5) strengthening mechanisms that increase the capacity for effective planning and management of climate change in least developed countries and small island developing states, with a focus on women and youth. and local and marginalized communities in addressing climate change (Al-Sarihi and Loumi, 2019)

SDG 14: Life below water

Many Arab countries have long coastlines and low-lying coastal areas, making them highly vulnerable to sea level rise. This poses risks to vital infrastructure and densely populated cities along the coast. Climate change is exacerbating the water scarcity crisis in the Arab region, affecting freshwater resources and the health of marine ecosystems. Some Arab countries are also affected by the decline in river flows, the impact of groundwater, and the consequences on river mouths, coastal cities, and ports, which also affects marine biodiversity. Arab countries are home to valuable coral reefs, such as those in the Red Sea and the Gulf of Aqaba. Rising sea temperatures due to climate change increase the risk of coral bleaching. Fishing is also an important economic activity in some Arab cities. Ocean and sea warming, and acidification caused by climate change can disrupt fish migration patterns, change the marine environment, and impact fish stocks, with potential impacts on local economies and food security.

Arab countries have unique coastal ecosystems, including mangroves, seagrass beds and salt marshes, which are highly sensitive to changes in sea level and temperatures. Climate changes can lead to the loss of these vital systems, affecting biodiversity in Arab countries. Despite these challenges, Arab countries have opportunities to promote sustainable development and address the repercussions of climate change by investing in infrastructure that is resistant to these changes, developing the coastal zone management system to become more resilient and flexible, and supporting sustainable practices in fisheries, which results in stimulating the achievement of SDG 14 while also mitigating the negative impacts of climate change.

SDG 15: Life on land

Some Arab countries are focusing on combating desertification and land degradation caused by overgrazing, unsustainable agricultural practices, and water scarcity. Sustainable land management practices, afforestation and reforestation initiatives are crucial to combating land degradation, as Saudi Arabia, Oman, Egypt, and Jordan aim to plant several million trees and palm trees, with a target of planting about 50 billion trees in the Middle East. Most Arab countries are adopting national strategies and plans to transition towards clean and renewable energy, relying on their abundant resources of solar and wind energy to enhance the production of sustainable and clean energy. Sustainable water management practices are necessary to adapt to the effects of climate change and demonstrate the

importance of regional cooperation to preserve biodiversity in Arab countries, through the exchange of knowledge and experiences, building capabilities, and coordinating joint efforts in implementing climate action, programs and projects necessary to implement SDG 15. Integrating SDG 15 into national development policies, strategies and plans, and community participation, will also have an important impact in stimulating its achievement, addressing the repercussions of climate change, and mitigating climate change, so that the region can move towards a more resilient and environmentally sustainable future.

SDG 16: Peace, justice and strong institutions

The importance of effective governance and its integration into the system of planning, financing, implementation, monitoring, and evaluation appears to confront the repercussions of climate change in the Arab region, especially in light of the repercussions of climate change, which has led to increasing disputes over scarce natural resources. Effective management of water resources, irrigation systems, uses of natural fertilizers, and management of agricultural waste have become essentials that cannot be overlooked for rational dealing with and adaptation to the repercussions of climate change. As urban centers expand rapidly due to rapid population growth and the influx of rural migrants into cities, the infrastructure becomes unable to serve the increase in population. Climate-induced pressures such as famines also force many rural people to find natural resources in neighboring regions or countries. For example, more than a million Somalis live as refugees in the Horn of Africa and Yemen and 1.1 million remain inside Somalia as internally displaced people. Likewise, climate refugees in Sudan are moving from north to south due to increasing rates of desertification, with the highest levels of food insecurity recorded in the southern conflict zones of North and South Darfur, and parts of South Kordofan and Blue Nile states. These exceptional circumstances that countries are going through negatively affect the ability of governments to focus efforts and financial resources to effectively manage the planning system to mitigate and adapt to the repercussions of climate change.

SDG 17: Partnerships for the goals

Various international reports that focus on monitoring, following up and evaluating the progress being made in achieving the SDGs have warned that the effects of climate change may negatively affect the level of progress in the sustainable development agenda, which threatens to reverse many of the gains achieved over the past decades. In addition to the negative impact of conditions of instability, equality, and economic inequality. Climate change and sustainable development are also linked by multiple links, through the 2030 Agenda for Sustainable Development and the 2015 Paris Climate Change Agreement. Both agreements provide the greatest opportunity for many countries to bring about positive and systemic change that ensures a resilient, productive and healthy environment for current and future generations, and a framework for cooperation and integration. Coordination to confront the repercussions of climate change.

1.5 Best practices to balance climate action and sustainable development

The Arab Strategy for Disaster Risk Reduction is the generally agreed regional framework for integrating disaster risk reduction measures into development, while helping to build regional, national, and local capacities in this area. The strategy was adopted by the Council of Arab Ministers Responsible for the Environment at its twenty-second session, held at the League of Arab States in December 2010. Many United Nations organizations, Arab agencies and technical organizations, the International Federation of Red Cross and Red Crescent Societies, and the Global Fund for Disaster Reduction and Recovery presented One of its implications for the World Bank is the support necessary to develop and implement the strategy. The strategy emphasizes the commitment made by the League of Arab States to strengthen the integration of disaster risk reduction measures into regional policies for sustainable development, common country assessments, and environmental and disaster management.

The United Nations Development Program (UNDP) also issued the Arab Climate Resilience Initiative as a regional initiative, prepared in coordination with regional and national partners. The initiative responded to the increasing climate risks in the Arab region. The initiative also helped Arab countries understand potential climate impacts, while promoting an integrated, cross-sectoral approach to low-emission and climate-resilient pathways to climate change. The Arab Climate Change Resilience Initiative focused on building knowledge related to climate change trends and priorities and enhancing the ability of Arab countries to access financing related to climate action. on implementing strategic policies on priority areas such as water security, drought, and access to sustainable energy; and establishing new partnerships to scale up local action for climate-resilient development. One of the main streams of activities under the initiative was to hold political dialogues on climate change challenges and solutions in the region. The Arab Initiative for Adaptation to Climate Change also provided catalytic support for implementation in 4 countries in the region, including Djibouti, Egypt, Somalia, and Sudan, by providing small grants to support the formulation of new projects submitted to the Green Climate Fund on the topic of climate resilience. The initiative also supported the design of several new multi-country initiatives that are set to emerge as a regional platform for achieving the SDGs and the Paris Agreement. These include a new initiative on the nexus between climate action and achieving the SDGs, as described in more detail below, as well as new regional initiatives on climate change, peace and security, and sustainable energy solutions for communities displaced by unstable situations.

The United Nations Development Program (UNDP) and the Islamic Development Bank provided development assistance to countries in the Arab region to combat climate change. Key areas of investment include agriculture and water security, with an increasing focus on ways to make these investments resilient to climate change. In 2016, the United Nations Development Program and the Islamic Development Bank established a new phase of the partnership by signing a global memorandum of understanding on enhancing cooperation in several strategic areas of work, including climate change. The government of UAE initiative to launch the first edition of Climate Week in the Middle East and North Africa region is an important step forward, with the aim of providing a platform for governments, cities, private sector leaders, financial institutions, and civil society organizations to explore the challenges and

opportunities posed by climate change and translate them into action plans.

From the above, health systems in Arab countries need to adapt and prepare to respond and confront the repercussions of climate change on health and human capital. And including childhood as one of the environmental strategic axes. This includes the most vulnerable migrant and displaced children and should be recognized as part of government and business climate change strategies and plans, including key climate documents such as Nationally Determined Contributions and National Adaptation Plans. Children and young people must also be a key part of government climate change and environmental policy decision-making, especially those who are already moving and adapting to the impact of climate change. This should also include the systematic integration of climate change science into school curricula. and protect services that meet the needs of children and the impact of climate change through adaptation initiatives. Schools, water systems, sanitation facilities, health care and other social services must be resilient and able to withstand environmental shocks. and mobility preparedness, including "safe migration" as an option for children and youth affected by climate change. Expand safe and legal pathways for children and youth affected by climate change and provide migrant and displaced children with basic services regardless of their migration status.

The exchange of skills and training for young people between countries or cities of origin and destination, with a focus on raising skills for the jobs of the future, especially since the agricultural, oil and fossil energy sectors have become less viable. This is a win-win for youth, communities, economies, and the environment. There is no solution to climate change without involving young people, not only as it is now well established, but also from childhood, with increased efforts towards inclusion for all mitigation and adaptation programs, to ensure the inclusion of women, while emphasizing the need to provide gender-specific data, so that policies The programs being implemented are gender-responsive and evidence-based, with a greater focus on working with local organizations to support initiatives led by and benefiting women, and ensuring that the resources allocated to these initiatives are more efficiently used and that they actually respond to the needs identified by local communities affected by Climate changes, affected by forced displacement, as well as taking into account the special circumstances of each region.

1.6 Policy Recommendations

From the above, the Arab countries face a number of challenges that negatively affect their progress in achieving the SDGs. Successful experiences, best initiatives, and recent studies also indicate that adopting appropriate policies and implementing effective programs to address the repercussions of climate change can give an impetus to achieving the SDGs. in Arab countries and enhance their resilience. Below we review some of the main recommendations in this regard:

- Expanding the production and use of renewable and clean energy, especially as Arab countries enjoy great potential to produce solar energy, wind energy, and green hydrogen, by providing incentives, subsidies, and favorable regulatory frameworks. It should be noted that Arab countries have prepared executive plans that include specific quantitative targets for expanding renewable energy production, and a number of giant initiatives and projects for clean energy production have already entered into force, as will be discussed in the following chapters of the report.

- Raising energy efficiency by adopting the necessary measures to use energy efficiently in all sectors, especially industry, transportation, and urban development, to reduce greenhouse gas emissions, despite the Arab region's modest share of carbon emissions.
- Emphasizing the importance of implementing the new urban plan with the aim of expanding sustainable urban development policies and programs, especially with regard to sustainable housing, providing green and open spaces within cities, the gradual transition towards sustainable and smart transport, and implementing smart projects for managing public facilities and infrastructure (water and energy services and management). waste, etc.), supporting the exploitation of local resources to stimulate the local economy, and applying urban governance.
- Develop plans for integrated water management to enhance water security and resilience to confront drought and water scarcity in the Arab region. Expanding the implementation of sustainable agriculture projects and smart water-saving irrigation techniques, with the aim of increasing the efficiency of exploiting land and water resources, and focusing on growing drought-resistant crops, to enhance food security in the Arab region.
- Implementing measures to protect coastal areas from sea level rise and extreme climate events, such as building sea walls and restoring coastal ecosystems, setting new standards for the design of coastal cities, so that construction in the most exposed low-lying areas is prevented, and using advanced technologies such as "sponge cities", Which is based on absorbing surplus water, by creating underground reservoirs to absorb excess amounts of flood water, heavy rains, and rising sea levels.
- Developing the capacity of central ministries and local units responsible for confronting disasters in general, and climate disasters in particular, by providing information and improving mechanisms and methodologies for collecting and analyzing data to support decision-making and evidence-driven policy-making, implementing institutional capacity development programs for agencies responsible for emergencies and their workers, and raising Community awareness to prepare for climate disasters and deal with them quickly and effectively.
- The gradual transition towards applying the concept of integrated management, which is based on coordination between various government agencies and other relevant stakeholders and the application of good governance principles at the central and local levels, to raise institutional capabilities to deal with climate issues efficiently and effectively, and to give a strong impetus to the implementation of SDGs, which require close coordination, distribution of roles and responsibilities, and strengthening of partnerships among relevant stakeholders.
- Mobilizing the necessary resources to finance climate change adaptation programs through the development of innovative financing tools, such as green bonds and public-private partnerships, and emphasizing the need to allocate a percentage of the state budgets of Arab countries to finance climate change adaptation projects and implement SDGs as well, and raise the capacity of Arab countries should benefit from the financing available from international funds and encourage private sector participation through a system of innovative and smart incentives linked to a specific time frame and clear outcomes, and call on development partners from international institutions to provide financial and technical support to implement projects that serve both adaptation to the repercussions of climate change and the implementation of the SDGs too.
- Raising community awareness of the importance of dealing with the repercussions of climate change and SDGs as well and changing the culture of dealing with these issues as they are fundamental issues that affect the lives of citizens, especially marginalized groups, and that they are not considered an issue limited to developed countries only.

Chapter Two

Resilience and Adaptation of Water and Agricultural Sectors

2.1 Introduction

The agricultural sector stands out as one of the most vulnerable to the adverse effects of climate change. Climate variations are anticipated to exert significant negative impacts on agricultural productivity. These repercussions are multifaceted, starting with the alteration of natural, chemical, and biological soil properties, progressing to the proliferation of pests, insects, and diseases, and culminating in the transformation of the crops produced. In a report issued by the Food and Agriculture Organization (FAO) in 2018, it is emphasized that climate change exerts both direct and indirect influences on agricultural output. This includes shifts in rainfall patterns, the onset of droughts and floods, the geographical redistribution of pests and diseases, and the substantial volumes of carbon dioxide absorbed by oceans, which subsequently undergo acidification, impacting the health of the oceans and those whose livelihoods and nutrition rely on them.

Consequently, the agricultural and water sectors in the Arab region confront a wide range of climate change-induced threats that have direct implications for food security. These threats encompass rising sea levels, resulting in increased salinity and groundwater levels in agricultural areas, the loss of arable lands, decreased plant and animal yields, modifications in fish stock types and compositions and the displacement of numerous inhabitants from these areas due to land degradation or the scarcity of alternative employment opportunities. Given that most Arab countries are net food importers, there is a real possibility of food security crises stemming from the projected surge in foreign import expenses. The interconnection between climate, water, and food sectors necessitates a comprehensive approach that entails an integrated action plan for food and climate security policies. This plan should incorporate the application of new insights into climate-smart water management strategies.

This chapter delves into the means of cultivating resilience and adaptation within the agricultural and irrigation sectors in response to climate change. It commences with an analysis of the current state of these two sectors and the interconnectedness between them to identify the challenges that will be exacerbated by climate change. The chapter encompasses an examination of the status of agriculture and water resources sectors, followed by an assessment of the impact of climate change on these sectors. It also scrutinizes the challenges in key agricultural activities, including crop production, livestock and fish production, food security, and the influence of climate change on each of these domains. The dwindling availability of surface and groundwater resources and the influence of climate change on both are considered. Furthermore, the chapter delves into the issue of rising sea levels, highlighting how its effects extend to both sectors. The chapter concludes by outlining the most crucial policies and measures required to mitigate and adapt to climate change within the agricultural and water resources sectors in the Arab region.

2.2 Assessing and Monitoring Climate Change Impacts

In accordance with the projections made by IPCC, the Arab region is bracing itself for a hotter future, characterized by soaring temperatures, reduced rainfall, deteriorating water quality, and an increased frequency of droughts. These climatic changes are poised to take a toll on agricultural productivity. The escalating occurrences of extreme and scorching weather, coupled with the burgeoning population and unregulated urban sprawl, pose substantial challenges to both regional and national endeavors aimed at mitigating the impacts of climate change. This is especially concerning considering that most of the Arab world is situated within arid and semi-arid climates, already suffering with severe heat and year-to-year climatic fluctuations. Notably, in 2023, temperature records reached unprecedented heights, with five Arab countries registering new record-breaking temperatures. Many nations in the Arab region have now become accustomed to summer temperatures surging to 50 degrees Celsius.

Within the Arab region, there are also six least developed countries, characterized by predominantly rural populations and per capita annual GDP that may not exceed 600 US dollars. Gulf nations, while generally better equipped to adapt to climate change, remain among the most susceptible to adverse climate impacts (World Bank, 2012). Although the ability of Arab countries to confront these impacts varies based on numerous variables, there are shared characteristics throughout the region, including high temperatures, lengthy summers, and persistent water scarcity issues. Climate change is already exacerbating these challenges, impacting public health, water availability, the degradation of ecosystem services, agriculture, infrastructure, energy consumption, and economic activities. Extreme weather events are becoming more prevalent in the Arab region, characterized by extreme temperatures and shorter yet more intense spells of rainfall.

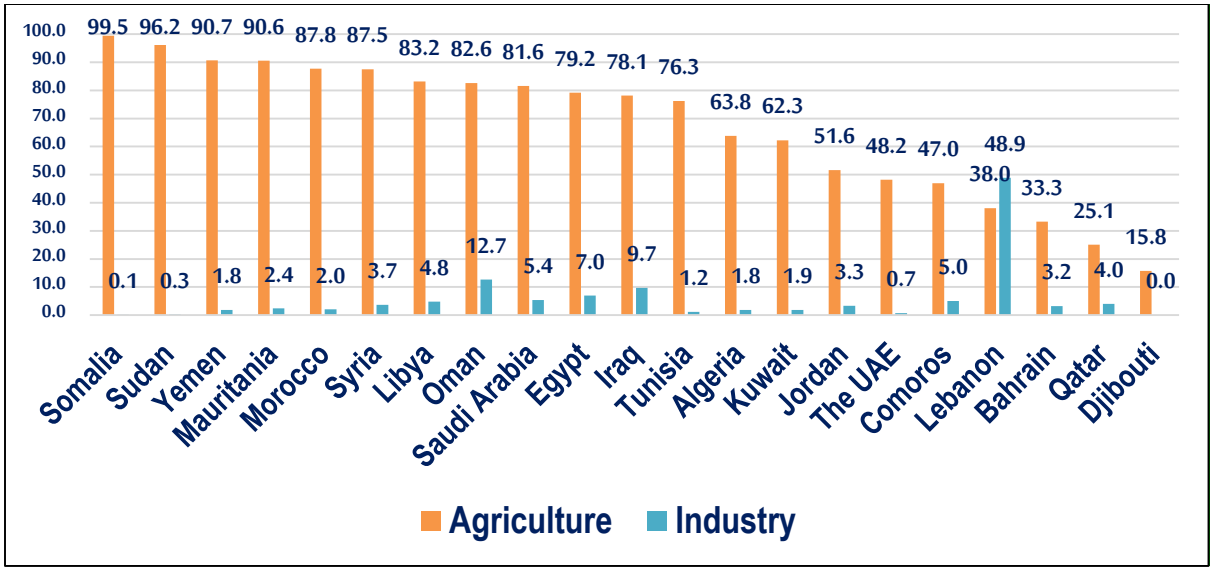
2.2.1 Water Resources: Challenges and Trends

The Arab region, vast in its geographical expanse, holds a paradoxical reality: vast lands with scarce water resources. Representing only 1% of the world's total surface water flow, the region grapples with dwindling non-renewable groundwater, primarily due to unsustainable consumption patterns. Since 1990, the average per capita water share in the Arab world has plummeted from 1,350 m3/year to approximately 650 m3/year in 2021 (Arab Monetary Fund, 2021). Alarmingly, this falls below the global water poverty line of 1,000 m3/year. Projections further indicate a dire future, with per capita availability likely dwindling to 300 m3/year by 2050, if current trends persist (Molden et al, 2011). Many countries in the region, encompassing the Gulf Cooperation Council (GCC) nations, Yemen, Jordan, Palestine, and others, are facing "absolute water scarcity," with shares dipping below 500 m3/year. Meanwhile, nations like Lebanon, Morocco, and Iraq fluctuates on the brink, classified under “water scarcity countries.” Despite its vastness, the Arab region receives a mere 2.1% of global average annual rainfall, housing only 0.3% of the world's annual renewable water resources (Saab & Sadik, 2016). Adding complexity to the situation is the fact that a significant portion of the Arab region's water resources is transboundary. While this has led to interdependencies, it also means that regional security is tied to how well these shared resources are managed. Unfortunately, despite the reliance on shared water, many countries lack clear, documented treaties for equitable distribution and management.

Groundwater, a vital lifeline, particularly for agriculture, is being consumed at alarming rates, with nations like Saudi Arabia and Yemen depending majorly on it for irrigation. The repercussions are evident, with groundwater reserves in two-thirds of the Arab region plummeting between 2002-2019. Moreover, by 2050, the region is set to face a sharp reduction in per capita groundwater shares. External threats such as pollution from industrial and agricultural activities, and seawater intrusion, further imperil the region's groundwater. Furthermore, climatic deviations, like the staggering temperatures reaching 50°C during summers, only exacerbate the region's water stress. This, coupled with its growing population and urban sprawl, amplifies the challenges. However, the scenario isn't merely a bleak canvas of dwindling resources. It's an encouragement for collaborative, innovative, and sustainable strategies. The region must prioritize water management, conservation techniques, and robust policies to safeguard this precious resource for its present and future generations.

The distribution of water resources in the Arab region reflects a significant allocation, with over two-thirds directed towards agriculture, approximately 5.7 percent channeled into industrial processes, and 26.8 percent earmarked for domestic use. Lebanon stands as an outlier, where a larger proportion is utilized in the industrial sector. The agricultural sector, a cornerstone of the region's economies, witnesses considerable variation in water usage. It dominates in several countries, surpassing 96 percent in Somalia and Sudan, exceeding 90 percent in Yemen and Mauritania, and rising above 80 percent in Morocco, Syria, Libya, Oman, Saudi Arabia, Iraq, and Egypt. In contrast, it remains below 25 percent in Qatar and barely scrapes 16 percent in Djibouti, as depicted in Figure 1.2.

Figure 2.1: Annual percentage of water use by sector (2019)



Source"data"AQUASTAT" for the year 2019.

2.2.2 The impact of climate change on water resources

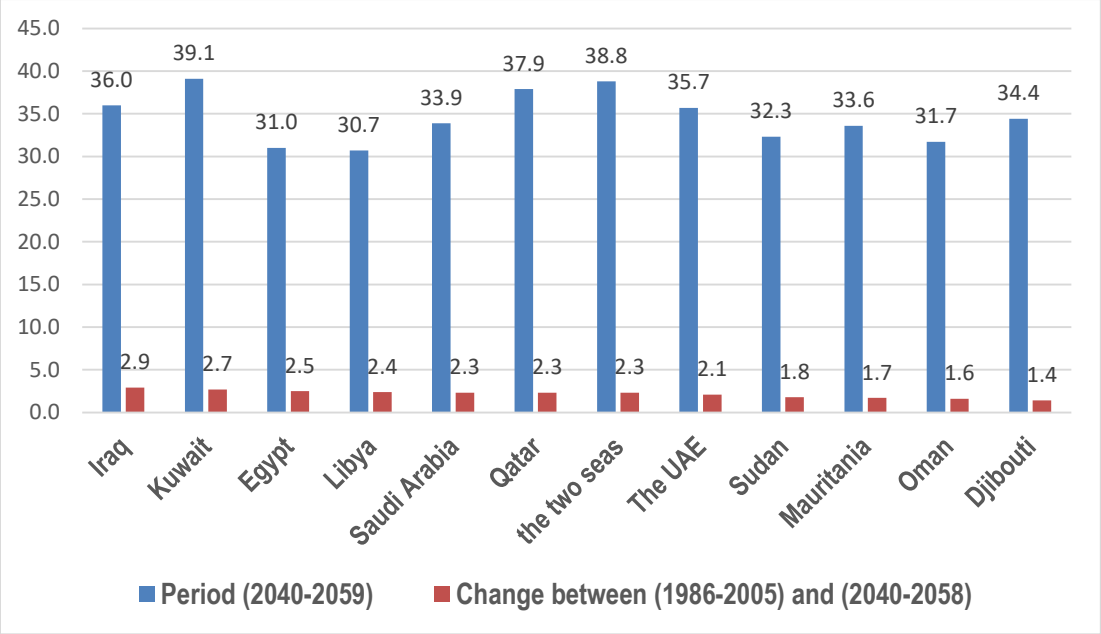
The impending consequences of climate change in the Arab region are poised to unleash a wave of challenges. These include heightened occurrences of droughts and scorching heatwaves, the compounding pressure of population growth, dwindling natural resources, particularly freshwater sources, and the looming threat of rising sea levels. The latter could inundate coastal areas, necessitating large-scale relocations and presenting monumental societal and economic hurdles. The Arab region is acutely sensitive to the perils of climate change, especially in the context of irrigated agriculture. The region struggles with an existing scarcity of water resources, with a substantial portion of the water budget dedicated to irrigating cultivated lands, exacerbated by the necessity of coping with high temperatures that demand greater water consumption. To illustrate, Egypt is projected to experience a 6 to 16 percent surge in the annual irrigation demand throughout the twenty-first century, primarily due to escalating evaporation rates, which will result in a more extensive water requirement for crops. The region is already grappling with a water deficit, which will exacerbate in tandem with population growth, expected to surge by more than 60 percent by 2045. Climate change further portends a 20 percent reduction in rainfall and an increase in evaporation, intensifying water scarcity. For instance, Syria faces the ominous specter of 60 percent of its land succumbing to desertification due to rising temperatures, decreased rainfall, and erratic weather patterns. These climate-induced challenges are poised to amplify the water crisis in the Arab region as it relies heavily on rainwater and groundwater for its freshwater supply.

A slew of climate model simulations reveals a projected decline in precipitation by over 90 percent across North Africa and the Middle East by the close of the twenty-first century. Climate change will intensify water consumption in critical sectors, particularly in countries experiencing constrained water resources, rapid population growth, and robust economic development. This will elevate the demand for supplementary irrigation, culminating in lengthier supplementary irrigation periods under climate change. In addition to the risk of receding rainfall, the Arab region is facing a looming threat of water resource evaporation, especially in vital water bodies like the Tigris and Euphrates rivers, the Jordan River, and Lake Tiberias. Over the last three decades, temperature spikes, induced by climate change, have accelerated water scarcity due to soaring evaporation rates. A significant portion of Arab water resources is comprised of surface water, making them highly susceptible to these changing climate conditions. Consequently, the temperatures could exceed 30 degrees Celsius in numerous Arab countries by 2050, underscoring the gravity of the situation (Figure 2.2).

Given the integral connection between agriculture and water resources, the agricultural sector is particularly vulnerable to the repercussions of climate change. Notably, five Arab countries are listed among the world's ten most susceptible to climate change risks. Several other Arab nations face a high or severe risk of climate change impact. The severity of climate change is projected to heighten in the future, with detrimental repercussions for financial resources and food security, particularly for groups reliant on agriculture. This region, already characterized by its arid conditions, will likely see further reductions in rainfall, intensifying drought occurrences and amplifying the existing water scarcity challenges. Particularly at risk are the coastal zones of countries like Egypt, Kuwait, Libya, Qatar, Tunisia, and UAE. These areas, characterized by their dense populations and low altitudes, face the looming threat of rising

sea levels. This rise is not only a danger in terms of land inundation but also carries the peril of saltwater intrusion, potentially rendering agricultural lands infertile. Furthermore, as temperatures rise, crop yields are expected to suffer, livestock may struggle to adapt, and fisheries are at risk due to altered sea temperatures and salinity in critical water bodies, including the Arabian Sea and the Mediterranean. Such changes can severely impact the food security of the region, with cascading effects on socio-economic stability and communal harmony. As the FAO's 2022 report suggests, proactive measures are essential to mitigate these risks and ensure sustainable growth for the region.

Figure 2.2: Average summer temperature (in degrees Celsius) and temperature change over the period (1986-2005) compared to the period (2040-2059)



Source: Azour & Duenwald (March 2022, 30)

2.2.3 The agriculture sector in the Arab region

The agricultural sector stands as one of the most vulnerable to the effects of climate change, given its intricate reliance on interconnected elements like soil, water, and climate. In the Arab region, agriculture occupies a relatively small share of the world's total cultivated area, approximately 5 percent. However, it struggles with unique challenges due to the predominance of arid and semi-arid landscapes. The region faces a problem where per capita land availability continually dwindles due to rapid population growth and urbanization. Rain-fed agriculture prevails as the predominant agricultural system in the Arab region. Irrigated land constitutes less than 28 percent of its total cultivated area. This places annual agricultural productivity and food security on a teetering balance, dependent on the unpredictable fluctuations of annual rainfall. Nonetheless, some Arab countries, notably those in the Arabian Peninsula and Egypt, exhibit a substantial reliance on irrigated agriculture. In these regions, fully irrigated agriculture encompasses 100 percent and 95 percent of the total cultivated area, respectively. These

approaches draw water from various sources, including surface water, groundwater, and integrated use of both. Supplementary irrigation practices are also employed in rainfed areas when rainfall is scarce. In this context, adapting to climate change entails addressing several aspects, including crop water requirements, crop selection with salinity and drought tolerance, efficient irrigation systems at both the channel and farm levels, and the management of storage tanks (FAO, 2013).

Rural communities play a significant role in the Arab region, with nearly half of the population residing in these areas and 40 percent of the workforce engaged in agriculture. Remarkably, the region features a higher participation of women in agricultural labor compared to the global agricultural workforce. For instance, Moroccan women constitute 23 to 35 percent of the family farm workforce, while Tunisia sees women contributing around one-third of the agricultural workforce. In Iraq, women make up half of the agricultural workforce. The livestock sector also holds substantial importance, contributing between 30 to 60 percent of the region's total agricultural output. It plays a pivotal role in ensuring food security, improving nutrition, alleviating poverty, and unemployment, supporting economic development, generating income, offering social protection, and safeguarding livelihoods. Moreover, it serves as a source of natural fertilizer. The demand for livestock products is on the rise, driven by population growth, urbanization, and increasing income levels. Notably, almost all countries in the region are net importers of animals and animal products.

2.2.4 The impact of climate change on the agricultural sector

The complex relationship between agriculture and the climate system engenders intricate and multifaceted risks, primarily stemming from agriculture's profound dependence on finite natural resources. Within this nexus, the distribution of climatic variables—ranging from temperature, radiation, precipitation, air, and water vapor pressure to wind speed—exerts a significant influence on the physical, chemical, and biological processes underpinning the productivity of agricultural, forestry, and fisheries systems. For forestry and fisheries systems, the primary challenge revolves around their exposure and sensitivity to climatic conditions, coupled with the capacity to adapt to shifting circumstances. It's worth noting that over 50 percent of the most vital agricultural areas in the Arab region belong to the two highest vulnerability categories concerning climate change. The regions most acutely affected by climate change are identified as the Nile River Valley, the Tigris and Euphrates River basin, the southwestern part of the Arabian Peninsula, and the western regions of North Africa. Agriculture emerges as extraordinarily sensitive to climate variations, not just with respect to long-term shifts in average rainfall and temperature that dictate the distribution of food crops, but also in terms of short-term fluctuations and the occurrence of extreme events, including droughts, floods, heatwaves, and frosts.

Climate change is likely to impede agricultural production, leading to an anticipated deceleration in the rate of production growth in the coming decades. The Arab region, which heavily relies on agriculture, is expected to experience reduced rainfall, coupled with heightened irregularity and more intense heat, factors that will amplify water usage and potentially curtail the productivity of certain crops. Some reports even suggest that climate change could cause crop productivity to decline by as much as 30 percent in countries like Egypt, Jordan, and Libya. Egypt is predicted to confront multiple risks on 12 percent of its agricultural lands. The diminished agricultural output throughout much of the region due to

climate change will elevate food prices and reduce food consumption, particularly among the most vulnerable communities, thereby increasing the number of people susceptible to food insecurity and at risk of hunger.

2.2.4.1 Impact of climate change on crop productivity

Crop productivity within the arid and semi-arid regions of the Arab world is poised to witness a substantial decline, with estimates indicating reductions ranging from 10 percent to as much as 30 percent by the year 2080 (IPCC, 2001). Notably, a study conducted in Morocco projected a 15 percent decrease in productivity for rainfed wheat and barley within ecologically suitable areas by the year 2050. This study further suggests that sugar beet in the suitable zone and barley in the intermediate ecozone could face even steeper productivity losses, reaching up to 30 percent by 2050. Similarly, an examination of climate change impacts on crop productivity in Egypt has predicted a range of declines in various crops. Rice production is anticipated to dip by 11 percent, soybean production by 28 percent, and corn and barley production by 20 percent, as highlighted in the research by Saab & Sadik (2016).

Syria is also expected to experience a decline in crop yields across its agro-ecological regions due to the influence of climate change. These analyses indicate that rain-fed crops will be severely affected, with wheat yields projected to drop by a substantial 39 percent when comparing rainfed yields from 2010 to 2050. Meanwhile, irrigated wheat, maize, and potato crops are expected to experience reductions of 16.9 percent, 4.8 percent, and 27.5 percent, respectively. This overall trend of declining yields in major crops is a recurring theme in many studies. Furthermore, the anticipated increase in temperatures will likely lead to an expansion of the geographic range of numerous agricultural pests, an enhanced ability of pest populations to survive winter, the emergence of new plant pests not previously encountered, and the transmission of pests and diseases across agricultural areas and between countries. This multifaceted challenge is expected to result in shrinking cultivated areas, reduced animal production, declining food output, and adverse effects on public health indicators.

2.2.4.2 Impact of climate change on livestock and fisheries

Natural pastures are a critical source of livestock sustenance for many Arab countries. The widespread deterioration of these pastures is expected to be primarily driven by water scarcity and a growing frequency of severe weather events. Arid regions in the Arab world are likely to witness a decline in livestock productivity and a surge in livestock mortality due to recurrent droughts, pasture degradation, and desertification. Regions most susceptible to these effects include the Nile River Valley, the Horn of Africa, southwestern Arabian Penninsula, the Fertile Crescent, and North Africa. A pertinent study published by the International Institute for Sustainable Development titled "The Political Economy of Climate in the Arab Region" highlights the devastating impact of droughts in 2007-2008, which resulted in the destruction of extensive areas of farmland and the loss of no less than 85 percent of livestock in approximately 160 villages in the Syrian countryside. This crisis forced around 800,000 individuals, previously reliant on agriculture and pastoral activities, to seek job opportunities in major urban centers. In Sudan, a 1.5-degree rise in average annual temperatures, coupled with a 30 percent reduction in rainfall, led to a substantial 70 percent drop in agricultural production and severe security instability.

Climate change exerts a direct influence on both the quality and quantity of available livestock feed. The nomadic livestock system is expected to witness a decline in productivity due to irregular rainfall patterns and a low-humidity environment. Projections indicate that by 2050, temperatures will continue to rise, rainfall will diminish, and the dry season will extend by two months in select countries, significantly reducing the period during which pastures can support grazing animals. This anticipated 25 percent reduction in livestock production can be attributed to decreased feed availability and elevated heat stress in mixed crop-livestock systems. Additionally, the substantial absorption of carbon dioxide by the oceans has resulted in acidification, which, in turn, affects livelihoods reliant on fisheries and aquaculture by altering marine and freshwater fish species. Ecosystems such as coral reefs, wetlands, rivers, lakes, and estuaries are particularly vulnerable to acidification and shifts in water temperatures, further compounding the adverse ecological effects.

2.2.4.3 The impact of climate change on food security

Food security in the Arab world has witnessed prolonged periods of environmental, social, and economic challenges. Current factors affecting food production systems in the Arab world include arid conditions, limited water resources, erratic cropping patterns, and insufficient knowledge and technology. Climate change is poised to introduce greater uncertainty and volatility into the realm of food security, primarily due to the inherent volatility of domestic food production. A critical interplay exists between agriculture and food security in Arab countries. Low agricultural productivity has a detrimental impact on food security and prices. Given that the Arab region is the world's primary importer of grains and agricultural products, these countries are highly sensitive to fluctuations in food commodity prices. They rely on imported food products to meet anywhere from 50 to 100 percent of their food requirements, particularly for strategic crops like wheat, which holds paramount significance in the region. While the GCC countries import approximately 100 percent of their essential food needs, they exhibit greater resilience compared to non GCC countries due to their surplus revenues stemming from the oil sector. Countries with relatively high poverty rates are especially vulnerable to fluctuations in global food prices.

2.2.5 Impact of climate change on sea level rise

Climate change plays a pivotal role in determining the extent to which urban safety requirements are met, with sea-level rise and increasingly frequent storms directly impacting many coastal and low-lying delta settlements. For instance, a World Bank report highlights that a rise in sea levels would result in the loss of approximately 42,000 square kilometers of coastal land in the Arab world, leading to the displacement of around 8.3 million people residing in the Nile Delta and coastal regions, forcing them to relocate to inland areas. Additionally, coastal cities like Alexandria in Egypt, Benghazi in Libya, and Algiers in Algeria face the imminent threat of complete submersion due to rising Mediterranean Sea levels. The most severely affected regions are anticipated to be the coasts of North Africa and the Arabian Gulf. Notably, roughly 15 percent of the fertile agricultural land in the Nile River Delta, which sustains approximately 6 million Egyptians, is at risk of submersion. IPCC Reports indicate that Alexandria, Egypt, is among the cities in grave danger, with the shores of Alexandria facing inundation even with a sea-level rise of just 0.5 meters, potentially displacing 8 million residents of Alexandria and the Nile

Delta unless preemptive measures are taken.

Aden and Hodeidah in Yemen are similarly under the looming threat of submersion by the Indian Ocean due to rising water levels. This calls for the urgent implementation of preventive measures to avert the pollution of freshwater supplies from saltwater intrusion, maintain the productivity of arable land, and prevent large-scale population displacement in search of new livelihoods and suitable housing. Weather-related disasters like forest fires and floods will compel more residents in the region to seek refuge, negatively impacting buildings and infrastructure, including water, electricity, and gas networks, while exacerbating rates of environmental migration. Sea-level rise will particularly endanger coastal areas in Egypt, Kuwait, Libya, Qatar, Tunisia, and the United Arab Emirates. Furthermore, like other coastal nations, Arab countries are at a high risk of flooding and saltwater intrusion, especially in river deltas, due to sea-level rise, affecting over 43 coastal cities in the region (UN-Habitat, 2022).

2.3 Adaptation to climate change in the Arab region

To comprehensively study and assess the impact of both moderate and extreme climate conditions on agriculture and irrigation, it is imperative to rely on inductive global climate models that can illuminate the extent of temperature increases, provide insights into future rainfall patterns, and anticipate the occurrence of extreme events, notably droughts. To address the multifaceted challenges posed by weather-related risks, particularly the assessment of impacts and risks, it is essential to adopt integrated adaptation policies that ensure a cohesive response. A key component of this approach involves harnessing scientific knowledge derived from a range of sources, including regional climate modeling, hydrological modeling, vulnerability assessments, impact evaluations, and analyses of disaster loss databases. These insights play a pivotal role in shaping policies related to adaptation and disaster risk reduction (ESCWA, 2018). Furthermore, this process entails the transformation of global datasets into information that is both relevant and applicable at regional and national levels.

2.3.1 Managing Water Resources: Supply and Demand

Adapting the water sector to climate change necessitates the implementation of prudent water resource management, often referred to as water governance. The objective is to ensure the agricultural sector's sustainable access to essential water resources while simultaneously minimizing any potential wastage of these precious resources. This imperative calls for the development of long-term strategies and mechanisms, tailored to the unique climate and disaster risks faced by Arab countries. It also involves the exploration of innovative solutions to alleviate the constraints of water scarcity on the agricultural sector (World Bank, 2018). To achieve these goals, Arab countries must engage in strategic planning that results in the formulation of water policies designed to enhance the efficiency of water resource management practices. These measures should be primarily focused on two key pillars: supply management and demand management. Supply management initiatives involve the preservation of existing resources, effective pricing strategies, and the exploration of alternative, non-traditional resources. Meanwhile, demand management focuses on regulating and optimizing the diverse uses of this critical natural resource, particularly within the agricultural sector, and aims to enhance its efficient utilization.

In terms of supply management and development, the emphasis is on harnessing surface water through infrastructure investments such as the construction of dams. Additionally, desalination of seawater is crucial for coastal countries, offering an additional water source, and recycling treated wastewater serves as an essential resource. The importance of these strategies is evident, given the agricultural sector's reliance on the availability of water resources, which may face potential reductions in the future, especially due to climate change induced factors such as drought, decreased rainfall, elevated temperatures, and heightened water evaporation. Failure to take timely and substantial measures could have adverse impacts on agricultural productivity, making it challenging to achieve food security and meet the requirements for economic and social development, including the Sustainable Development Goals. These objectives entail significant financial commitments, as noted in World Bank (2018b), which sets global investments for water supply and sanitation at $1.7 trillion—three times the historical investments in the sector. Additionally, more than $960 billion is needed to ensure water supply for agricultural production in 93 developing countries by 2050.

The Islamic Development Bank estimates that Arab countries require approximately $200 billion in investments for water resources infrastructure to meet the growing demand between 2015 and 2024 (Fathallah et al., 2021). This necessitates immediate action and investment in rainwater harvesting and traditional water storage, both for surface and groundwater, as well as transportation networks. Such measures are vital to adapt to the impacts of climate change, especially in regions characterized by fluctuating rainfall patterns and shared watercourses across borders. It is worth noting that several Arab countries have constructed water dams, especially in Egypt, Morocco, Algeria, Tunisia, Iraq, and Syria, within the framework of water resource preservation and disaster risk reduction. In pursuit of alternative water sources, some Arab countries are focusing on unconventional resources, which require advanced treatments such as desalinating seawater and recycling agricultural and sewage wastewater after treatment. While these efforts hold promise, it is crucial to invest in infrastructure and research and development, particularly in renewable energy sources like solar and wind, to reduce the cost and environmental impact of desalination. Treated wastewater, whether from industrial, agricultural, or sanitary sources, is a valuable resource that can be employed for irrigation, mitigating the need for untreated discharge into water bodies, which can have significant environmental consequences. Nevertheless, there are challenges related to consumer and plant health, as well as technical, health, and environmental issues that limit the expansion of treated water reuse in the agricultural sector. It is essential to enhance the efficiency of treated water reuse and reduce its environmental footprint.

In many Arab countries, water resources, particularly non-renewable ones, face significant pressure due to population growth and the demands of economic activities, especially agriculture, which is a major water consumer. In addition to resource scarcity, the indiscriminate use of fertilizers and pesticides negatively impacts water quality and sustainability. Therefore, the search for additional water resources must be coupled with increased efficiency in water use. This involves enhancing irrigation practices, as irrigation currently consumes approximately 90 percent of the total water utilized in most Arab countries. The promotion of water-efficient technologies, such as sprinkler and drip irrigation systems, and support for renewable energy adoption in agriculture, is essential. Efforts should also be directed towards upgrading water transport and distribution infrastructure and establishing maintenance programs to sustain efficient water use.

Adapting to climate change and building resilience against its detrimental impacts on water resources

and agricultural sector requires substantial financial resources. Given the fiscal constraints faced by many Arab countries, it is essential for governments to engage the private sector, encouraging it to play a more prominent role in infrastructure investment that can withstand climate change. Privatization of water management can be an effective approach, particularly in cases where countries struggle to fund infrastructure development, operation, and maintenance. The privatization of water management has received significant support from international donors and lenders. Alongside these policies, it is imperative for various Arab countries to promote awareness among the public about the significance of preserving water resources. Media outlets, educational institutions, and civil society organizations all play essential roles in raising awareness about the perils of water wastage and irresponsible exploitation.

2.3.2 Climate change adaptation measures in the agricultural and water sectors

Adapting to climate change in the agricultural and water sectors demands a reassessment of existing development policies, incorporating vital elements of climate change adaptation. This includes:

- Changes in Agricultural Practices: Enhance soil fertility and promote carbon sequestration to bolster the resilience of farming systems.
- Improved Irrigation Water Management: Implement more efficient water usage techniques in agriculture.
- Agricultural Diversification: Encourage diverse agricultural practices to enhance resilience against climate change impacts.
- Advancements in Agricultural Science and Technology: Foster innovation, provide advisory services, and develop information systems to aid farmers in adapting to changing climatic conditions.
- Risk Management and Crop Insurance: Establish strategies to mitigate risks and provide insurance coverage for crop loss due to climate-related events.

These modifications in agricultural production systems should lead to more productive and resilient livelihoods, foster sustainable and secure food systems, and ensure access to adequate food and nutrition. Recognizing the implications of climate change and embracing new farming techniques are crucial, especially in the context of a drier and more volatile climate. Key adaptation measures in food production include:

- Crop Diversification: Replacing water-intensive and drought-sensitive crops with more adaptable alternatives suited to changing climate conditions.
- Optimized Planting Practices: Adjusting planting dates to align with evolving weather patterns and cultivating suitable crop varieties in their respective climate zones to maximize water efficiency.
- Genetic Variability: Developing resilient crop varieties that can withstand environmental stresses (such as drought, extreme temperatures, and salinity) and are resistant to diseases and pests through breeding and genetic improvement programs.
- Efficient Irrigation: Implementing precise irrigation techniques such as drip irrigation, which are more water-efficient than traditional flooding methods.
- Crop Selection: Reducing the cultivation of water-intensive crops and opting for alternatives. For instance, UAE has adopted saline crops irrigated with seawater due to freshwater shortages. Jordan has shifted from open field vegetable cultivation to hydroponics to conserve water. Morocco is transitioning to resource-efficient digital agriculture.
- Enhancing Adaptive Capacity: Managing rangelands sustainably, improving soil and water

management and conservation, and introducing non-structural measures like crop insurance can reduce climate change's impact on livelihoods and improve food security.

The success of adapting the agricultural sector to climate change hinges on the integration of adaptation policies into national strategies and planning processes. This entails the development of comprehensive strategies that incorporate climate change considerations and the integration of adaptation policies into core national economic strategies. Additionally, it involves establishing systems and policies to confront and adapt to climate-induced shocks. Effective institutional and legislative frameworks and efficient water resource management are vital to sustainably develop water policies and strategies that ensure the continuous availability of water resources, efficient usage, and environmental preservation.

2.4 Policies and initiatives to mitigate climate change effects on agriculture, irrigation and water resources

2.4.1 Institutional and legislative framework

The institutional and legislative aspects form a fundamental foundation for shaping policies in various sectors of economic and social development, including climate change adaptation. These aspects encompass the creation of competent institutions, coordinating mechanisms between them, the decision-making structure (centralized or decentralized), policy development, and the enforcement of regulations. It is worth noting that most Arab countries have made considerable efforts to establish and enhance an institutional framework that identifies competent authorities, enacts legislation and regulations for resource management, and develops policies to optimize water utilization, especially in agriculture, taking into account future challenges like climate change. For example, Egypt has established a robust legislative and regulatory framework and several specialized institutions for water and agriculture management (Ministry of Agriculture and Land Reclamation, 2018). The "National Water Resources Plan" guides water resource planning in Egypt, involving multiple stakeholders to ensure efficient utilization. The Ministry of Water Resources and Irrigation is the primary authority responsible for water resource management. In Jordan, the Ministry of Water and Irrigation collaborates with the Ministry of Agriculture to manage and develop the water sector. Jordan has developed legislation, laws, and policies like the National Water Strategy 2016-2025, Groundwater Management Policy, and Irrigation Water Policy (Ministry of Water and Irrigation, 2017). The Ministry of Environment is also involved in environmental management for natural resources. Morocco enacted a water law (No. 15-36) in 2016, focusing on water resource management and policy measures to enhance water use efficiency and security. Institutions contributing to formulating national water policies include the Delegate Ministry in charge of Water, water basin agencies, and the Supreme Council for Water and Climate, which examines water trends and their impacts on resources. Lebanon introduced Law 221/2000 in 2000, the main legislation regulating the water sector, appointing the Ministry of Energy and Water to manage the sector. Lebanon has divided its water management into four independent institutions by region. Iraq assigns water planning responsibilities to the Ministry of Water Resources, with cooperation from other key institutions such as the Ministry of Agriculture, Ministry of Energy, Ministry of Municipalities and Public Works, and Ministry of Environment.

Despite these institutional and legislative reforms in Arab countries, some nations still face

challenges in effective water resource management due to complex organizational structures, unclear responsibilities, overlapping roles, weak coordination, centralization, bureaucratic processes, institutional inefficiency, and legislative barriers. Therefore, addressing water resource crises and their impact on agriculture isn't solely about the availability of resources but also entails addressing these administrative issues. The World Bank and the Food and Agriculture Organization of the United Nations highlight that many Arab countries, despite developing water management institutions, encounter difficulties in sustainable resource management. They emphasize that climate change, combined with population growth and development requirements, necessitates coordinated actions by relevant institutions (FAO and EBRD, 2018). Several countries primarily focus on crisis management for events like droughts and floods instead of conducting predictive scientific studies and long-term planning. However, with water resources and related services like irrigation facing potential shocks due to increasing climate variability in the coming years, a shift from reactive responses to balanced, long-term approaches are necessary (FAO and EBRD, 2018). Given these challenges, there is a critical need to develop an institutional and legislative framework for water resource management and policy improvements to adapt to climate change. This includes involving various institutions, coordinating sectoral water-related policies, enforcing regulations, and enhancing collaboration among water-related bodies.

2.4.2 Encouraging scientific research and development

Scientific research and technology institutions hold a crucial role in advancing water resources and agriculture, promoting climate-smart agriculture, and adapting to climate change, provided that the right conditions are met, especially regarding institutional, regulatory, legislative, and financial aspects. A report by the World Bank and the International Food Policy Research Institute emphasizes the importance of reallocating a portion of public support for agriculture toward research, development, and innovative green methods to reduce emissions and enhance productivity, meeting growing food demand and ensuring food security. At the Arab level, several countries have specialized institutions for scientific research in water and agriculture. Regionally, the Arab Center for Dry Zone Studies (ACSAD) was established under the League of Arab States, uniting national efforts for agricultural research in arid and semi-arid regions. ACSAD's objectives include providing scientific data, advanced technologies, and agricultural knowledge, developing drought-tolerant crop strains, and enhancing water resource management (ACSAD, 2010). Arab countries have also partnered with the International Center for Agricultural Research in Dry Areas (ICARDA) to develop crop varieties adapted to high temperatures and dry conditions. Despite these initiatives, the contribution of Arab researchers to agricultural research remains relatively low, with only about 0.3 percent compared to 10 percent in developing countries and 30 percent in the United States (Arab Monetary Fund, 2016). Several challenges hinder the impact of these research institutions, including limited funding, inadequate incentives for researchers, and difficulties in attracting scientific and technical personnel.

The private sector's contribution to research is limited, there's a lack of training, and technology transfer and application lags. As a result, technology diffusion and the development of value chains face significant gaps. Furthermore, the use of advanced technology is often limited, resulting from inadequate coordination between research, academic institutions, extension services, and agricultural organizations. Nonetheless, some Arab countries have witnessed localized technological advancements aiming to enhance crop productivity. For instance, Sudan has developed drought- and heat-resistant wheat varieties,

while Egypt has created water-saving machines, improving wheat yields and saving irrigation water. Innovations in soilless agriculture techniques have boosted water efficiency and crop yields. These local achievements underscore the potential for scientific research to drive water resources and agricultural sector development in the Arab region.

To effectively address the challenges posed by climate change, investment in scientific research and innovation is crucial. Policies must focus on adopting innovative methods that improve water efficiency, develop heat- and drought-tolerant crop strains, reduce greenhouse gas emissions, enhance climate resilience, and boost agricultural productivity. This includes adopting technologies such as artificial pollination, modern AI-supported farming practices, digitization, and automation of agriculture. Capacity building, training, and skill development of researchers are vital to adapt water resources and agriculture to climate challenges. To support this, Arab governments should increase their support for research institutes, universities, and research centers, providing them access to biotechnology, plant genetic improvement, and water treatment technologies. Additionally, promoting the use of renewable energy is crucial to ensure sustainability in water and agriculture management.

2.5 Recommendations

- **Development of National Adaptation Strategies:** It is paramount to establish national adaptation strategies to prioritize urgent needs and set guiding principles for addressing climate change. These strategies should guide efforts to tackle issues arising from inadequate water and food security, climate change impacts, and extreme weather events.

- **Integration of Strategies and Coordination:** Addressing the complex challenges posed by climate change, particularly in terms of water and food security, necessitates the integration of strategies, policies, and initiatives at local, national, regional, and global levels. Inter-ministerial coordination is essential because adaptation responses often span multiple ministries and sectors.

- **Role of Development Policies:** While sound development policies are essential, they alone are insufficient to adapt the agricultural and water sectors to the impacts of climate change. A development agenda that supports agricultural sustainability and specifically targets climate change impacts will enhance overall resilience and adaptation.

- **Agricultural Adaptation Financing:** Many countries in the region require financial support for agricultural adaptation efforts, particularly those most vulnerable to climate change. Assistance should be channeled to these countries to facilitate their adaptation endeavors.

- **Integration into International Climate Change Negotiations:** Adaptation and mitigation strategies in agriculture and water sectors must be seamlessly integrated into ongoing international climate change negotiations. This ensures the development of appropriate incentive mechanisms, encompassing innovative institutions, technologies, management systems, and the necessary financing mechanisms.

- **Building Resilience:** Resilience-building should focus on both human systems and the

interconnected ecosystems upon which they rely. A resilience-based approach acknowledges the complex and dynamic nature of human-environment interactions, guiding institutional measures and responses.

- **Climate-Sensitive Agricultural Projects:** Implementation of climate-sensitive agricultural projects with high carbon absorption and emissions mitigation capacity is essential. These projects may involve expanding tree cultivation, such as figs, olives, and palms, and increasing forested areas. Additionally, the development of animal feed supplements to reduce emissions from livestock while increasing productivity is important.

- **Promoting Sustainable Irrigation:** Encouraging alternative flood irrigation methods in rice fields, a significant contributor to human-caused methane emissions, is crucial. Utilizing water-efficient systems can reduce water consumption by up to 30% and methane emissions by 48% (Saroj Kumar Jah, 2012).

Chapter Three

Mitigation Policies and Energy Sector Reform

3.1 Introduction

The Arab countries' contribution to global CO2 emissions does not exceed 5.5%, the region is becoming one of the most heavily affected countries by extreme weather patterns. Table (3.1) depicts the Notre Dame-Global Adaptation (2020) Index ranking the Arab countries and classifying them from "low vulnerability" such as the United Arab Emirates, Kuwait, Qatar, and Morocco to "highly vulnerable" to climate change effects among the 182 assessed countries such as Comoros, Mauritania, and Yemen. They also vary in readiness to improve resilience, where the idea is to properly priorities investments by governments, businesses, and societies to address the upcoming global challenges more effectively. Climate change has a vast range of potential macroeconomic effects as previously mentioned. In the short to medium term most of them will depress economic activity and spur inflation. First, there are the physical risks. Climate change leads to greater frequency and severity of catastrophic climatic events, particularly droughts, floods, windstorms, and earthquakes. Second, there are the so-called transition risks, related to the cost of adopting policies to move first to a low-carbon and then to a net-zero economy. With regards to economic output, direct negative effects are first expected to materialize in agriculture and fisheries. Other sectors that will be affected rapidly are energy, transportation, tourism, construction, and insurance. In the short to medium term, extreme climate events will cause unanticipated shocks to several components of aggregate demand and aggregate supply.

On the supply side, we can expect shortages in commodities and damage to infrastructure and productive capital. There will also be a trade-off between the need to reduce output to curb emissions and to dedicate financial and human resources to combat climate change, and the need to maintain economic growth to support employment creation. Compliance with tighter environmental regulations will force companies to reduce production, spend money on emission reduction strategies and new technologies, and will thus reduce their profitability, productivity, employment, and ultimately real GDP. This could widen the output gap and could affect macroeconomic forecasting. Yet, if companies and governments address and mitigate them, in the long run the climate risks would have stimulated significant investments in clean and much more efficient energies, technologies, and production processes overall. On the demand side, negative effects can come from lost household wealth, and therefore lower private consumption, following floods and storms. This would be particularly exacerbated in countries in which households are largely uninsured. Private investment could decrease in the carbon-based industries but might also be crowded-out by public investment in low-carbon technologies, further depressing aggregate demand. In addition, investment does not thrive in uncertain environments, and uncertainty about both the evolution of climate change and the evolution of the policies to mitigate it could dampen the investment appetite of entrepreneurs.

According to the Organization for Economic Cooperation and Development (OECD), without mitigation actions, global temperature rises of 1.5-4°C may lower global real GDP by 1.0-3.3% by 2060 and by 2-10% by 2100. This calls for climate policies to achieve the objectives of the COP21 agreement require a swift and significant reduction in carbon emissions. The longer it takes to implement such policies, the sharper the future reduction in carbon emissions will need to be. Transition and physical risks will both be exacerbated by such delays. How much GDP growth needs to be sacrificed to achieve a given reduction in carbon emissions depends on the decrease in the energy intensity of output. This can

come from lower energy use, more efficient energy consumption, and/or the adoption of cleaner sources of energy. Lower energy use reduces output significantly. Shifts to cost-effective low-and zero-carbon energy supply, and greater energy efficiency, shall therefore be implemented broadly and as early as possible to avoid large negative supply shocks. The fiscal effects of climate change are ambiguous. Carbon pricing and carbon taxes could create room for an increase in public revenues. However, the government would also need to finance subsidies for the deployment of renewable energies.

Table 3.1: The Notre Dame-Global Adaptation (2020) Index ranking of the Arab countries

County	ND-GAIN	Vulnerability	Readiness	Country	ND-GAIN	Vulnerability	Readiness
Algeria	99	59	138	**Mauritania**	143	165	119
Bahrain	65	108	56	**Morocco**	66	51	87
Comoros	158	149	166	**Oman**	57	81	56
Djibouti	122	125	139	**Qatar**	38	44	44
Egypt	107	100	129	**Saudi Arabia**	47	74	39
Iraq	120	99	155	**Sudan**	177	178	176
Jordan	73	49	97	**Syria**	153	116	185
Kuwait	60	53	69	**Tunisia**	67	59	81
Lebanon	117	86	158	**UAE**	31	40	29
Libya	125	93	170	**Yemen**	171	160	180

Source: Notre Dame Global Adaptation Index (University of Notre Dame, 2020).

Migrating to a net zero economy would lead, at least initially, to sharp increases in the price of carbon, translating into higher electricity, gas, and petrol prices, thus causing increased costs of production for firms across most sectors. While inflationary pressures could adjust in the medium term, this will first reduce consumers' buying power, decrease spending and aggregate demand, and increase unemployment. In the longer run, however, the shift to renewable energies and the increased energy efficiency will contribute to reducing inflationary pressures. Transition to net zero requires significant adjustments and actions supported by coordination between the government, businesses, and enabling institutions. The burden of green transition must be shared across and within countries and all stakeholders and sectors as every individual, institution and economic sector contribute to emissions, either directly or indirectly through their role in global production and consumption systems. Unfortunately, this burden is not evenly felt by all stakeholders since contributions to emissions is not the same across all stakeholders. But this does not mean that who contributed most will carry the greatest part of the cost of climate change. This is also true at the global level; although the rising anthropogenic greenhouse gases' (GHG) emissions are mainly the responsibility of industrialized countries, the impacts of climate change will be more severe in developing countries and countries on their growth pathways. Consequently, some sectors will obviously need to change to become more resilient, while others will need to mitigate in order to pursue a low-carbon development path. The energy sector will be covered in

this chapter, which together with the transport sector accounts for around 65% of greenhouse gas emissions in Arab countries.

The region is required to take parallel action on three different axes. The first, the governments need to remove inefficiencies in resource allocation and consumption, mainstream green investments in infrastructure and improve information systems. The second hinges on the progress in the transition to a Low-Carbon development by accelerating the conversion to renewable energy, decarbonizing the oil and gas production, and improve energy use for electricity and industry. The third builds on the enabling environment to green transition by leveraging the private sector, enhancing the interlinkages between institutions and involvement of local government while protecting vulnerable groups.

3.2 Evolution of Energy Sector

One of the key drivers of socioeconomic development in the Arab countries is the energy sector, encompassing various operations involved in the production, transformation, and distribution of energy. The abundance of hydrocarbon resources, coupled with the rising importance of renewables and and the commitment to the Paris Agreement, plays a vital role in the economic growth and development of these countries given their large oil and gas reserves (Mohideen et al. 2023). The Arab world's contemporary development trajectory has been shaped by its energy resources. Endowed with some of the most significant oil and natural gas reserves globally, Arab countries have produced and exported more oil than any other region in the past four decades, and they have sufficient energy reserves sufficient to supply world energy markets for over a century at current production rates (Fattouh and El-Katiri, 2012). For instance, in Egypt, the energy sector accounts for 13% of the country's gross domestic product (GDP), serving as a significant driver of economic and social development. Saudi Arabia is the world´s biggest producer of oil and oil extraction accounts for 46% of GDP. Algeria's economy heavily relies on petroleum and natural gas exports, contributing roughly one-third of the country's GDP annually.

The Arab countries are home to the world's richest oil and natural gas resources, holding roughly 55.2% of the world's proved oil reserves Among the six Arab member states of OPEC. Additionally, 11 other Arab countries also possess proven oil reserves, given that 80.4% of the world's total oil reserves are found in OPEC member nations. Saudi Arabia has emerged as the leading global oil producer and exporter, hosting the second-largest proved oil reserves of 267.19 billion barrels in 2021 (Amran et al. 2020). Following closely, Iraq, United Arab Emirates and Kuwait are significant producers in the region, contributing to the Arab countries' top oil-producing status and serving as major oil exporters worldwide, with 145.02, 111.5, and 101.50 billion barrels, respectively (IEA, 2020; OPEC, 2023)

In 2014, Arab nations accounted for 31.22% of the world's oil production, which decreased to 31.08% by 2020 (Doranehgard and Dehghanpour 2020; Khan et al. 2021). During this period, global oil production rose by 2.53%, while Arab countries experienced a 1.89% increase in production. This increase in production can be attributed to rising demand driven by population growth and industrial expansion (IEA, 2023). The Arab countries' position as significant players in the global oil market underscores their importance in meeting the world's energy needs and making them more vulnerable to oil and gas becoming stranded assets. According to the Carbon Tracker Arab countries will most likely bear

major losses where around 10 trillion US$ are at stake. Arab countries, while possessing significant oil and gas resources, are also among the world's major CO2 emitters. In 2019, they accounted for around 5.04% of global CO2 emissions witnessing a 4.03% increase from 2014 to 2019. Among these nations, Saudi Arabia stands out as the highest CO2 emitter, producing 495.2 Mt, followed by Egypt with 225.5 Mt, UAE with 178 Mt, and Algeria with 142.4 Mt (IEA, 2023). The Arab region heavily relies on fossil fuels to meet both domestic and international energy demands.

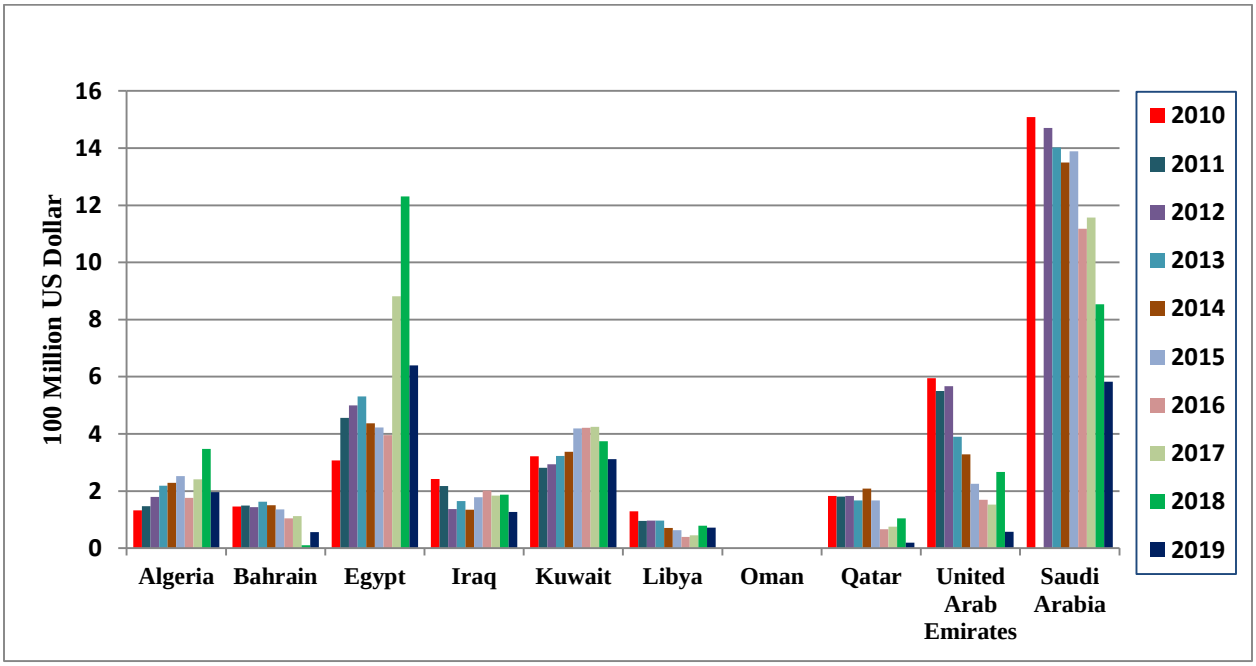
The obligations imposed on the oil refining sector by environmental regulations have resulted in a search for the best technologies and procedures that contribute to decreasing emissions at the lowest possible cost. According to the International Energy Agency (IEA, 2023), there is a roadmap consisting of five phases that oil and gas firms must follow to reduce their emissions to net zero emissions by 2050. The first phase is to **capture, utilize and store carbon**. Applying carbon capture and storage processes at all stages of the oil and gas supply chain results in considerable reductions in emissions. The second phase is to **cope with methane emissions**, which account for about 30% of greenhouse gas emissions since the industrial revolution, by discovering and repairing leaks to reduce methane emissions. To attain optimal methane intensity, oil and gas firms will need to make significant efforts to clean up their supply chains. The third phase in lowering CO_2 emissions is to **eliminate non-emergency gas flaring**. Non-emergency flaring alternatives include investing in infrastructure to compress or liquefy the gas, which can then be utilized to create power. The fourth phase is to **use low-emission electricity to power manufacturing plants**. The fifth phase is to **use low-carbon hydrogen in refineries**. Because it requires little equipment and can be co-located with other industrial hydrogen contractors, hydrogen is suitable for use in refinery operations. Some are in suitable locations for the deployment of renewable energy sources, such as coastal areas that could be gradually included in future as hydrogen import and export centers.

The transport sector is one of the major energy consumers, accounting for around 26% of overall energy demand and producing approximately 25% of world CO_2 emissions. It directly affects the daily lives of individuals. Additionally, the region's transport systems are not equipped or planned at this time to handle the problems posed by climate change. The Arab region's transportation sector will need to undergo significant adjustments as a result of any future incentives to reduce greenhouse gas emissions, such as carbon pricing or other measures. The consequences of climate change also have an impact on the housing sector. Households account for 29% of the world's energy demand, and they also produce 26% of its carbon dioxide emissions. Therefore, improving this sector's energy efficiency and cutting carbon dioxide emissions will significantly contribute to the achievement of sustainable development goals. As a result, programs are being established to improve building energy efficiency and lower associated energy needs. The possibility of the housing industry to switch to clean energy increases because of the high rates of urbanization in Arab countries and the need to conduct massive urban expansion projects, creating a chance for more sustainable urban development.

To address the negative economic effects of energy subsidies on national economies, the decline in global petroleum prices, and the drive to explore greener alternatives, many Arab nations have taken steps to phase out energy subsidies. As of 2019, nearly half of the Arab nations had energy subsidies, with the proportion of GDP spent on subsidies ranging from 13.6% in Libya to 0.3% in Qatar (IEA, 2018).

Figure (3.1) illustrates the variation in electricity subsidies across Arab countries from 2010 to 2019.

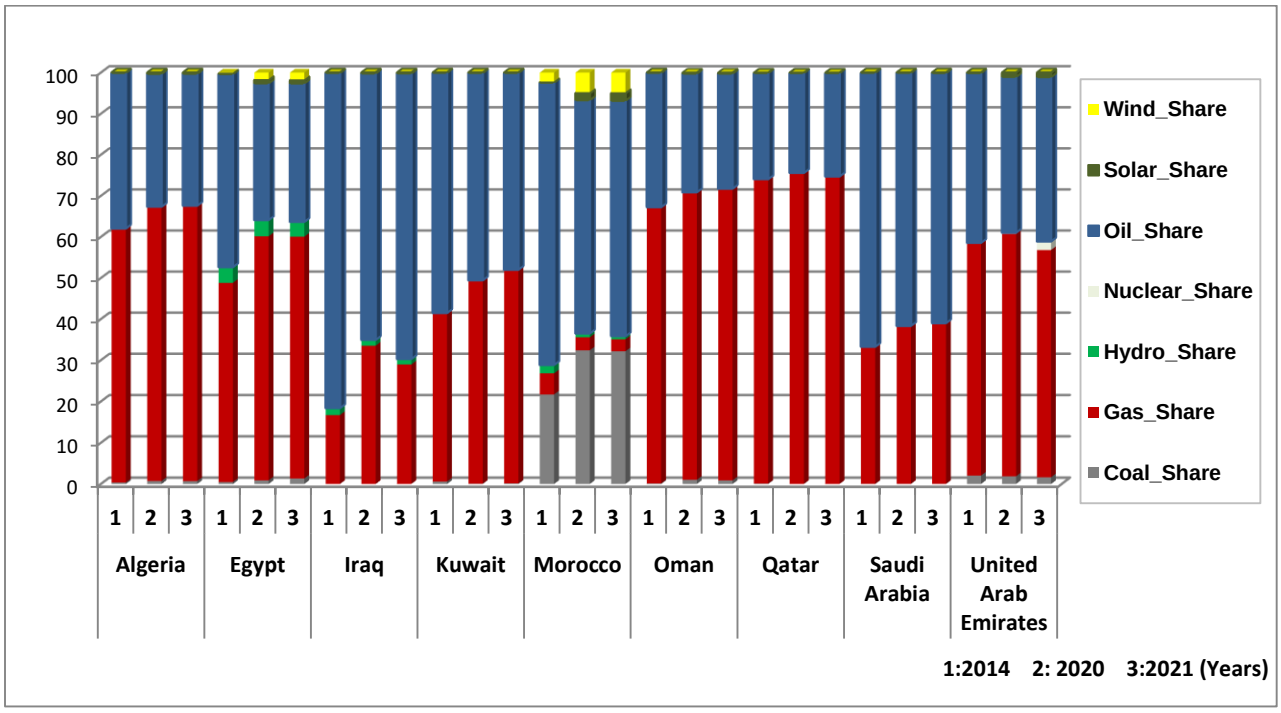
Figure 3.1: Electricity Subsidy in Selected Arab Countries (2010-2019)



Source: (Arab Development Portal, 2023): https://www.arabdevelopmentportal.com

The onset of the fourth economic era has led to a significant surge in global energy demand. As the Industrial Revolution has driven structural changes in the economy, innovation has become vital in addressing these challenges. To tackle the rising energy demand while mitigating the environmental impact, efforts have been focused on increasing energy efficiency, modernizing industrial techniques, and promoting renewable energy (RE). Sustainable resources like wind, solar, and geothermal energy offer environmentally friendly alternatives to traditional sources such as coal, natural gas, and oil (Koc et al. 2019). Arab countries, despite abundant fossil fuels and low prices for primary energy and power, have historically been hesitant to prioritize and utilize RE sources. In recent years, several factors, including the region's RE potential and considerations of economic, political, and climatic factors have spurred a growing interest in developing and adopting RE. Arab nations are now actively pursuing national programs and setting strategic goals to increase the utilization of RE. These goals encompass enhancing energy security by diversifying energy sources, meeting domestic and regional development needs, and strategically preserving and storing the region's natural oil and gas resources. By embracing renewable energy, Arab countries aim to address energy challenges, reduce dependency on fossil fuels, and contribute to solving issues related to oil and gas exploration and transportation.

Figure 3.2: Percentage of Energy Resources Contribution in Power Generation



*Source: Authors' calculations based on (Our World in Data, 2022)

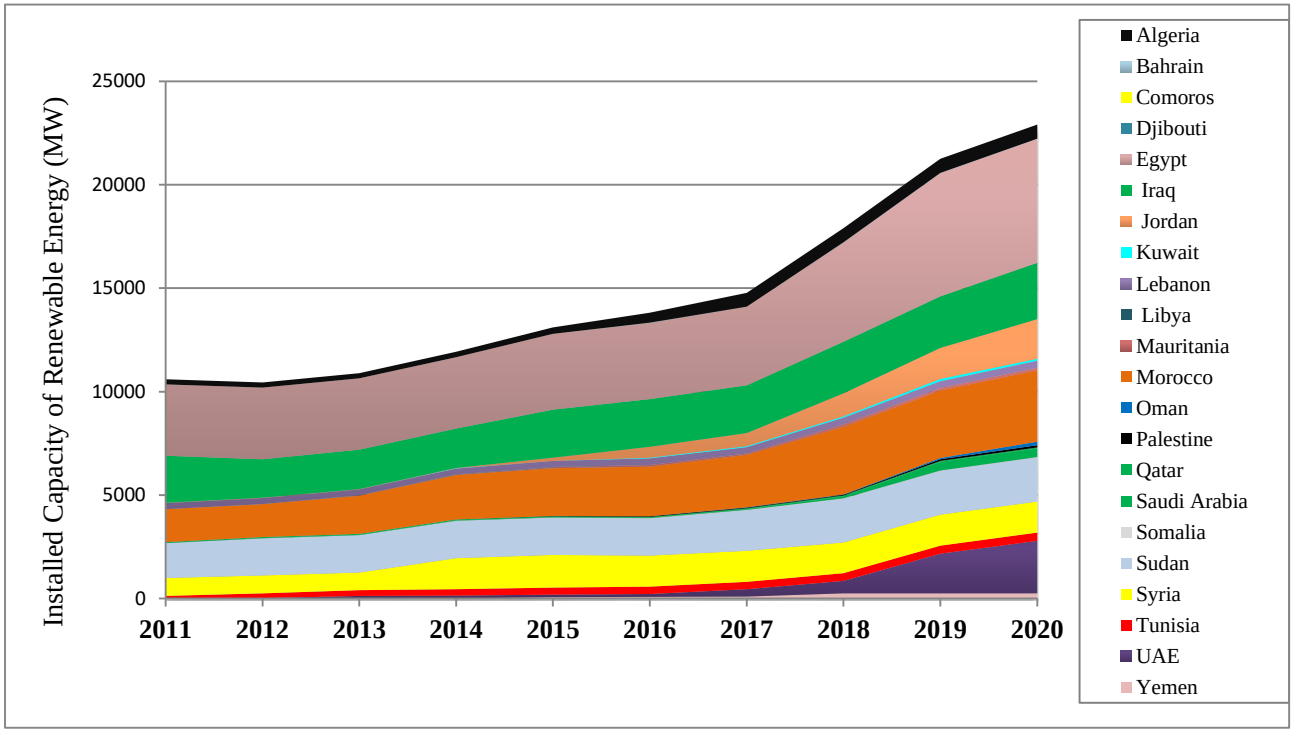
The energy mix in Arab countries has historically been dominated by oil and natural gas, accounting for over 90% of primary energy consumption in 2020, as shown in Figure (3.2). The discovery of oil in the early 20th century led to a significant increase in oil production and export, transforming the economies and raising the standard of living in many Arab countries. However, there has been a growing awareness of the need to diversify the energy mix due to factors such as increasing cost of oil, the need to reduce greenhouse gas emissions, and the desire to enhance energy security. As a result, there has been a growing investment in renewable energy sources in Arab countries, with an installed capacity of 14.5 GW in 2020, expected to rise significantly in the future. Among the 22 Arab nations, Qatar has consistently relied on natural gas, with 74% of its energy production in 2014, rising to 75.61% in 2020, and declining to 74.73% in 2021. Meanwhile, Oman, Algeria, UAE, and Qatar ranked among the top users of oil for energy production, with varying rates between 67.134 to 48.924%. Iraq ranked first in oil dependence in 2014 at 81.6%, which decreased to 64.8% in 2020 and increased to 69.5% in 2021. Morocco relied significantly on oil at 66.7% in 2014, but it has made efforts to reduce this dependency to 56.7 in 2020 and increased slightly to 57.3% in 2021. For coal-based energy generation, Morocco stands as the largest country relying on coal at 21.7%, but its usage decreased slightly by 0.218% in 2021 after an increase of 10.703% until 2020. UAE follows as the second-largest coal-dependent nation, with a dependency rate of 2.05% in 2014, declining to 1.6% in 2021.

3.2.1 Renewable Energy in Arab Countries

In terms of renewable energy sources in the Arab region, most countries are making significant progress, particularly in solar, wind and hydropower energy development. The Arab region holds high potential for renewable energy, especially solar and wind power. Figure (3.3) presents the total installed capacity of renewable energy in Arab regions from 2011 to 2020, the total installed capacity of renewable energy reached 22,596 MW, a substantial increase from 11,991 MW in 2014. This reflects the growing interest of Arab countries in adopting renewable energy solutions in line with their climate action commitments under the Paris Agreement and the United Nations Sustainable Development Goals (SDGs).

However, despite this progress, there is still a long way to go for these countries to meet their renewable energy targets. Egypt leads in 2020, with 5980 MW of installed capacity. Followed by Morocco, Iraq, and UAE with capacities of 3447 MW, 2490 MW, and 2540 MW, respectively. In 2019, hydroelectric, wind, solar, and biofuel power plants had capacities of 11,121 MW, 3287 MW, 7235 MW, and 349 MW, respectively. Notably, new wind energy installations in Egypt, Morocco, Tunisia, and Mauritania, as well as additional concentrated solar power (CSP) capacity in Saudi Arabia and other projects in Algeria, Morocco, Egypt, and UAE, have contributed to these figures. Regarding electricity access, most Arab countries, such as Syria, Comoros, Yemen, Sudan, Djibouti, Mauritania, and Somalia have lower coverage rates ranging from 92% to 17% (Mahmoud & Habib, 2019).

Figure 3.3: Total Installed Capacity of Renewable Energy in Arab Regions (2011 – 2020)



Source: (IRENA, 2021)

3.3 Energy Efficiency and Renewable Energy Strategies and Policies

Energy efficiency and renewable energy strategies play a pivotal role in ensuring the sustainable development of Arab countries. These nations have formulated national energy strategies, energy efficiency action plans, and allocated investment funds to promote the dissemination of best practices, except for Comoros and Mauritania. Despite the government commitment and regulatory frameworks in place, the implementation of these programs is progressing slowly. The National Energy Efficiency Action Plans focus on various economic sectors such as construction, transport, industry, commercial and public services, agriculture, and forestry, each benefiting from specific energy efficiency policies. However, broader measures can be adopted to enhance energy efficiency across all sectors, including the development of markets for Energy Service Companies and energy price reforms to reduce energy subsidies.

The construction sector stands out as one of the highest energy consumers in Arab countries due to demographic growth and increasing urbanization. Energy efficiency measures in this sector encompass implementing building codes for envelopes and systems, setting thermal insulation standards, and establishing minimum energy performance standards and labelling systems for appliances. The transport sector also exhibits significant energy consumption due to urbanization and improved household income levels. To promote energy efficiency in this sector, most countries have implemented policies related to urban planning, urban transport initiatives, and scrappage schemes for old cargo transport vehicles and taxis. Other measures include introducing compulsory technical inspections, providing tax incentives for low fuel consumption vehicles, setting emission limit standards, conducting energy audits for commercial vehicles, and promoting the use of electric vehicles.

Investments in energy efficiency within the industrial sector do not receive the same priority as those focused on increasing production capacity. Some countries have taken steps to promote energy efficiency in commercial activities and public services, including the development of energy-efficiency service markets, promotion of energy audits, adoption of high-performance lighting, and the integration of renewable energy for public lighting. Behavioral changes and awareness-raising activities are also encouraged. Similarly, measures to improve energy efficiency in the agriculture sector, particularly in optimizing energy performance levels on farms, have been implemented, such as installing solar pumping projects and promoting renewable energy production.

To increase renewable energy penetration, Arab countries have established specific schemes or programs, like the National Renewable Energy Action Plans. Table (3.2) depicts the national energy strategies of various Arab countries. Regulatory frameworks primarily focus on solar technology, both utility-scale photovoltaic (PV) and small-scale PV, and large-scale wind technology. Despite the declining costs of renewable energy technologies, their penetration in the Arab countries still lags behind other regions globally. The region, however, offers a wide range of financial incentives to support renewable energy adoption. Barriers hindering investments in renewable energy include a lack of comprehensive regulatory frameworks, environmental and social risks, and limited supporting schemes.

Table 3.2: National Energy Strategies in Arab Countries

Country	National Energy Strategy for Energy Efficiency	Financial Support for GHG Reduction (US Billion $)	Target Gas Rate for Reduction (%)	Time Frame	Natural gas liquid (EJ) (2020)	Crude oil (EJ) (2020)
Algeria	2030	Not Specified	7 to 22	2030	681,600	1,782,702
Bahrain	N.A	Not Specified	6	2025	27,259	355,202
Comoros	N.A	1.33	23	2030	N.A	N.A
Djibouti	N.A	5.45	40	2030	N.A	N.A
Egypt	2030	246	By sector	2030	50,088	1,192,956
Iraq	2030	100	15	2030	83,358	8,351,883
Jordan	2020	7.54	31	2030	0	42
Kuwait	N.A	Not Specified	7.4	2035	334,377	5,130,062
Lebanon	2020	Not Specified	30 to 31	2030	N.A	N.A
Libya	N.A	N.A	N.A	N.A	60,748	816,272
Mauritania	N.A	35.255	11	2030	N.A	N.A
Morocco	2020	38.8	45.5	2030	0	172
Oman	2020	Not Specified	7	2030	12,275	1,946,699
Palestine	2020	Not Specified	25	2030	N.A	N.A
Qatar	2030	NIFS†	278‡	2030	1,692,423	1,316,218
Saudi Arabia	2030	5.93	26.6	2040	2,372,180	19,009,540
Sudan	2030	14.4	‡ by Sector	2030	0	188,517
Syria	N.A	Not Specified	Not Specified	2030	3988	79,476
Tunisia	2030	14.3	45	2030	65,175	65,175
UAE	2050	NIFS†	23.5	2030	1,510,193	5,760,427
Yemen	2009	35.255	11	2030	26,335	291,108

Source: Authors' compilation from various sources such as country-specific national commitments (NDCs); (Dadashi et al., 2022).

Not conditional on obtaining international financial support. ‡ In million tons of carbon dioxide equivalent.

Disseminating and implementing energy efficiency measures and renewable energy strategies encounter challenges. These challenges stem from issues related to enforcement, implementation, and monitoring of programs, as well as from investors and consumers' behaviors. The main barriers identified in the literature encompass both governmental and technical aspects. Governmental barriers include a lack of institutional coordination among agencies or ministries, hindering decision-making processes, poor enforcement of regulatory policies, and insufficient financing solutions. Additionally, long and bureaucratic administrative procedures limit private sector involvement. Technical barriers include low manufacturing or servicing capacities, a scarcity of accredited equipment testing laboratories, and the private sector's limited capacity to develop projects in the energy sector. Renewable energy integration into the grid poses a significant challenge, as existing grids are unprepared to handle the unpredictability of renewables, potentially affecting energy security. Lack of energy exchange and interconnection between countries, absence of an electricity market, and energy storage difficulties are additional barriers to renewable energy deployment. Furthermore, a shortage of energy statistics in the region hinders the analysis of action plan implementation, identification of successful measures, and the promotion of energy efficiency and renewable energy. Increasing public awareness of these issues is essential to further deploy these technologies in the region.

UAE and Saudi Arabia have both committed to achieving net zero carbon emissions by 2050 and 2060, respectively, demonstrating that the countries in the area are aware of the challenges caused by climate change and the potential presented by the shift to a greener and more sustainable economy. Saudi Arabia has promised to inject investments in the range of $190 billion for climate action, so that by 2030 half of its electricity would come from renewable energy sources. UAE has committed investments in the range of $160 billion for the development of renewable energy. To combat desertification and lower emissions, it has also pledged to plant 10 billion trees over the next few decades. The most significant green city being built in Saudi Arabia is NEOM city, which is anticipated to run fully on renewable energy. Qatar released a national climate change action plan with the goal of reducing greenhouse gas emissions by around 25% by 2030. At the same time, Qatar committed to lowering the greenhouse gas emissions "Carbon intensity" of liquid natural gas facilities. The Ministry of Environment and Climate Change was a part of the Qatari government. Several other countries in the area, including Iraq and Oman, have also made commitments to significantly reduce their greenhouse gas emissions.

To maximize the benefits of renewable energy, work must be done to conduct an evaluation of the policies and standards that aim to improve the investment climate to develop the renewable energy sector and track progress in the Arab region, while developing plans to achieve the desired goals. Figure (3.4) depicts indicators for evaluating the renewable energy sector in Arab countries based on four primary criteria: market structure, policy framework, institutional capacity of the country, and availability of financing and required investments. The indicators were calculated according to nine different factors and 30 quantitative and qualitative sub-indicators (Mahmoud & Habib, 2019).

Egypt, Jordan, and Morocco occupy the lead in the renewable energy sector among the various Arab countries with an overall index of 75%, as Egypt has achieved a breakthrough in the renewable energy sector arrangements, which Pushing the private sector to enter strongly into it. Jordan’s leadership in the renewable energy sector comes from being the first Arab country to achieve its declared goals in this sector before the date set for them in 2020. Jordan is the first country in the region that implemented

the principle of separating ownership of the entire renewable energy sector from the state. With a distinguished and notable performance of the Renewable Energy Fund allocated to this matter, UAE comes in second place for leadership in the renewable energy sector with a general index of 73% and is ranked first among the Gulf Cooperation Council countries, as UAE was able to achieve the lowest cost of producing photovoltaic energy in the world. Tunisia ranks third in the region with an overall index of 70%. Tunisia has made significant progress in attracting private investments and has succeeded in introducing competitive auction and bidding systems for the energy sector, which has helped attract local and international investors to the Tunisian markets.

Despite this, Arab countries need to establish more sustainable networks in the renewable energy sector, open to the private sector, and work to continuously improve their regulatory and institutional capabilities that dominate the renewable energy sector, as well as exert more efforts in working to improve renewable energy networks to support access to its desired goals.

3.4 Enabling Energy Transition

Energy transition, also known as energy system transformation, represents a significant structural shift in the energy sector, transitioning from fossil-based to zero-carbon sources. The primary goal is to curtail energy-related carbon dioxide (CO2) emissions, mitigating climate change and limiting global temperature rise to within 1.5 degrees Celsius of pre-industrial levels (IRENA, 2023). Several Arab countries have set ambitious net-zero targets, with Lebanon, Oman, Tunisia, and the United Arab Emirates aiming for 2050, while Bahrain, Kuwait, and Saudi Arabia target 2060 (Net Zero Tracker, 2022).

The Arab region is witnessing a transition towards more sustainable and resilient energy systems, with renewable energy taking center stage. These region-wide developments underscore the strong commitment of Arab nations to embrace financially, socially, and environmentally sustainable energy solutions, achieved through the accelerated adoption of renewable energy technologies. To strengthen energy transition efforts, regional cooperation and knowledge-sharing among countries are crucial. Establishing flexible and responsive regional cooperation through task forces or technical platforms, focusing on four main pillars, can facilitate the transformation of the Arab energy sector towards increased reliance on renewables, while attracting necessary public and private investments and mitigating associated risks and challenges.

The first pillar involves monitoring and benchmarking at the regional level, supplementing national policy monitoring and existing international and regional benchmarks. This practice enhances implementation by defining priorities, areas for cooperation, and decision-making processes. Creating a common understanding of trends and developments contributes to establishing ambitions, scenarios, and shared visions, enabling countries to identify comparative advantages and develop prospective strategies in alignment with the international sustainable development agenda and climate change challenges.

Figure 3.4: The Status of Arab countries in Renewable Energy Sector Indicators

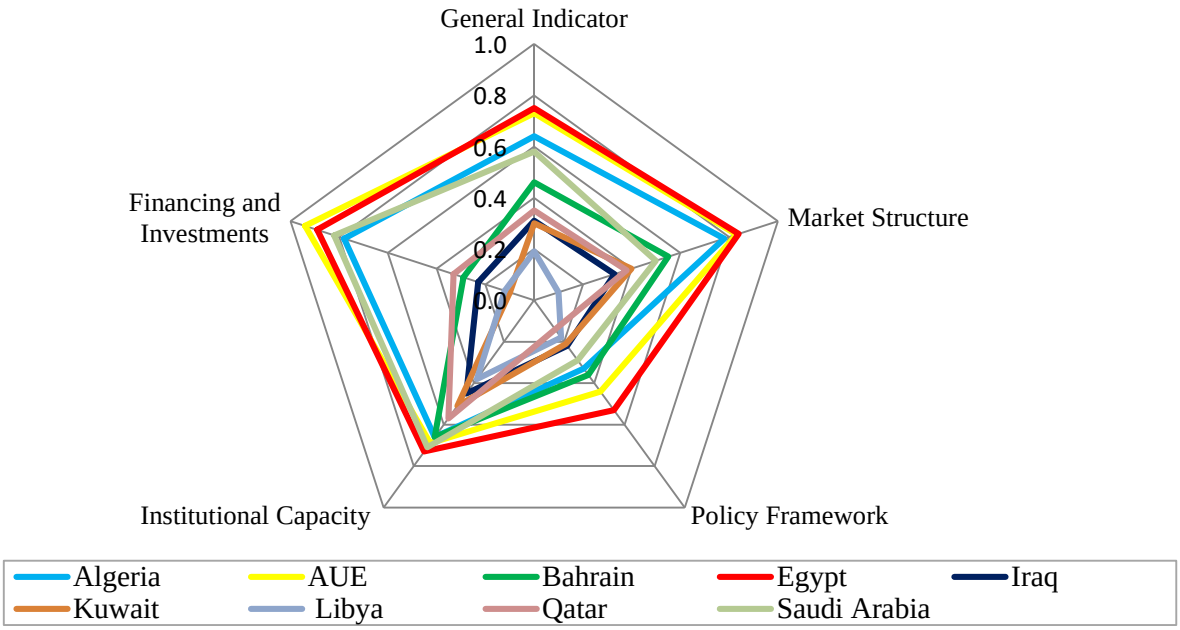


Figure 3.4a: Oil-Exporting Countries

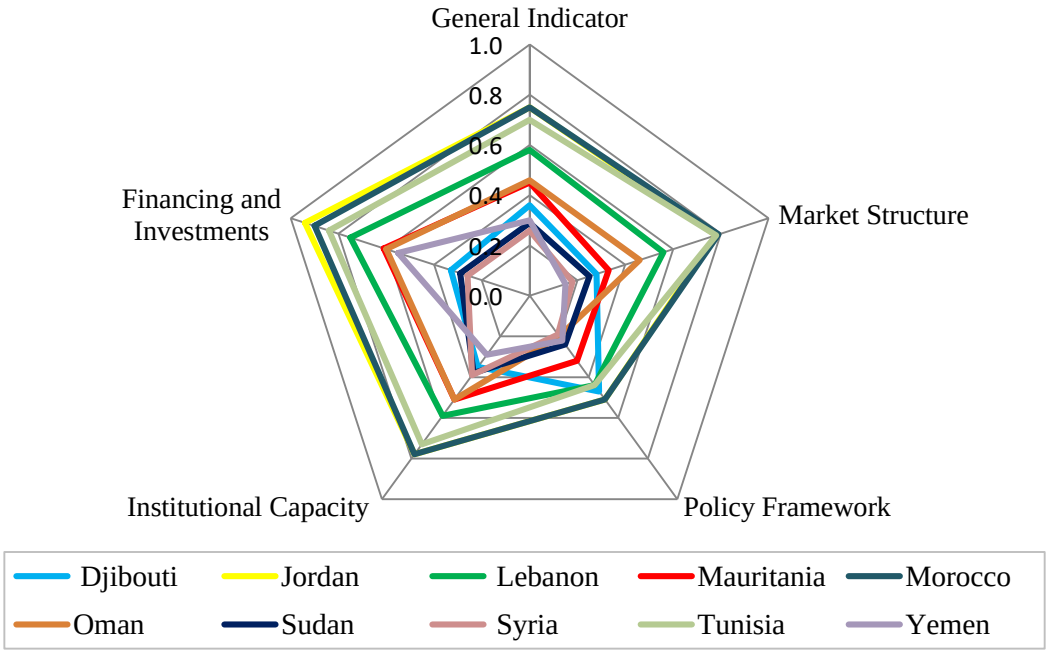


Figure 3.4b: Non-Oil Exporting Countries

Source: (Arab Development Portal, 2023)

The second pillar revolves around cross-sectoral and multi-stakeholder dialogue at the regional level to enhance coordination and efficiency among technical and financial partners, ministries, public institutions, private sectors, experts, and other stakeholders. Engaging all concerned parties in the dialogue and fostering a better understanding of related sectors and policies can unlock new opportunities at national, regional, and international levels. The regional platform serves as a vital bridge, fostering coordination, synergies, mutual understanding, and collaborative actions, thereby mitigating natural competition between stakeholders and organizations.

he third pillar encompasses capacity-building initiatives for public authorities, market players, energy managers, energy auditors, technicians, and raising awareness about methods, tools, and best practices in energy efficiency and renewable energy. Strengthening communication about the benefits of energy efficiency and renewable energy is essential, targeting various stakeholders such as national and local decision-makers, the private sector, civil society, and the public. Regional networks can play a pivotal role in developing strategies for better dissemination, awareness-raising, and communication on these crucial topics, providing guidelines, studies, and tools. A skilled and well-trained workforce is fundamental to a successful energy transition. Energy transition modeling indicates that tens of millions of additional jobs are likely to be created in the coming decades as investments increase and installed capacities expand. This requires a diverse range of occupational profiles, necessitating concerted efforts in education and skills development. Governments play a critical role in coordinating efforts to align educational offerings with projected industry needs, encompassing vocational training and university courses. To attract talent to the renewable energy sector, it is essential to ensure that jobs are decent, and equal access to job training, hiring networks, and career opportunities is provided to women and youth.

The fourth pillar illustrates that financial support and investment play a pivotal role in driving the energy transition in Arab countries. Many Arab nations have made substantial efforts to provide financial incentives to private renewable energy developers. This includes measures such as facilitating land access, streamlining the permit acquisition process through enhanced stakeholder coordination, and developing standardized contractual documents. Well-designed incentive mechanisms have also been implemented to mobilize finance effectively.

Fiscal incentives, particularly tax-related measures, are among the key factors influencing investors' decisions and the overall attractiveness of the renewable energy sector within a country. Policy makers view fiscal incentives as a complementary tool to support a broader renewable energy policy and financing portfolio. Improving access to finance is identified as a priority for all Arab countries. The region has become highly attractive to private investments globally, reflecting increased investor confidence in the legal system, institutions, supporting mechanisms, and, most importantly, the profitability of renewable energy projects. Countries like Egypt, Tunisia, and Lebanon have witnessed a surge in private sector investments in renewable energy projects, signaling an improvement in the overall investment climate. In Egypt, for instance, total investments in solar and wind projects have surpassed USD 2 billion, with more than 30 consortiums contributing their equity and receiving debts from international and commercial lenders. The International Finance Corporation provided USD 660 million in funding for the Benban projects, near Aswan, out of the total project investments of USD 730 million. The European Bank for Reconstruction and Development also played a role in financing solar projects with a commitment of USD 500 million (Ministry of Electricity and Renewable Energy, 2022).

In Tunisia, bidding and auction schemes have not relied on state sovereign guarantees, demonstrating trust in the utility as a reliable energy off-taker. Similarly, GCC countries, Morocco, and Algeria have created highly attractive investment conditions, supported by the strong financial positions and partnerships offered by their utilities and the scale of renewable projects tendered. The majority of awarded or tendered projects have been solar PV projects. The surge in PV investment across the Arab region is expected to continue, driven by ambitious targets and policies addressing both utility-scale commercial installations and decentralized rooftop installations (RCREEE, 2019).

Despite these positive developments, the energy transition faces challenges and is off-track. The aftermath of the COVID-19 pandemic and the impacts of other global events have compounded the difficulties. Urgent action is needed to address these challenges and course-correct the energy transition to limit global temperature rise. Existing pledges and plans fall short of meeting the 1.5°C pathway set by organizations like the International Renewable Energy Agency, resulting in a significant emissions gap (IRENA, 2023). To achieve the necessary course correction, bold and transformative measures are required. This includes translating climate pledges into detailed national strategies and plans, implementing them through robust policies and regulations, and ensuring sufficient funding support. Public financing, both domestic and international, must be increased and strategically channeled. Various policy instruments should be utilized to direct public finance, encompassing government spending, debt, equity, and ownership of assets.

A more comprehensive definition of 'risk' is essential, considering broader environmental and social considerations, not just narrow investor-centric definitions. Public policy and finance must continue to attract private capital. Fiscal policy measures can be employed, such as reinvesting windfall profits of fossil fuel energy revenues in energy transition technologies, reducing fossil fuel subsidies, and introducing or raising CO_2 prices. It is crucial to ensure that the socioeconomic benefits of these instruments are distributed fairly.

To foster a sustainable energy transition, national bioenergy and hydrogen strategies should be developed, with a focus on prioritizing sectors for decarbonization. Incentivizing or mandating a circular economy approach for energy-intensive products will reduce energy demand and the need for critical materials. Enhanced regional and international collaboration in sustainability governance, energy and climate finance, technology and innovation, regional power grids, and green hydrogen development is vital. Moreover, a greater focus should be placed on achieving universal access targets set by Sustainable Development Goal 7 (SDG 7), ensuring that energy is accessible to all while progressing towards a low-carbon future. By taking these comprehensive and coordinated actions, Arab countries can pave the way for a successful and sustainable energy transition.

Despite making strides in providing access to electricity and clean fuels, significant portions of the Arab population still struggle to access affordable, reliable, and sustainable energy in their homes, schools, and communities. The challenges have been exacerbated by the COVID-19 pandemic and subsequent shocks, which threaten to deepen existing energy disparities. While the four core pillars mentioned earlier serve as foundations for accelerating renewable energy solutions across the region, their application becomes particularly challenging in crisis contexts. SDG 7 urges countries to ensure access to affordable, reliable, sustainable, and modern energy for all. Notably, those most in need include the

record number of refugees and internally displaced persons (IDPs) in the Arab region, a result of ongoing conflicts.

Energy has emerged as a key challenge for countries facing conflict and heightened fragility due to the influx of refugees and IDPs from neighboring countries and regions. In such countries, the ability of communities to cope with and rapidly recover from crises hinges on their access to energy. Instead of reverting to expensive, import-dependent solutions like diesel or oil, an increasing number of countries are turning to solar solutions to meet community needs while laying the groundwork for a sustainable energy future. In crisis contexts, energy plays a pivotal role in facilitating community access to water, social services such as healthcare and education, transportation, and communication needs. It is also critical for reviving livelihoods and local economies. In these situations, localized renewable energy solutions are highly sought after, as they not only address short-term needs but also build resilience for the future. Expanding the use of localized energy solutions is important for both short-term requirements and long-term development perspectives, as it helps alleviate pressures on host communities and reduces fiscal burdens on the government.

3.5 Conclusion and recommendations

In conclusion, to achieve a successful energy transition in Arab countries, while avoiding stranded fossil fuel resources and leveraging innovations and digital technologies, several recommendations should be considered:

- **Strategies Transition:** Countries should create comprehensive strategies for transitioning from fossil fuels to renewable energy sources, while considering the risk of stranded assets. This process could involve a gradual phase-out of fossil fuels, planning for future uses of existing resources, and exploring opportunities for carbon capture and storage. Arab countries should also focus on diversifying their energy sources by increasing investments in renewable energy technologies, such as solar, wind, hydro, and geothermal. This will reduce reliance on fossil fuels, lower carbon emissions, and ensure a more sustainable energy mix.
- **Innovations and Digital Technologies:** Encourage innovation and research in renewable energy technologies by providing support for research institutions and offering incentives for the private sector to invest in research and development of clean energy solutions. Invest in and adopt innovative solutions and digital technologies to improve energy services, efficiency, and grid management. This can include smart grid technologies, energy storage solutions, advanced metering infrastructure, digital platforms for energy management, and AI-driven solutions for optimizing energy use. Modernize electrical grids to accommodate renewable energy sources, improve grid resilience, and allow for increased energy efficiency. This can also include investing in infrastructure for electric vehicles, which would help in reducing emissions from the transportation sector. This will drive innovation, improve the efficiency of renewable energy solutions, and address energy challenges specific to the Arab region.
- **Introduce Carbon Pricing:** Implement carbon pricing mechanisms, such as carbon taxes or emissions trading schemes, to internalize the environmental cost of carbon emissions. This will incentivize the transition to low-carbon technologies and discourage excessive fossil fuel

consumption.

- **Promote Energy Efficiency:** Encourage energy efficiency measures across all sectors, including industries, buildings, transportation, and agriculture. This will help reduce energy consumption, lower **Support Fossil Fuel Transition:** Gradually shift investments from fossil fuel-based infrastructure towards sustainable energy projects. This can involve repurposing fossil fuel facilities for renewable energy production and ensuring a just and fair transition for affected communities and workers. This will require investing in education and training to build a skilled workforce that can support the energy transition. This includes capacity building in renewable energy technologies, energy efficiency, and other related fields.
- **Regional Integration and International Partnerships:** Foster cooperation and partnerships with neighboring Arab countries and international allies in the energy sector. Enhance regional integration and cooperation to achieve energy transition goals, could include establishing cross-border electrical grid connections, investing in joint infrastructure projects, and deepening market ties. Create interconnected regional electricity grids to facilitate the efficient exchange of electricity between countries. This can enhance energy security, enable the sharing of renewable energy resources, and optimize power generation and consumption. This can lead to collective efforts in addressing common challenges and promoting sustainable energy solutions at the regional level. Strengthen international partnerships to leverage global expertise, share best practices, and access funding for renewable energy projects. Partnerships with global organizations can provide technical assistance, capacity building, and financial support for energy transition initiatives. These initiatives can enhance energy security, reduce costs, and optimize the use of renewable energy sources across the region.
- **Focus on Crisis Contexts:** Pay particular attention to energy access and sustainability in crisis-affected regions, including refugees and internally displaced populations. Prioritize the deployment of localized renewable energy solutions to address immediate needs and build resilience.
- **Regulatory Frameworks and Policy Support:** Establish clear and stable regulatory frameworks that support renewable energy investments and provide long-term policy support to ensure the growth and stability of the renewable energy sector. Further regulations and policies to facilitate the energy transition could include carbon pricing, and policies that promote energy efficiency and the use of clean technologies. Encourage the adoption of circular economy principles, promoting the reuse and recycling of energy-intensive products and materials. Invest in green technologies and explore the potential of bioenergy and hydrogen as viable decarbonization options.
- **Access to Finance:** Enhance access to finance for renewable energy projects through various mechanisms, such as public-private partnerships, international funding, and development banks' support. Promote investment in green technologies and explore the potential of bioenergy and hydrogen as viable decarbonization options.
- **Encourage Public-Private Partnerships:** Engage the private sector in energy transition efforts through public-private partnerships (PPPs). PPPs can attract private investments, bring in technical expertise, and accelerate the implementation of renewable energy projects. Governments should allocate significant investments to promote the development and deployment of renewable energy technologies. Financial incentives, grants, and subsidies can help attract private investments and accelerate the adoption of renewable energy solutions.

By following these recommendations and harnessing the potential of regional and international collaborations, Arab countries can effectively navigate their energy transition journey, maximizing the benefits of renewable energy while minimizing the impact on stranded fossil fuel resources. This will not only contribute to climate change mitigation but also drive economic growth, enhance energy security, and improve the overall well-being of the Arab population.

Chapter Four

Decarbonisation and Green Structural Transformation of Arab Economies

4.1 Introduction

This chapter explores ways for mitigating or removing carbon emissions from economic activities within Arab countries, with a specific focus on the manufacturing industries. This is part of a broader and crucial goal of expediting structural transformation in Arab economies. This chapter embarks on defining and evaluating the levels of structural transformation within Arab countries. It also examines the role played by the industrial sector, particularly the manufacturing industries, in accomplishing this transformation and the development implications therein. These evaluations are informed by the outcomes of structural transformation experiences in both developed and emerging countries and relevant empirical studies. Moreover, the chapter endeavors to comprehend the impact of the industrial sector and manufacturing industries on carbon emissions within Arab countries. This includes identifying the significance and role of manufacturing industries in these nations and analyzing their structure and primary activities while focusing on their relationship with emissions. It further scrutinizes the existing production and export structures within Arab countries to determine the extent of dependency on climate-insensitive activities and products. Anticipating the prospects for transformation and the potential challenges associated with a green shift becomes a key component of this analysis. Ultimately, this knowledge will inform a set of practical recommendations for the green transformation of industries within Arab countries, simultaneously accelerating and enhancing the quality of their structural transformation.

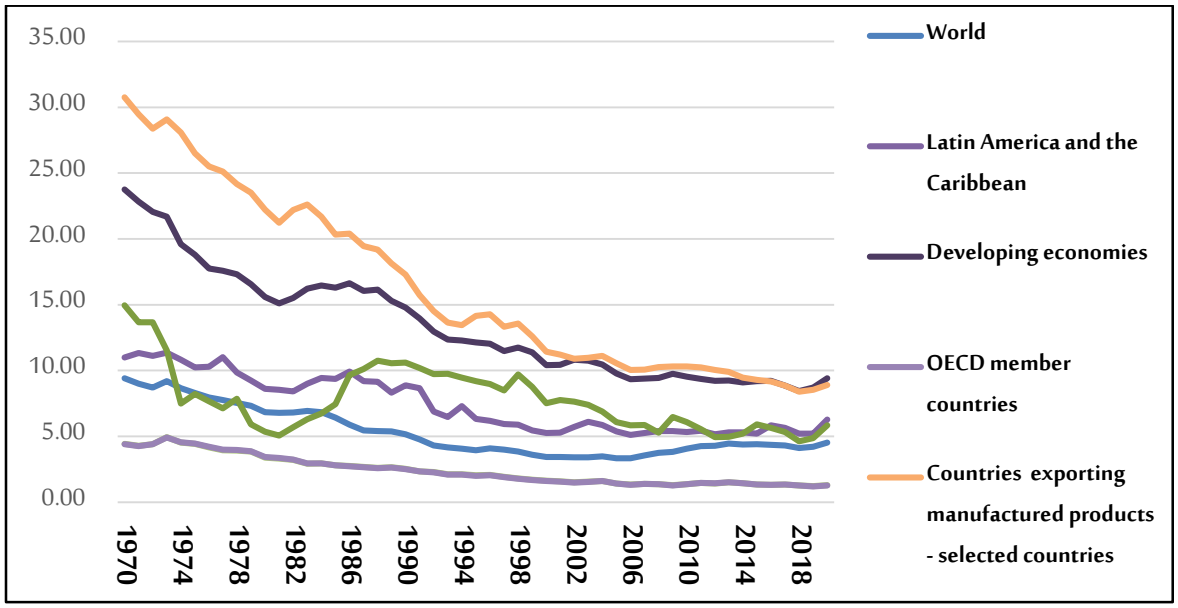
A comprehensive review of experiences in economic development, both in developed and emerging countries, underscores the importance of dynamic structural transformation. This process involves transitioning from primary and traditional production structures to advanced stages characterized by manufacturing industries, and eventually services and modern technologies. International experiences reveal an additional dimension in these pathways, focusing on the transition to low-carbon activities that consider climate-related concerns. Many countries have committed to carbon neutrality by 2050 as part of their efforts to reduce greenhouse gas emissions and combat climate change. The world is increasingly translating these commitments into national obligations, incorporating them into domestic policies and legislation. Considering this context, the pivotal role of economic sectors, particularly the industrial sector, in achieving structural transformation becomes evident. However, experiences and research findings highlight that most developing countries, including several Arab countries, encounter the "middle-income trap." This phenomenon signifies the challenge of sustaining structural transformation throughout development. This chapter aims to address these various dimensions and propose policies that facilitate structural change and enhance the quality of production structures in Arab countries. The focus will be on fostering and advancing manufacturing activities. Additionally, it aims to present a viable pathway toward green transformation that can be pragmatically pursued as a public good. This, in turn, necessitates governmental support and assistance. The chapter also strives to illuminate the opportunities available to Arab countries to harness this transformation for their benefit.

4.2 Measuring and evaluating structural transformation in Arab countries.

Delving into the process of structural transformation and economic sector development in Arab countries. This section investigates how the composition of these economies has evolved over time. Key aspects under consideration include the changing contributions of the agricultural, manufacturing, and service sectors, as well as the challenges and opportunities presented by these transformations. It also explores the factors that have influenced these shifts and analyzes their implications for the development trajectory of Arab countries. Scholarly research reveals a consistent pattern in economic development. The manufacturing sector, in terms of both employment and value added, initially expands during the early stages of economic growth in low-income countries. However, as nations progress and average income levels rise, the relative importance of manufacturing starts to decline, while the service sector experiences growth. An interesting observation is that as the service sector's share of value-added surges, the share of value added in manufacturing begins to wane. Tracing this trend in relation to the structural transformation process in developed and emerging countries. While exploring how this process is marked by continuous growth in the manufacturing sector's share of value added before it starts to decline at higher income levels. This decline is then offset by the expansion of the service sector, driven by increased productivity.

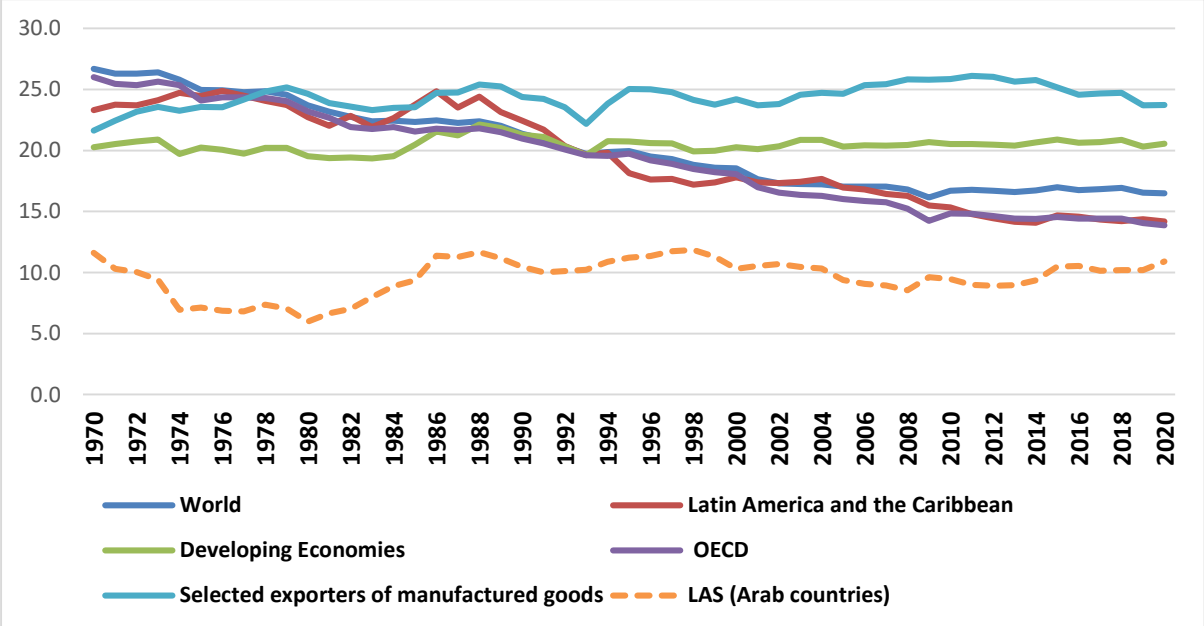
Within the Arab world, the analysis of production structures over time paints a picture of shifting economic landscapes. Notably, the agricultural sector's share in GDP has consistently decreased, falling from approximately 15% in 1970 to about 5.8% in 2020 (Figure 4.1). This trend aligns with broader developing economies. However, the decline has been even more pronounced in countries like Libya, Iraq, Kuwait, Qatar, and Saudi Arabia, showcasing unique economic circumstances. In contrast, the share of manufacturing industries in GDP has displayed a degree of stability. Despite declining globally and in other regions, the manufacturing sector's contribution to GDP has remained the lowest in comparative performance across the Arab world over the past five decades (Figure 2.4). These findings highlight the differences in structural transformation paths, which can be attributed to various factors. One major influencer is the initial development levels from which countries began their transformation. Additionally, price fluctuations have significantly affected the relative importance of sectors, particularly in oil-rich countries where rising prices elevate the importance of extractive industries. Lastly, external factors like climate conditions, political instability, and security issues have created variations in sectoral performance.

Figure 4.1: Agricultural output share in GDP in various world regions % (1970 – 2020)



Source: Researcher's calculations based on UNCTADStat, 2023.

Figure 4.2: The contribution of manufacturing industries to GDP (1970-2020)



Source: Researcher's calculations based on UNCTADStat, 2023.

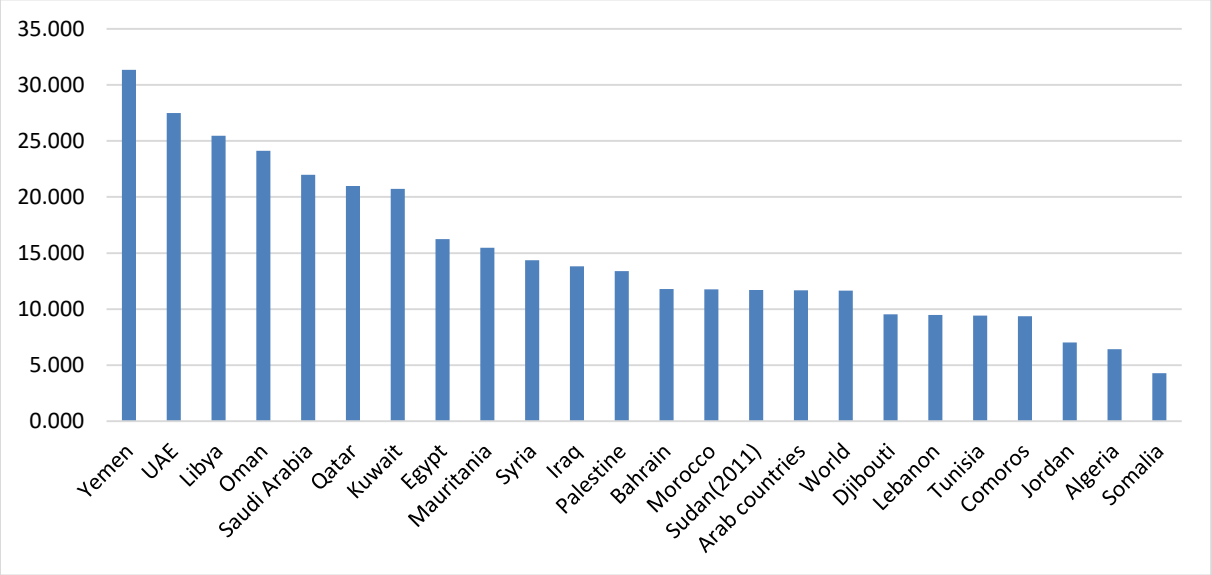
The contribution of the service sector to Arab countries' GDP has experienced fluctuations, which have set them apart from other regions. This phenomenon can be attributed to the unique composition of GDP structures in Arab countries, which are more sensitive to variables like prices, climate, and stability. In regions like Europe, developed countries do not experience the same sensitivity or high fluctuations in sectoral shares of GDP. The volatility of the service sector's contribution to GDP in Arab countries is particularly notable. It reaches its highest rates in Arab oil-producing nations, such as Libya, Iraq, Kuwait, Qatar, and Saudi Arabia, as well as countries like Yemen, Palestine, and Mauritania. These fluctuations are influenced by factors distinct to each country. The analysis serves to underscore the unique challenges faced by Arab countries in managing their service sectors and underscores the need for tailored policies to address these complexities.

4.2.1 Measuring structural transformation in Arab countries.

Considering the previous analysis of the evolution of production structures in the Arab countries and employing established methodologies for measuring structural transformation based on the shares and relative contributions of value added at current prices (as detailed in Appendix 2), this section of the report examines the progress in achieving structural transformation within Arab countries over a multi-decade timeframe, spanning from 1970 to 2020. The various trajectories observed across these nations emphasize the prolonged duration required to bring about changes in the complex relationships between economic variables. This transformation also necessitates advancements in technology, alterations in production methodologies, shifts in institutional composition, improvements in human capital, and other factors that evolve over extended periods. Evaluation of structural transformation in Arab countries focuses on three fundamental sectors: agriculture, industry, and services. To provide a more accurate depiction of the structural transformation in Arab countries, the contributions of five economic sectors, encompassing agriculture, manufacturing industry, mining and extraction, construction, and services are analyzed. The data is sourced from the United Nations Conference on Trade and Development (UNCTAD) database, covering years from 1970 to 2020. To ensure the reliability of measurement results, these contributions are averaged over ten years periods throughout the 1970-2020 timeframe, thereby mitigating the impact of any abrupt changes due to extraordinary circumstances (as detailed in Appendix 3).

The findings from measuring structural transformation during two periods, 1970-1979 and 2010-2020, reveal that Arab countries have lagged other global regions and groups in achieving structural transformation. The country-level results highlight Yemen as having attained the highest rates of structural transformation. Notably, the agricultural sector in Yemen witnessed the most substantial reduction in its contribution to output in favor of other sectors. Its average contribution decreased from around 46.3 percent during 1970-1979 to merely 16.8 percent during 2010-2020, leading to a noteworthy increase in the structural transformation index. Oil-producing countries, especially GCC member states (excluding Bahrain) and Libya, also experienced heightened structural transformation. This transformation is primarily linked to changes in the contributions of mining and extraction activities, favoring the services sector to a greater extent than the other sectors. The remaining Arab countries, inclusive of both oil-dependent middle-income and lower-income nations, follow this pattern (Figure 4.3).

Figure 4.3: Structural transformation index (SCI) in Arab countries (2010-2020) - (1970-1979)

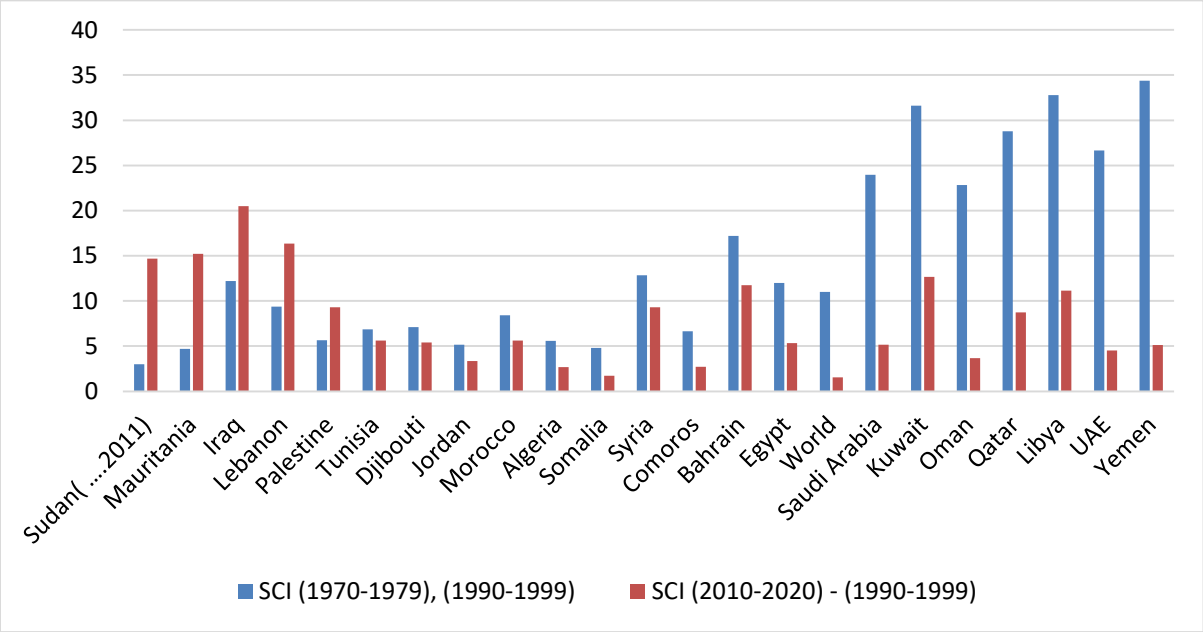


Source: Researcher's calculations based on UNCTADStat, 2023

To elucidate the pace of structural transformation achievement within Arab countries over the past five decades, the Structural Transformation Index (SCI) is calculated for two distinct time periods within the 1970-2020 timeline. SCI is calculated using sectoral contributions for the periods 1970-1979 and 1990-1999, followed by a calculation for the periods 1990-1999 and 2010-2020. This analysis reveals a clear divide between the two groups of countries. The first group comprises a range of Arab nations with varying characteristics, which achieved most of their structural transformation in recent decades. These countries include Sudan, Mauritania, Iraq, Lebanon, and Palestine, and encompass middle-income oil-dependent countries and other middle- and low-income non-oil countries. Conversely, the remaining countries achieved a lower rate of structural transformation during the second period compared to the first. Among this latter group, oil countries, especially GCC states (excluding Bahrain) and Yemen, are among the countries with a slower pace of transformation. This group aligns with the countries that attained the highest rates of structural transformation during the broader timeframe. The dynamics of structural transformation in these countries peaked during the initial historical phase, after which it slowed, a trend substantiated by the steady or declining contributions of manufacturing industries to output (indicating early withdrawal from manufacturing) and the reduced pace of transformation. This deceleration is also reflected in the share of the mining and extraction sector and service activities, particularly during recent decades. This trend applies to the remaining Arab countries but at a relatively lower pace, encompassing Egypt, Bahrain, the Comoros, Syria, Somalia, Algeria, Morocco, Jordan, Djibouti, and Tunisia. In essence, most Arab countries concentrated their structural transformation efforts in the earlier decades, with a subsequent slowdown in recent decades (Figure 4.4).

A comparative assessment shows that structural transformation was generally more rapid during the first period compared to the second. Measurement results underscore the widening gap among Arab countries, especially within the oil-dependent countries, primarily represented by GCC countries (excluding Bahrain) and Libya. This reveals a notable reduction in the dynamics of structural transformation in recent decades (the second period) in comparison to the earlier decades (the first period).

Figure 4.4: Change in the pace of structural transformation in Arab countries for selected periods during the years 1970-2020



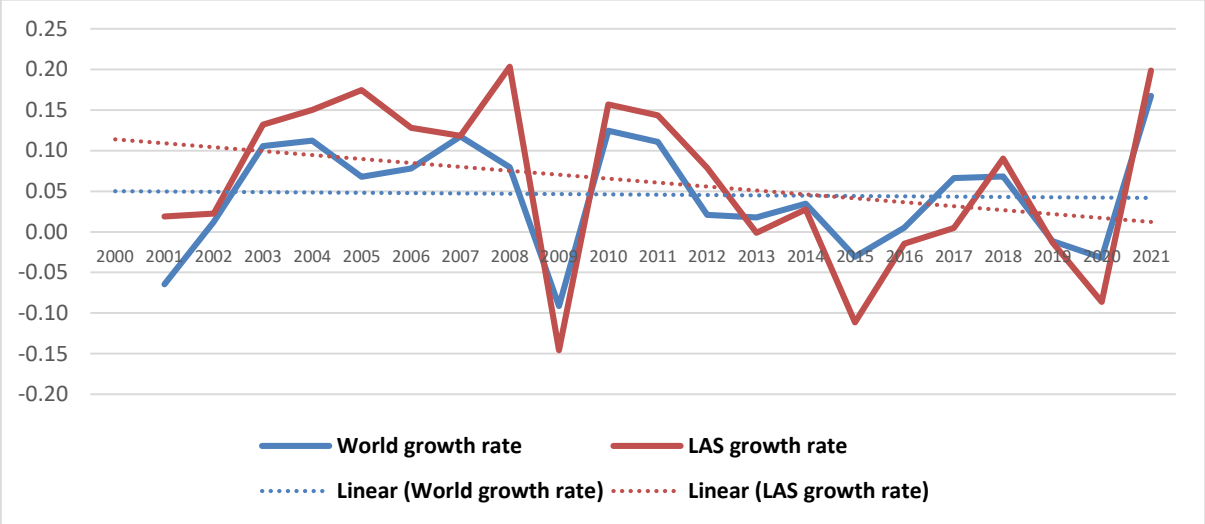
Source: Researcher's calculations based on UNCTADStat, 2023

4.3 Manufacturing industries and carbon emissions

Before delving into the review and analysis of the relationship between manufacturing industries and climate change issues, particularly carbon emissions and their ecological impacts, it's important to consider several fundamental facts about this sector and its global and regional significance. As of 2021, the global gross value added by the manufacturing sector totaled around $16 trillion, a substantial increase from approximately $6.2 trillion in the year 2000. The contribution of this added value in Arab countries also grew from roughly $98.3 billion in 2000 to about $352 billion in 2021. This boost elevated the Arab countries' share in the global value added by the manufacturing sector from 1.5 percent in 2000 to approximately 2.1 percent in 2021. This growth was driven by an average annual growth rate of 6.0 percent in Arab countries, surpassing the global average of around 4.0 percent over the same period from 2000 to 2021 (Figure 4.5). However, it's important to note that most of this growth relied on contributions from a limited number of Arab countries that saw significant increases in the value added to their

manufacturing sectors. Four Arab countries, Saudi Arabia (30.9%), Egypt (17.8%), the United Arab Emirates (12.2%), and Algeria (12%), collectively accounted for approximately 73 percent of the total value added in the Arab world in 2021. This distribution remains consistent when analyzing the two-decade average, albeit with variations in the order of contribution among these four countries. Together, they continue to make up roughly 71 percent of the Arab region's total.

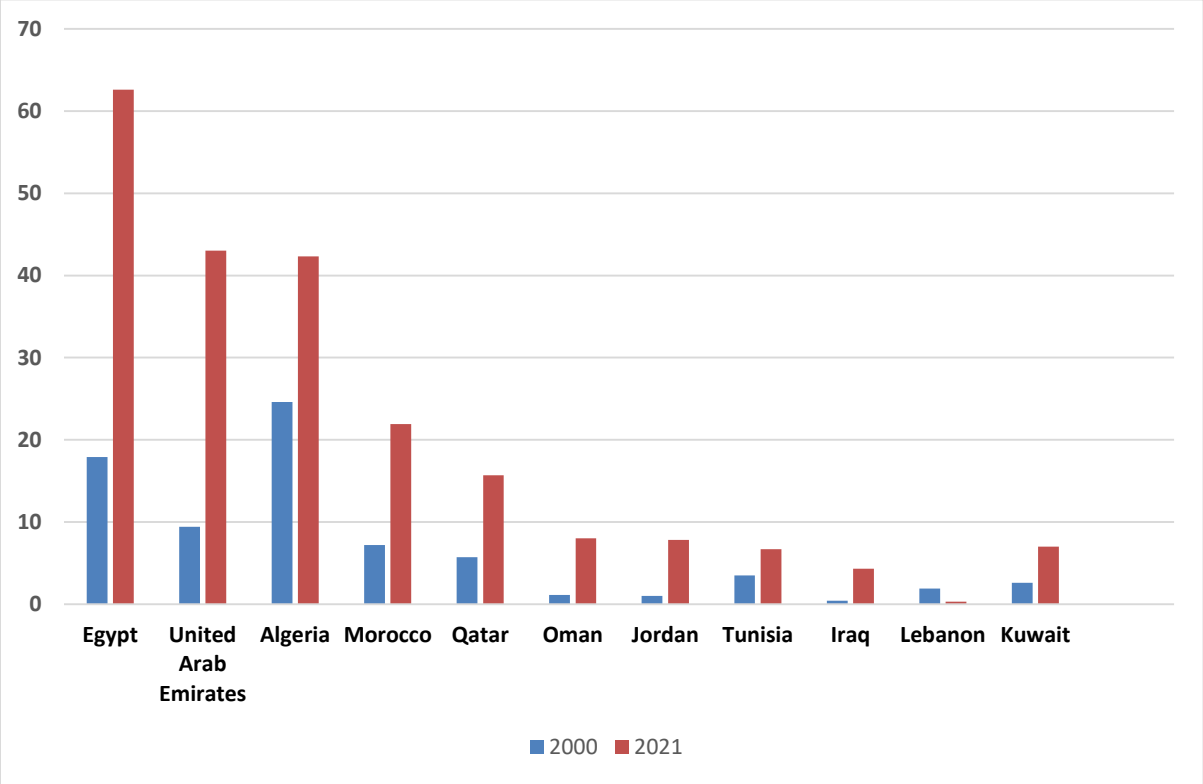
Figure 4.5: The rate of change in the value added of the manufacturing sector at the global and Arab levels during the period from2000-2021 (%)



Source: Prepared by the researcher based on World Bank (2023)

Turning our attention to carbon emissions originating from Arab countries and their development activities, international databases reveal that these emissions are primarily concentrated in a limited number of Arab nations, notably those rich in oil reserves. When assessed by carbon dioxide emissions volume, five Arab countries are listed among the 30 largest global sources of emissions. These countries are Saudi Arabia, Egypt, the United Arab Emirates, Iraq, and Algeria. Additionally, six Arab countries rank among the 30 largest global sources of emissions when evaluated by average per capita emissions. Remarkably, four of these Arab countries claim the top positions in the world, with Qatar, Kuwait, Bahrain, and the United Arab Emirates leading the way. The small number of populations in these countries, despite their abundant oil resources, largely contributes to this result. Following these high-emitting countries are Saudi Arabia and Libya (as detailed in Appendix 4). Notably, the list of Arab countries with the highest emissions aligns with those making the greatest contributions to industrialization. This list includes Saudi Arabia, the United Arab Emirates, Egypt, and Algeria. Nevertheless, it's important to highlight that, despite the decreased contribution of the rest of the Arab countries to the value added by the manufacturing sector, several of these nations have managed to achieve higher growth rates than the four countries with the highest contributions. This is particularly evident in countries like Oman and Jordan (Figure 4.6).

Figure 4.6: The added value of the manufacturing sector in several Arab countries for the years 2000 and 2021 - ($billion) - at current prices



Source: Prepared by the researcher based on World Bank (2023)

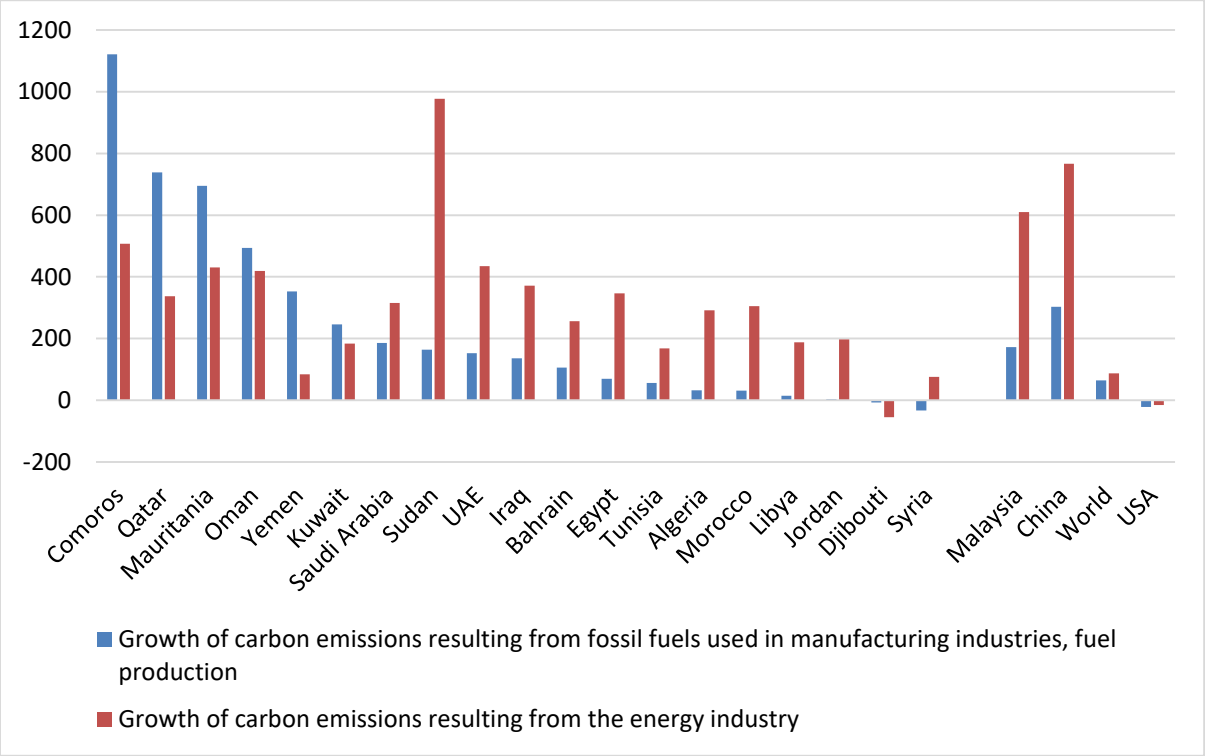
This analysis of the contributions of the manufacturing sector to both the Arab and national outputs reveal several noteworthy findings. Most prominently, it underscores the sector's increasing share and the concentration of major contributions within a limited number of Arab countries. Furthermore, it shows that, despite declining contributions from the rest of the Arab countries to value added, many of these nations have experienced significant growth in this value. This indicates the expectation of ongoing growth in the manufacturing sector and its associated carbon emissions. This expectation is in line with global estimates, which predict a surge in demand for manufactured products due to the projected expansion of the global middle class by roughly 3 billion individuals over the next two decades. It's also consistent with the historical trend of growing emissions from manufacturing activities. The data reveals that emissions have increased from about 0.5 billion tons equivalent in 1990 to approximately 16.1 billion tons equivalent in 2019. The impact of manufacturing activities on climate change can be distilled into two core dimensions. First, it pertains to their energy consumption, primarily through the utilization of fossil fuels, especially in industries that involve raw material conversion through processes such as heating, boiling, and smelting. Examples include iron steel, aluminum, fertilizer, petrochemicals, and other sectors. Second, it relates to the emissions stemming directly from industrial activities, which are specific to the nature of each industry. For instance, the cement industry, chemical industries, and others contribute to these emissions. Global estimates indicate that these industrial activities are responsible for

roughly 30 percent of the world's total carbon emissions. Notable contributors include the iron and steel industries (7.2 percent), chemical and petrochemical industries (6.1 percent), the cement industry (3.0 percent), and other industrial sectors. These findings underline the significance of the manufacturing sector's role in global emissions (as detailed in Appendix 5).

At both the regional and national levels, data pertaining to the escalation of carbon emissions, whether associated with manufacturing activities or stemming from the energy sector and its production, reveal that from 1990 to 2021, emissions linked to manufacturing activities in Arab countries surged by an average of approximately 251.5 percent. Concurrently, emissions tied to the energy industry, which includes the generation of power in public and private facilities, escalated by an average of roughly 307.9 percent. These figures significantly surpass the global averages, with manufacturing activities worldwide growing by approximately 65 percent and the energy industry by only about 87 percent during the same period. These growth rates align with the dominance of energy-intensive industries in Arab countries, contributing to around 24.8 percent of global emissions. To assess Arab performance, we can draw insights from several advanced, emerging, and developing countries with per capita income levels like those in Arab nations. These countries are also featured prominently on international lists of carbon emissions, whether based on total volume or per capita measurements. Notable examples include the United States, China, and Malaysia. It becomes evident that the Arab performance mirrors the general trend in emerging and developing industrialized countries, such as China and Malaysia, with increases in both sources of emissions. Notably, the most substantial surge occurs in emissions tied to the energy sector, surpassing the growth observed in emissions associated with manufacturing activities.

In contrast, advanced industrialized countries like the United States display a decline in the rate of emissions from manufacturing industries as well as the energy sector. These emissions registered a decrease of approximately -22 percent for manufacturing and about -15 percent for the energy industry during the same period (Figure 4.7). This disparity between Arab countries and emerging economies in emission growth patterns on one hand and developed nations like the United States and the European Union on the other, can be primarily attributed to a continuous shift in manufacturing activities. This transition is characterized by a move toward higher-tech industries that are further removed from primary material conversion and processing activities. It also reflects the ongoing transformation in the quality of energy sources used in the energy industry. This transformation involves a growing adoption of gas and other renewable energy sources, coupled with a reduction in the use of oil and coal.

Figure 4.7: Growth of carbon emissions resulting from fossil fuels used in manufacturing industries, fuel production, and the energy industry in Arab countries and several industrial comparison countries between the years 1990 and 2021 (%)



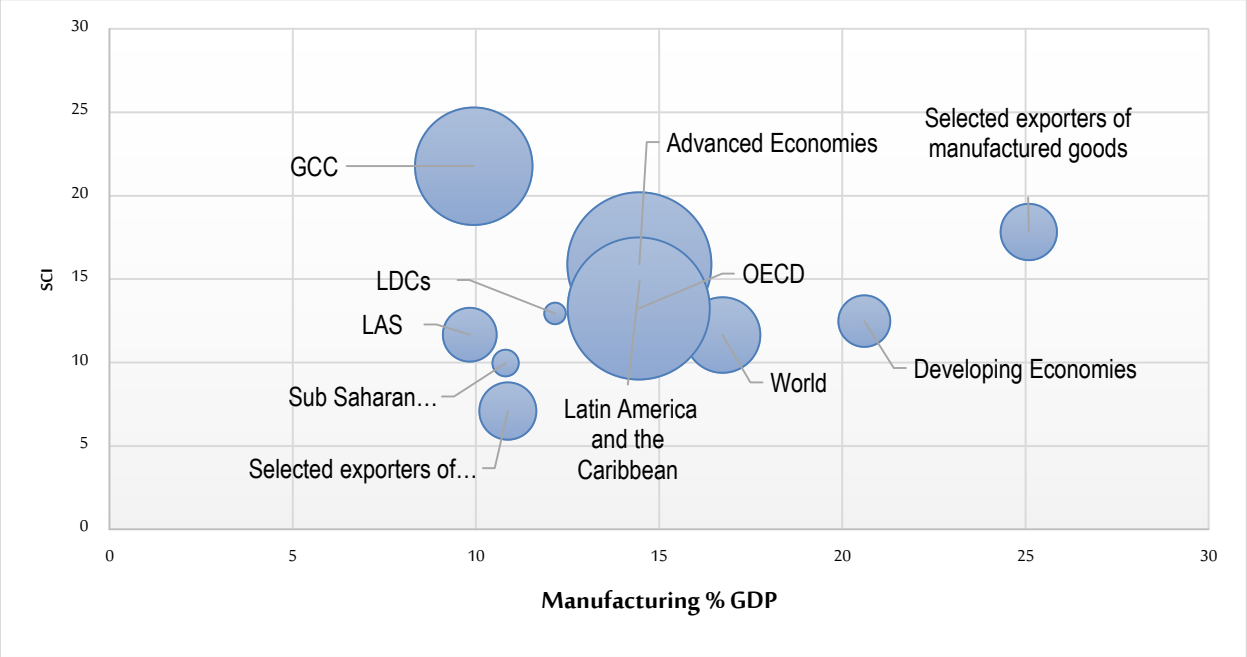
Source: EDGAR, 2023

4.4 The impact of structural transformation and the growth of industrialization on average per capita income

Drawing upon the aforementioned data and analysis, this section of the report endeavors to establish a link between the Structural Transformation Index (SCI) computed by the report's team (see Appendix 2) for the two distinct timeframes of 1970-1979 and 2010-2020. This link is explored alongside the industrialization rates, specifically measured by the significance of the manufacturing sector's contribution to the GDP during the 2010-2020 period. Additionally, the average per capita income of the GDP at current prices for the year 2021 in U.S. dollars is considered. As depicted in Figure (4.8), where the horizontal axis illustrates the manufacturing sector's contribution to the output, the vertical axis represents the rate of structural transformation, and the size of the circles corresponds to the average per capita income, it becomes apparent that Arab countries, when considered as a regional grouping, fall short of the averages achieved by economies that predominantly rely on exporting manufactured products. This category primarily encompasses a blend of developed, emerging, and developing countries. Arab nations also lag behind developing economies and even countries with lower levels of development in terms of the manufacturing sector's contribution to output, the degree of structural transformation, and relative

regions, as measured by the criterion of average per capita income. In this regard, developing economies, as well as Latin America and the Caribbean, exhibit superior performance. At the individual country level, it is evident that several Arab countries have managed to enhance the role of manufacturing industries in output without a corresponding impact on structural transformation. This is exemplified by countries like Jordan, Tunisia, Morocco, and Bahrain. Conversely, some nations have achieved a substantial rate of structural transformation without relying heavily on the manufacturing sector's substantial output contribution. This is the case with Gulf Cooperation Council countries and Libya. Finally, there are countries that have achieved moderate rates for both the manufacturing sector's contribution to output and structural transformation, such as Egypt and Palestine.

Figure 4.8: The relationship between structural transformation (SCI) and the contribution of manufacturing industries to output and their repercussions on average per capita income in Arab countries and comparative international regions 2021



Source: Prepared by the researcher based on World Bank (2023) and UNCTADStata (2023).

The figure underscores that there is no direct and linear correlation between the level of structural transformation, the level of industrialization, and the average per capita income in Arab countries. This outcome can be attributed to the complex interplay of multiple factors, as substantiated by economic theory and empirical studies. These factors mainly differ in terms of the causality between structural transformation and economic growth. Moreover, institutional data and development realities vary significantly among Arab countries, encompassing disparities in resource endowments, institutional structures, and levels of stability. Consequently, it is vital to emphasize that while targeting structural transformation through a sustained path of industrialization and enhancing the manufacturing sector's contribution to the Gross Domestic Product represents an essential and integral aspect of long-term

growth and prosperity, it is not the sole avenue for achieving these objectives. Some countries have successfully achieved higher levels of transformation and prosperity without relying extensively on manufacturing activities. This expands the opportunities for Arab countries to diversify and deepen their economic activities, both in terms of commodities and non-commodities. Of particular significance is the alignment of these activities with development agendas centered around sustainability and the advantages derived from transitioning to environmentally friendly practices.

4.5 Assessing the relationship between benefit structure and carbon emissions.

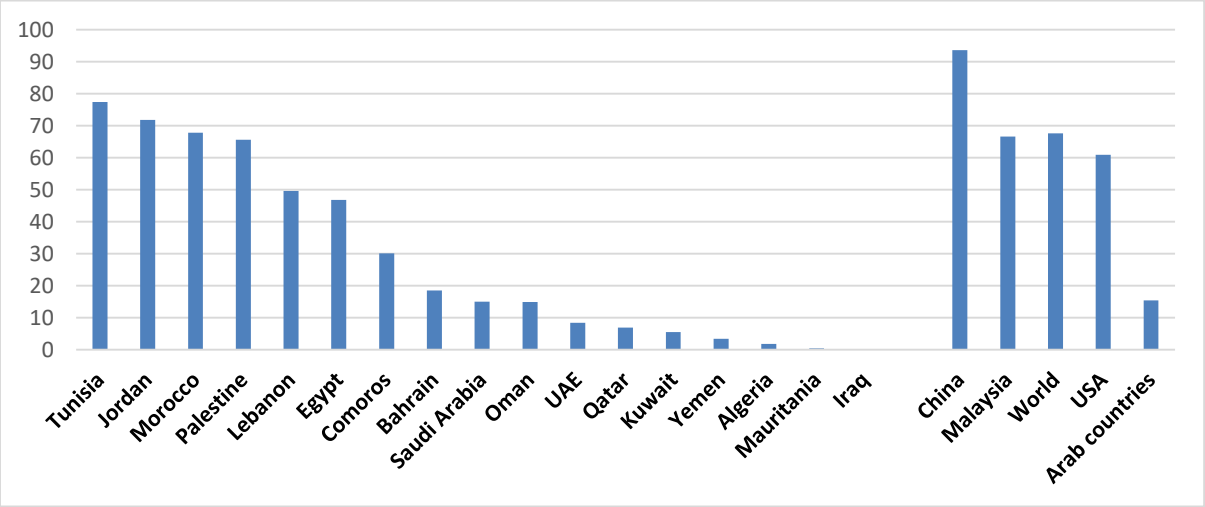
To assess the potential of the manufacturing sector in driving and expediting structural transformation in Arab countries while considering climate and green transformation imperatives, it is essential to gauge the current state of this sector. This evaluation should account for its relative and competitive advantages compared to the desired path of green transformation. By adopting the classic definition of exports as "surplus domestic production," which also serves as a central component for mobilizing essential resources to fund development endeavors and stabilize national budgets, a quantitative, structural, and qualitative analysis of these exports can offer a deeper understanding of the composition of commodity (manufactured) activities and the structure of their competitiveness. This, in turn, allows us to assess the extent to which our export capabilities are associated with commodity structures that are environmentally friendly. The data reveals that the total value of merchandise exports from Arab countries in 2021 is projected to reach approximately $1.2 trillion, representing about 5.3 percent of global exports. It is worth noting that this contribution has remained relatively stable, averaging around 5.9 percent during the 2010-2021 period. A closer examination of the export structure unveils that oil exports, including fuels and metals, constituted approximately 62.0 percent of the total merchandise exports from Arab countries in 2021. This proportion remained steady, averaging about 59.6 percent over the 2010-2021 period. In stark contrast, exports from manufacturing industries accounted for only about 15.4 percent on average during the same period. This discrepancy is evident when comparing the global average and the performance of countries included for comparison (Figure 4.9). The data also depicts an uptick in the value of manufactured goods exports from Arab countries, rising from approximately $102 billion in 2010 to around $324.8 billion in 2021. However, this only represents about 1.5 percent of the global total, with an average of roughly $167 billion annually for the period 2010-2021, equating to a mere 1.3 percent of the global total for the same duration. These low contribution rates signify insufficient industrialization efforts and a failure to translate these efforts into the development of export capabilities for manufactured products in Arab countries. It is noteworthy that only one emerging country among those compared, Malaysia, achieved a similar percentage of about 1.2 percent for the same period, roughly on par with the total Arab contribution (World Bank, 2023).

This performance mirrors the reality of the contribution of Arab countries to global value chains, highlighting the extent to which production and export structures in these countries are interwoven with the activities of the global production movement led by multinational corporations. Arab countries lag behind advanced, developing, and emerging economies, with their contribution to these chains amounting

to a mere 2.8 percent. Notably, this contribution is primarily concentrated in a number of oil-producing countries that are members of the Gulf Cooperation Council, revolving around products linked to fossil fuel derivatives (UNCTAD-Eora, 2023).

At the core of Arab exports of manufactured goods, the data for the year 2021 reveals that activities within non-climate-sensitive industries contribute significantly to the overall export composition of Arab countries. This is predominantly represented by chemical and petrochemical industries and basic metals (ITC, 2023). Examining a model from one of the Arab countries with the highest contribution to the value added by Arab manufacturing industries, alongside the highest levels of carbon emissions per capita, such as the United Arab Emirates, it becomes evident that three products account for approximately 86.6 percent of its total exports. These products include oil and gas (44.4 percent), refined products (27.02 percent), and basic metal products (15.13 percent). This analysis underscores that the structure of exports and gains in Arab countries largely depends on activities and industries that are not conducive to climate considerations and the requisites of green structural transformation. This outcome is consistent with indicators tracking the volume and proportion of Arab exports of environmental goods concerning total exports. These indicators serve to gauge the international interest in implementing policies and steering measures to realign the comparative advantages of production structures, considering climate considerations. Such policies emphasize the development of the relative importance of environmentally friendly products in international trade. These environmental goods include items related to environmental preservation, such as pollution reduction and resource management, as well as products designed to be more environmentally friendly or less polluting, such as industrial air filters, wastewater treatment products, and renewable energy technologies like solar panels and wind turbines (IMF, 2023).

Figure 4.9: Average contribution of exports of manufactured goods to the total exports of Arab countries and a number of comparative countries and regions as an average for the period 2010-2021%



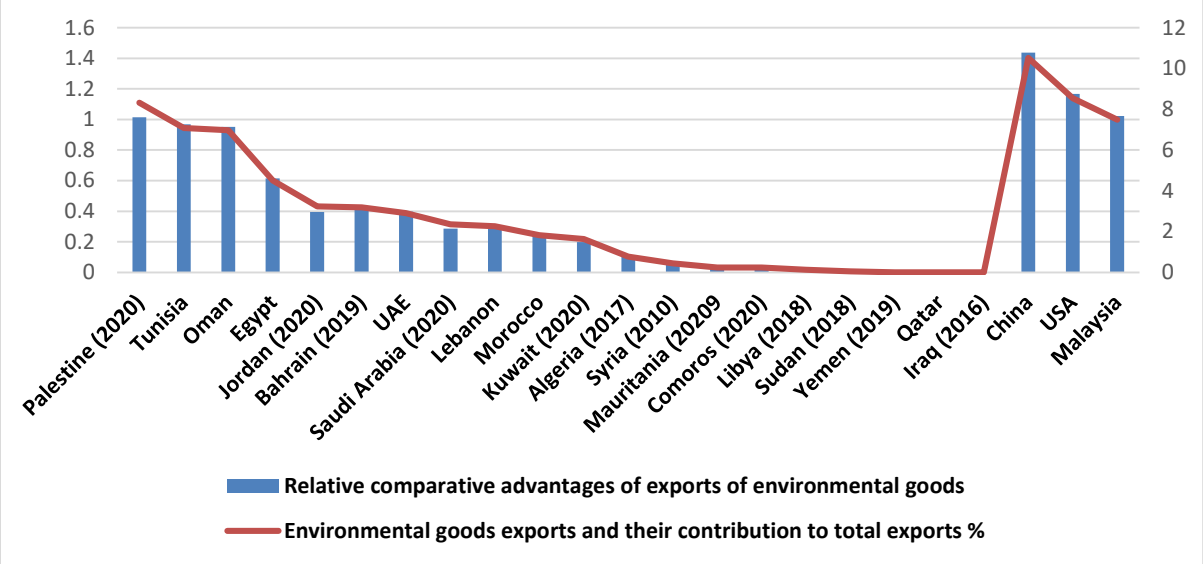
Source: Researcher's calculations: based on World Bank (2023)

The data on exports of environmental goods reveal several challenges, both on a global scale and within the Arab world. However, the Arab challenges are particularly pronounced. The global average percentage of these exports stands at approximately 7.14 percent, and in developed and emerging comparative countries, this figure is not far from the global average, at about 4.4 percent. In contrast, the average for Arab countries is much lower, hovering around only 0.7 percent, equivalent to a mere 18.7 billion dollars, averaged over the period from 2010 to 2021. It's important to note that the highest shares of these exports, as expected, originate from non-oil Arab countries, while oil-based Arab countries exhibit a decline in their contributions. However, it's worth emphasizing that some Arab countries that have achieved high percentages of environmental goods in their total exports, such as Palestine, Tunisia, Oman, Egypt, and Jordan, are not major contributors to the overall volume of Arab exports or to Arab exports of manufactured goods. Consequently, their contributions to environmental exports remain relatively low in the context of the entire Arab region. For instance, Palestine's exports represented only about 0.6 percent of the total Arab environmental exports. Conversely, some Arab oil-producing countries achieved lower percentages, like UAE and Saudi Arabia, but due to their significantly higher export volumes, their combined exports in environmental goods constituted about 65 percent of the total Arab environmental exports on average for the 2010-2021 period, with 45 percent attributed to UAE and roughly 20 percent to Saudi Arabia.

Examining the pace of development, the data indicates a clear improvement in the proportions of environmental exports as a share of total exports in most Arab countries over two periods: 2000-2009 and 2010-2021. This trend aligns with comparative performance and global averages. Notably, developing countries, such as China and Malaysia, have experienced faster growth rates than their counterparts in developed countries, like the United States. These variations can be attributed to a range of factors tied to the current level of structural transformation, the composition of production structures, and the diversity of targeted products and exports in each country. The results of this analysis confirm the decline in comparative advantages for Arab countries in the realm of environmental product exports, especially when considering comparison countries. Additionally, it's worth noting that emerging countries like Malaysia share similar comparative advantages with Arab countries such as Palestine, Tunisia, and Oman. Nevertheless, Malaysia has been more efficient in harnessing these comparative advantages, resulting in higher volumes and proportions of their environmental goods exports (Figure 4.10).

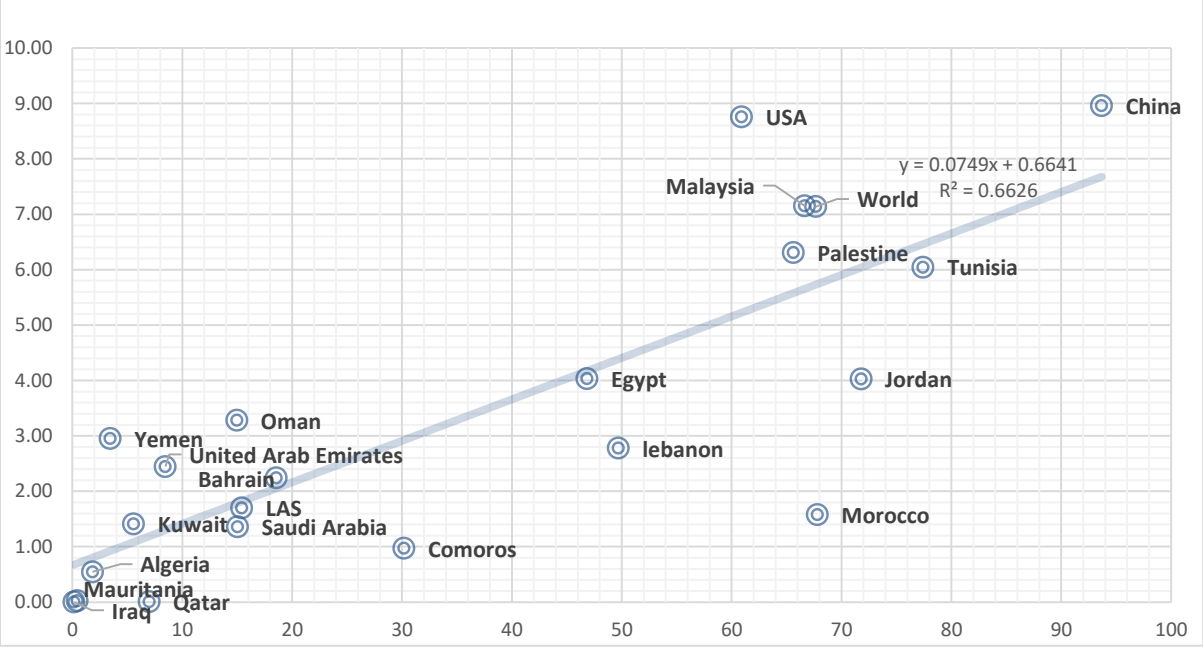
Within the analytical framework of environmental exports in Arab countries, an evident correlation exists between exports of manufactured goods and their environmental counterparts. This correlation indicates that countries where the share of manufactured exports in their total exports increased significantly are also the ones that succeeded, to a large extent, in boosting the proportion of environmental goods in their total exports (Figure 4.11).

Figure 4.10: The relative comparative advantages of exports of environmental goods and their contribution to total exports in Arab countries and a number of comparative countries for the year 2021 or according to the latest available data



Source: Prepared by the researcher-based IMF database (2023)

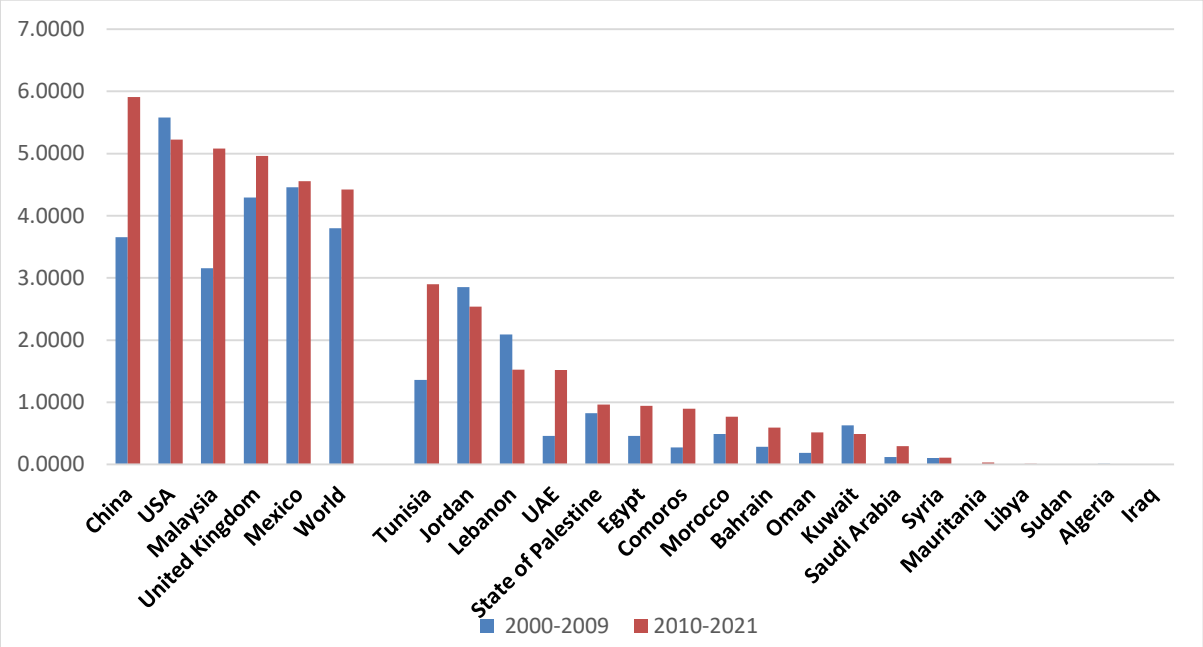
Figure 4.11: The relationship of exports of manufactured and environmental goods in Arab countries as an average for the period 2010-2021 (%)



Source: Prepared by the researcher based on World Bank (2023), and IMF (2023)

In the same context of evaluating the quality of existing industries in Arab countries and their reliance on competitive advantages that align with climate benefits and contain high technical content, we can rely on an index measuring the proportion of exports of low-carbon technological products relative to total national commodity exports. Examining this indicator and its development over two periods, 2000-2009 and 2010-2021, reveals that there continue to be insufficient levels of exports of low-carbon technological products. However, there is a relative improvement in the performance of most Arab countries when comparing the two periods. This improvement is most prominent in non-oil-producing countries and least in oil-exporting and low-income countries, except for the UAE. The latter's unique situation might be attributed to its role in re-export activities. The highest rates of improvement are observed in Tunisia and the UAE (Figure 4.12). This analysis underscores the need for Arab countries to invest more efforts in aligning their production and export structures, competitive advantages, and environmental dimensions with global economic trends and the agendas aimed at achieving carbon neutrality. This necessity is evident both quantitatively, as reflected in the declining volume and relative importance of manufactured exports in the global market, and qualitatively, as evidenced by the limited participation in global value chains. At the environmental level, the analysis emphasizes the importance of focusing on the size and relative significance of environmental exports and low-carbon technology-based products within the context of Arab manufactured exports and global environmental exports.

Figure 4.12: Evolution of exports of low-carbon technology products relative to total exports in Arab countries and comparative countries as an average for the periods 2000-2009 and 2010-2021%



Source: Prepared by the researcher based on World Bank (2023)

4.6 Findings and recommendations

This chapter has shed light on the inadequacy of structural transformation in Arab countries, which often find themselves ensnared in the "middle-income trap," differing from the trajectories of developed countries in the past and emerging economies today. It has underscored the urgent need for countries to accelerate and direct their transformation efforts, aligning them with climate change considerations. There's a clear call to develop manufacturing activities that support green transformation. On a practical level, this necessitates treating green transformation as a public good that demands government support. Additionally, the chapter has highlighted the subpar contribution of manufacturing activities to the Arab countries' economic output. Most of this contribution is concentrated in a limited number of Arab countries. While some Arab countries have succeeded in enhancing their manufacturing sector's contribution, it has largely plateaued over the past two decades. The fundamental structure of Arab industries primarily depends on activities that do not align with carbon reduction requirements, such as energy-intensive industries reliant on fossil fuels. This chapter has reaffirmed the need for a robust effort to achieve structural transformation in line with climate benefits, emphasizing the sensitivity of this action within the production and export structures of Arab countries.

It is worth noting that both Arab and international indicators stipulate an anticipated growth in industrial activities and product demand, signifying a potential increase in associated emissions. This comes at a time when the net zero emissions target for 2050 mandates a reduction in global manufacturing emissions by roughly 25% from its current level by 2030. This represents an annual average decline of about 0.63% until 2030. Meeting these goals places a significant responsibility on the world, including Arab nations, to shift the current course of industrial activities. In light of these observations, and with the aim of aligning structural transformation and industrial development with green transformation, recommendations can be proposed. These recommendations are centered on a set of potential policies for this transformation, focusing on the adoption of modern industrial policies that support green transformation. Two main paths can be pursued:

- **First Path: Reducing Carbon Emissions within Existing Comparative Advantages:** This path calls for intensive research and development efforts to reduce emissions within the current structure of comparative advantages. Collaboration with national and international research centers and promoting international best practices is essential. For industries with significant emissions, like cement, iron and steel, and petrochemicals, the international community offers scientific and practical methods for emission reduction. For example, replacing fossil fuels with biomass energy for cement production can be a promising and cost-effective short-term solution. The medium and long term offer more scope for transitioning to renewable or lower-emission energy sources.
- **Second Path: Structural Transformation and Emissions Reduction while Developing New Comparative Advantages:** This path centers on reevaluating the role of manufacturing and its activities within Arab economic structures. This reevaluation should consider two key limitations: increasing the knowledge and technology content of new activities to drive qualitative progress and contributing to emissions reduction by focusing on the production and export of "environmental goods." Many Arab countries possess comparative advantages in producing such goods, but these advantages need to be translated into practical actions.

The two paths above represent a comprehensive approach to driving structural transformation while mitigating emissions, aligning with the goal of achieving green transition in Arab countries.

Chapter Five

Financing the Green Transition: Alternative instruments to meet new challenges

5.1 Introduction

The challenge of financing climate action is a multifaceted issue for developing countries, including Arab nations, and is rooted in four key considerations. Firstly, despite the commitment made since COP15 in Copenhagen in 2009 by developed countries to provide financial support to developing nations for climate change mitigation and adaptation, these commitments have only been partially fulfilled, and they fall short of meeting the needs of these developing countries, particularly in the Arab region. This challenge has become even more pronounced during the COVID-19 pandemic and amid geopolitical events like the Russian-Ukrainian war. Developed countries, led by European nations, have shifted their focus to strengthening their own food and pharmaceutical sectors and expediting their energy transformation. Secondly, the significant rise in the debt burden of many Arab countries, especially non-oil-producing ones, in the wake of the COVID-19 pandemic, has considerably constrained their fiscal space and borrowing capacity. Furthermore, these countries face challenges accessing global financial markets due to declining credit ratings and the resurgence of international interest rates. Thirdly, most Arab countries struggle with their financial sectors, encompassing legislative, institutional, and human resource deficiencies. These limitations hinder their ability to efficiently mobilize both local and international savings. In addition, these countries typically have weak domestic savings, particularly in lower- and middle-income Arab nations. Fourthly, the Arab region faces planning challenges, with many countries failing to adopt effective indicative planning. This weakness in planning impedes economic transformation from agriculture and natural resource-based economies to knowledge-based and manufacturing industries. It also hinders the formulation and implementation of policies that strike a balance between economic, social, and environmental objectives. These planning challenges are compounded by fiscal constraints, mounting debt, and the inefficiency of their financial sectors. Given these intricate and overlapping dimensions, Arab countries at large, particularly lower- and middle-income nations, confront significant hurdles in securing the necessary funds for implementing climate change mitigation and adaptation plans. This is in stark contrast to Arab countries with financial surpluses. Under these circumstances, it appears that financing and executing climate action goals may falter, despite the evident and growing impacts and risks of climate change, much like the challenges encountered in sustainable development efforts thus far.

Conversely, the impediments in various aspects of sustainable development due to the aforementioned dimensions may be the primary obstacle to achieving tangible progress in climate action. Many Arab countries grapple with increasing poverty rates, underdeveloped infrastructure, and shortcomings in essential areas like food, healthcare, and education. To address this, a development model that harmonizes traditional development objectives with climate considerations is required. Despite these accumulated challenges in the Arab development landscape, there is potential to draw lessons from Arab and non-Arab nations that have successfully navigated developmental challenges. These lessons emphasize modern, non-conventional, and innovative financing mechanisms to accelerate green growth by funding projects that not only create wealth and employment but also align with climate action goals, whether related to mitigation or adaptation. Several countries have made substantial strides in transitioning their budgets toward eco-friendly practices, strengthening partnerships with local private sectors, and attracting foreign direct investments in green sectors. As the domain of financial innovation

and development continues to expand, offering increasing annual volumes, these developments provide tangible alternatives that can help overcome severe financial constraints in countries with funding gaps. They can also enhance the effectiveness of savings mobilization in wealthy Arab countries.

5.2 Financing green transition in Arab countries

The Sustainable Development Goals and climate summits have issued a resounding call to action for countries worldwide. This clarion call revolves around the imperative of eradicating poverty, enhancing healthcare and education, reducing inequality, promoting sustainable economic growth, and addressing the critical issue of climate change. To accomplish these goals, effective mobilization and allocation of funding are essential. International endeavors have coalesced to create innovative financial tools known today as "green financing." Green financing encompasses funds sourced at local, national, or international levels, arising from public, private, and alternative financing channels, all aimed at supporting climate mitigation and adaptation measures. Simultaneously, agreements such as the Kyoto Protocol and the Paris Agreement have called for the provision of financial assistance from developed countries, which are the wealthiest, to poorer and developing nations. These agreements acknowledge that countries' contributions to climate change and their capacity to mitigate and cope with its consequences vary considerably. Investments required for mitigation or climate adaptation initiatives surpass the financial means of most developing countries. In general, developing countries, including Arab nations, are at risk of experiencing the accelerating repercussions and damages associated with climate change. The impact of these climate effects will be more pronounced in Arab countries with low incomes, coastal locations, arid landscapes, agriculture-based economies, and other countries exposed to food security risks, infrastructure degradation, unemployment, extreme poverty, and price volatility. These factors place a significant burden on the region, necessitating additional and sustainable financing for climate efforts. This funding is vital for improving the ability to adapt and mitigate the consequences of climate change, enhancing infrastructure, promoting sustainable economies, transforming agriculture and production bases, and achieving energy transition, among other crucial goals. Middle- and low-income countries face a unique challenge due to preexisting budget deficits, mounting debt burdens, and limited fiscal capacity. They must develop financing strategies that transcend traditional frameworks. These strategies should provide essential financial support and development opportunities, thereby alleviating economic and financial conditions. In this context, the report explores several innovative financing solutions and practices with international significance and outlines the conditions for their successful implementation. It's worth noting that many Arab countries may lack the financial capacity to cover the costs of necessary climate investments, even with concessional financing. This is particularly true for nations with unsustainable debt levels and greater vulnerability to climate change, such as agricultural economies, island nations, and water-scarce countries. A study by Aligishiev, Bellon, and Massetti (2022) highlights that even with manageable debt levels, many countries may lack the fiscal space required to make effective climate adaptation investments. Considering these challenges, the Paris Agreement has underscored the leadership role of developed, wealthier nations in mobilizing climate-related financing from diverse sources, tools, and channels. It emphasizes the pivotal role of public funds, bolstered by various policies and procedures, in addition to fostering a shared understanding of financial requirements for developing countries and enhancing the predictability of financial support.

An OECD report (2022) showed that developed countries mobilized a combined $83.3 billion for climate action in developing countries from 2013 to 2020. This amount grew from roughly $52 billion in 2013, although it remains below the $100 billion target. While most of the funding was allocated to climate mitigation efforts (70%), funding for climate adaptation grew both in relative and absolute terms. Loans continued to be the primary instrument used for public climate finance. The report also indicated that most of the funding was directed towards Asian countries and middle-income countries. As for high-income Arab countries, which generally possess strong financial solvency, they have started to recognize the urgency of directing investments towards sectors that enhance climate resilience. Recent global events, such as the COVID-19 pandemic, health and food crises, and inflation, have prompted these countries to adopt climate-aware strategies. Initiatives have been launched to transition to clean energy, secure water, and food resources, and undertake projects related to solar energy production, water desalination, hydrogen production, afforestation, mass transportation, and more. Whether in low- and middle-income Arab countries or high-income Arab nations, the capacity to mobilize sustainable investments, regardless of their sources, is of paramount importance. It is not sufficient to rely solely on convincing investors to engage in green sectors. Governments must play a proactive role in encouraging green investments by intervening directly in the real economy. This can be accomplished through subsidies, taxes, or state guarantees to borrowers. This approach is more effective than expecting all lenders from the private sector to divest from financing high-carbon emissions, especially if these emissions are reflective of the public policies of countries. Furthermore, green finance should explore ways to foster mutually beneficial partnerships between Arab countries and the international community. Such partnerships could be related to mechanisms for carbon credits, public-private collaborations, or the establishment of primary and secondary markets for efficient green bonds and instruments. These instruments have the capacity to mobilize the funds required for environmental projects.

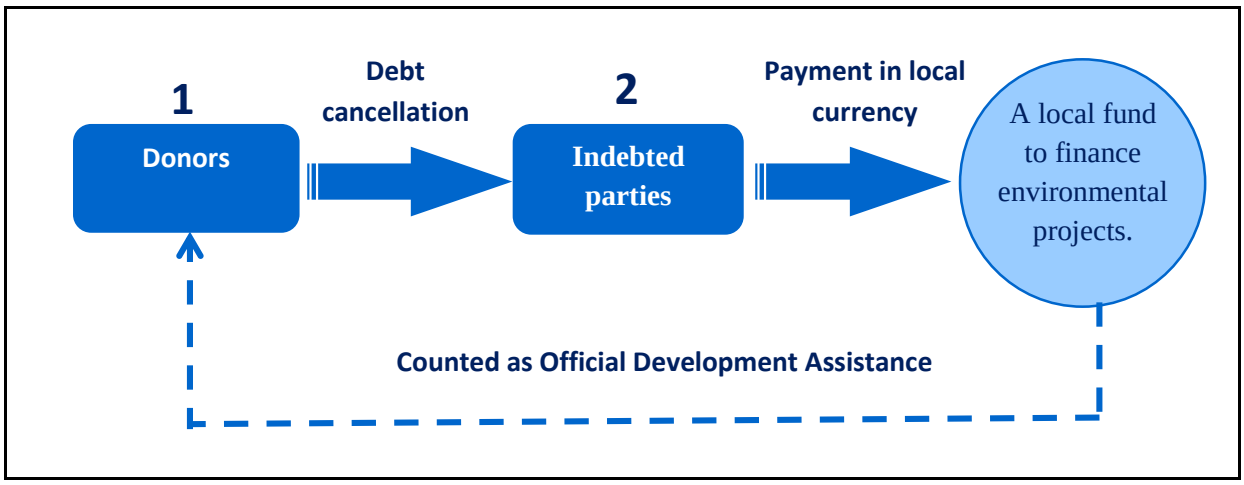
5.3 Diversifying financial instruments to achieve green transition.

5.3.1 Debt swaps for climate action

Debt swaps represent a mechanism through which external debt payments are transformed into domestic investments, enabling the implementation of climate-resilient projects. These swaps are facilitated through cooperative arrangements between debtor nations, creditors, and donors, as illustrated in Figure 5.1. The process operates by identifying projects that can help alleviate the debt burden. Creditors, in turn, participate in the ownership and management of these projects, creating a solid commercial foundation. Simultaneously, this approach promotes investment in climate action. There are two significant benefits to this mechanism. First, it offers a solution for countries struggling with limited foreign currency reserves by exchanging a portion of their external debt for direct investments that support climate initiatives without straining the state's budget. Second, it contributes to bolstering the local economy's resilience by diversifying investment opportunities in alternative, green sectors with substantial added value. This diversification raises the potential for higher growth, thereby facilitating the achievement of sustainable development goals and fulfilling obligations under various climate

agreements. It's important to note that the effectiveness of debt-for-investment swaps in environmental transformation hinges on the size of the swap. When the swap size is small, its positive impact on the debtor's economic condition is marginal (ESCWA 2020). On the other hand, debtor countries must have adequate funding available to deposit into investment funds to prevent resorting to cash financing, such as printing more currency, which could have adverse consequences.

Figure 5.1: Debt-for-climate action swap mechanism



Source: Olshanskaya et al. (2020)

5.3.2 Financial market instruments: green bonds and sukuks

Green bonds are financial instruments tailored to support environmentally or climate-related projects. They are often associated with tax incentives to enhance their appeal to investors. These bonds are typically asset-linked and backed by public budgets, resulting in credit ratings like other debt obligations issued by the same entity. The World Bank paved the way for green bonds by issuing the first official one in 2009. Climate bonds specifically fund projects aimed at reducing carbon emissions or mitigating the impacts of climate change, while green bonds encompass a broader category of instruments related to projects that have a positive environmental impact. The presence of Arab countries in the green bond market remains limited. Apart from UAE, Qatar, and Saudi Arabia, only three countries participate in this market: Lebanon, Morocco, and Egypt (Table 5.1). Morocco was one of the early Arab adopters of green bonds, issuing them in 2016. The Moroccan Capital Market Authority, in collaboration with the International Financial Corporation of the World Bank Group, established a well-designed regulatory framework for green bond issuance. Nevertheless, this market has primarily remained local. More recently, Egypt has actively entered the green bond market, issuing $750 million in green bonds in September 2020. Egypt thereby became the first country in the region to issue sovereign green bonds (Labidi, 2022).

Table 5.1: Green Bonds: Cumulative Issuance 2012-2021
(million US dollars)

Country	Saudi Arabia	Egypt	United Arab Emirates	Lebanon	Morocco
Value	**1300**	**850**	**2554**	**60**	**356**

Source: International Finance Corporation (2022)

Certain Arab countries, particularly in the Gulf, have witnessed faster growth in green sukuks. Green sukuks have the advantage of attracting a wider range of investors who prefer not to hold fixed-return bonds. Unlike traditional bonds, sukuks adhere to the principle of profit and loss sharing. Sukuks are financial instruments issued in equal denominations, representing common shares in the assets of a specific project or private investment activity. This structure facilitates the purchase and trade of these sukuks. In essence, an Islamic sukuk is comparable to a share issued in uniform denominations, signifying a common stake in the net assets of a joint-stock company. Green sukuks can contribute to the advancement of green investments by providing the necessary financial resources for these endeavors, tailored to the required terms, risk levels, sector types, and suitable financing methods. In this way, Islamic sukuks promote the mobilization of savings and the allocation of investments by directly connecting saving and investment activities based on profit and actual returns generated through real productive activities, thereby increasing the creation of wealth and actual income (Labidi, 2022).

5.3.3 Strengthening public private partnership

The state's general budget alone cannot bear the financial burden of funding critical infrastructure projects. To tackle this issue, resources must be mobilized from the local and international private sector, drawing upon their expertise. Public-private partnerships play a pivotal role in expanding investment opportunities in climate-sensitive infrastructure. However, private sector involvement in these partnerships can be challenging due to the uncertainty surrounding climate change's impact on future supply and demand, prices, and asset-related risks. These partnerships require a level of predictability to attract investments. This calls for the establishment of well-structured public-private partnership mechanisms that distribute risks and responsibilities equitably over long-term strategies, compensating for climate change's uncertainty. Such mechanisms need to build options, solutions, and feasibility studies into the early stages of the partnership cycle to harness their predictive capabilities. Public-private partnerships have thrived in many countries worldwide over the past two decades, proving effective in financing, constructing, managing, and operating infrastructure and public facilities. These partnerships span various sectors, including renewable energy generation, transportation, health, education, water, sanitation, and more. Different forms of cooperation have emerged, such as concession contracts, operational leasing contracts, and more, all aimed at promoting the development of these sectors in a sustainable and efficient manner. This approach emphasizes sustainability, proper utilization, and the enhancement of services and maintenance. The significance of public-private partnerships lies in their ability to provide financing, operations, management, and maintenance for infrastructure projects, alleviating the burden on the state's general budget in terms of capital expenditures. This allows the

reallocation of resources to other development sectors, reducing the budget deficit without increased borrowing. In Arab countries, capital spending, particularly on infrastructure, is already on the decline. Conversely, current spending has risen, primarily due to expanding government administration and population growth, leading to higher allocations for education, health, support, and other areas. Public-private partnerships offer an efficient way to leverage private sector efficiency, speed, cost-effectiveness, and quality in implementing public projects.

Various forms of contracts govern public-private sector partnerships, including concession contracts, management contracts, leasing, and new projects. Within these forms, several contracts have emerged, such as buy-build-operate (BBO), build-operate-transfer (BOT), build-own-operate-transfer (BOOT), and build-lease-own-transfer (BROT), among others. Successful international experiences highlight the importance of fulfilling specific prerequisites for the success of public-private sector partnerships. These prerequisites include: (1) Legislation and laws must be established to ensure transparency, fair competition, oversight, and monitoring; (2) Establish institutional frameworks dedicated to overseeing these partnerships and equip them with skilled personnel boasting technical, financial, and legal expertise to present projects to potential investors; (3) Conduct feasibility studies to select projects suitable for partnership arrangements; and (4) Define selection rules and criteria for choosing investors and awarding contracts, taking into account the financial, technical, and operational aspects.

Raising public awareness about the benefits of public-private partnerships in financing, developing, and operating climate-related projects is paramount. This awareness can help maximize the advantages of this mechanism for national climate change projects, both in terms of funding and operations. World Bank data indicates that countries like Brazil, China, India, and Turkey have more effectively harnessed this financing tool compared to Arab countries, with transaction volumes reaching $451 billion, $289 billion, $268 billion, and $156 billion, respectively. Among Arab countries, Morocco leads the way with approximately $22.5 billion. Morocco has gained valuable experience from multiple deals, facilitating the implementation of energy generation projects worth $16 billion, as well as projects in water and sanitation, education, health, railways, highways, and more. The success of these partnerships can be attributed to the formation of a national committee dedicated to public-private partnership projects, characterized by credibility and transparency. This committee operates according to a well-defined institutional plan. Notable examples of successful public-private partnerships in Morocco include the Noor 1, Noor 2, Noor 3, and Noor Midelt solar energy projects, with a combined investment of $4.2 billion. Among these, Saudi company ACWA Power, through build, operate, and transfer (BOT) contracts, has played a significant role in making Morocco one of the world's top renewable energy producers, contributing to a substantial reduction in carbon dioxide emissions (Moroccan Solar Agency, 2021).

5.3.4 Roles of regional development funds and sovereign funds

Several development funds are accessible in the region, with notable institutions like the Arab Fund for Economic and Social Development, the Islamic Development Bank, the Arab Monetary Fund, national development funds such as the Kuwaiti Fund for Economic and Social Development, and sovereign funds like the Saudi Investment Fund, the Kuwaiti Investment Fund, and the Abu Dhabi and Dubai Fund. Some of these financial institutions have begun to acknowledge the ramifications of climate change as a critical challenge that could jeopardize public safety, health, the sustainability of economic activities, and infrastructure. They have also responded to persistent calls from climate conferences over the years. Many development financial institutions in the region have initiated programs to support the transition to green economies. These programs encourage projects that mitigate environmental degradation, reduce carbon emissions, and promote the establishment of new green projects, particularly in the renewable energy sector. For instance, the Arab Fund has pledged concessional loans for green projects, provided technical assistance for feasibility studies and green project designs, and launched competitions to fund small, innovative green projects.

Considering the substantial assets held by Arab sovereign funds, estimated at approximately $3.5 trillion (representing 34% of global sovereign fund assets in 2023), their shift towards dedicating a significant portion of their resources to address climate change is commendable. Historically, these funds leaned towards investments in conservative sectors to hedge against financial uncertainties and shield economies from oil and gas price volatilities. However, the global financial crisis of 2008, combined with significant drops in oil prices in 2014 and 2020, prompted a reevaluation. Many oil-producing nations, particularly those in GCC, have recalibrated their economic strategies. This pivot includes a strong emphasis on economic diversification, a shift towards green economies, and renewable energy, all underpinned by the overarching objective of sustainable development. Aligning with this change in direction, some of these nations have refined the roles of their sovereign funds. For instance, the Saudi Investment Fund, in its 2020-2025 plan, expressed its commitment to realizing the Kingdom's Vision 2030. This vision encompasses ambitious projects, including the Green Middle East Initiative, which targets a reduction in carbon emissions by a significant margin and proposes the plantation of 50 billion trees.

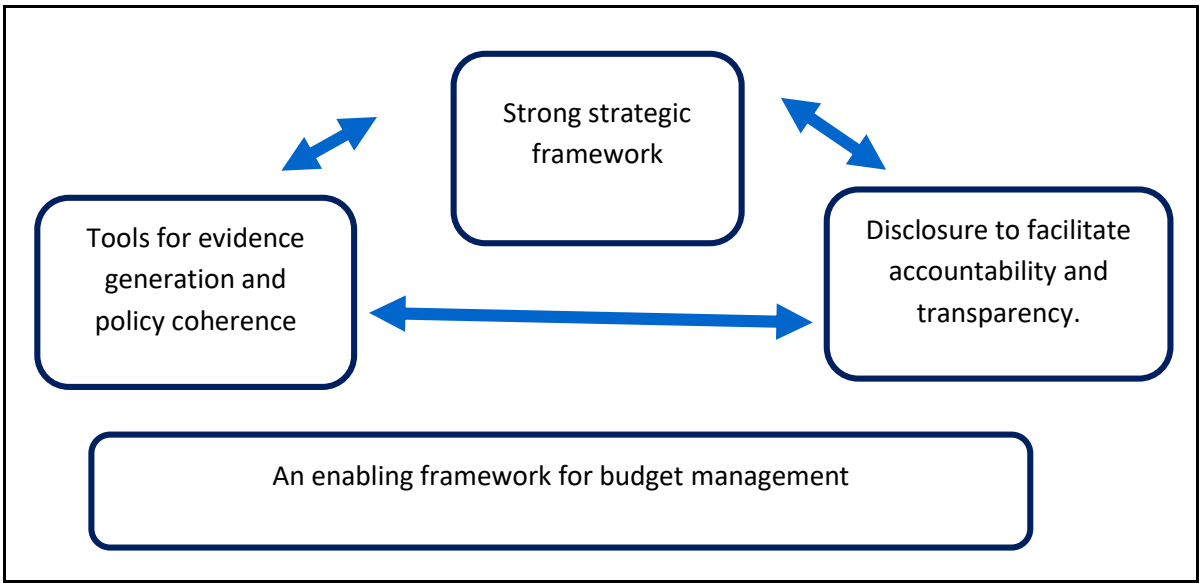
These innovative initiatives and the evolving role of regional financial institutions mirror the transformation observed in their global counterparts. Such shifts amplify awareness about sustainable and profitable investment opportunities in green economies and renewable energy sectors. As technology advances, the potential for growth in these domains is immense. This progressive landscape presents fertile ground for the private sector to flourish. Sovereign funds are playing their part by introducing and managing financial instruments like bonds, green sukuks, and carbon certificates, energizing the market. Such moves not only bolster regional cooperation among Arab countries but also facilitate global collaborations, promoting the exchange of technology, information, research, and expertise.

5.4 Greening fiscal policy to expand fiscal space

The concept of greening the budget is fundamentally about harnessing the power of public policy tools to advance environmental and climate objectives. Through a financial lens, the greening of fiscal policy seeks to tackle the resource mobilization challenges. The primary goal is to bolster fiscal space within the budget, ensuring the financing of the energy transition without the looming threat of unsustainable debt. One of the key merits of greening measures is their dual benefit. For instance, reforming the subsidy system, such as reconsidering water pricing to reduce wastage of water resources while safeguarding the interests of low-income populations, offers a twofold advantage. It not only curtails public spending on water price subsidies but also safeguards this precious resource. Similarly, expediting the energy transition by investing in renewable energies and sustainable infrastructure contributes to an improved fiscal landscape. This shift helps in reducing hydrocarbon subsidies while upholding a sustainable environmental agenda. Despite the evident advantages of these green strategies, the absence of a comprehensive vision for integrating green practices into public policies is a pressing issue. Many countries suffer from inadequate depth when it comes to the environmental transformation aspects embedded within their financial laws. OECD recognized this gap and devised a comprehensive framework for greening the budget, composed of four essential pillars, as illustrated in Figure (5.2). These pillars encompass (1) a robust strategic framework, (2) tools for generating evidence and ensuring policy coherence, (3) transparency measures to facilitate accountability, and (4) an enabling budget management framework.

In the Arab region, it's evident that green budget policies have not accumulated the attention they deserve. This situation is attributed to the constrained financial capacities of non-oil-dependent countries, a degree of hesitancy in certain oil-producing nations, and the decline in governance frameworks. The existing trajectory for public finance reform falls short in terms of expanding fiscal space and adequately funding the environmental transition. To ensure the successful execution of budget greening, it's imperative to develop a diverse set of tools that strengthen this endeavor. At the expenditure level, it's crucial to conduct thorough assessments of the impact of measures on national environmental and climate objectives. Stress tests should be employed to ensure the considerations of efficiency. In terms of cost-effectiveness, the establishment of performance targets that align with national environmental and climate goals is a prerequisite. This comprehensive approach is vital for the effective implementation of green budgeting strategies.

Figure 5.2: OECD greening the budget framework



Source: OECD (2021)

5.5 Greening monetary policy and banking supervision

Numerous central banks worldwide have taken proactive measures to assess the risks associated with climate change. Extensive studies have consistently highlighted the adverse consequences of climate risks on the fundamental objectives of central banks, which include ensuring price stability and financial stability. Climate change cannot be ignored by central banks due to its potential to disrupt price stability, leading to the excessive inflation of essential goods, and its impact on financial stability, including the threats posed by physical and transitional risks to sectors such as banking, insurance, and financial markets. Consequently, central banks have a responsibility to address these detrimental consequences and actively participate in green transition. They can do so by deploying both their monetary policy tools and their regulatory authority over the banking sector. Nevertheless, the extent of their involvement hinges on their ability and willingness to infuse their monetary policy tools with "green" attributes to steer economic financing towards projects that prioritize environmental preservation and expedite the transition to a more sustainable ecological model.

The evolving landscape due to climate change and its economic implications necessitates a departure from the principle of "market neutrality" in the implementation of traditional monetary policies by central banks. As climate risks escalate, central banks are increasingly considering the carbon intensity of assets in the context of their monetary policy decisions. In this regard, there is a pressing need to enrich the toolkit of central banks with incentivizing mechanisms aimed at fostering an economy that embraces environmentally responsible practices. This could involve introducing differential interest rates and incorporating green standards into banking supervision systems, thereby promoting the financing green transition. To illustrate these concepts further:

- **Differentiated Interest Rates:** Arab central banks can promote environmental projects and reduce the carbon footprint in conventional sectors by offering varying interest rates on lending operations. The state budget could bear the cost of supporting environmentally friendly projects, while the interest rates for financing other projects would align with the prevailing market rates.
- **Greening Guarantees in Refinancing Operations:** Central banks play a pivotal role in establishing a legislative framework conducive to accelerating the green transition and removing carbon exposure from the financial system. This applies particularly to the assets of non-financial companies included in the guarantee framework. This framework enables an expansion of the green asset classes and may include environmental considerations in safeguard frameworks. Two key approaches are vital:
    - **Environmental footprint approach,** which adjusts deductibility and collateral eligibility based on the environmental impact of financial assets.
    - **Environmental risks approach,** where credit is re-evaluated considering the repercussions of climate change on the financial sector.
- **Greening Banking Supervision Standards:** Arab central banks have a critical role to play in reducing the carbon footprint within their portfolios and those of the banking sector. This can be achieved by implementing green monetary policies and greening banking supervision systems, thereby encouraging banks to improve their management of climate risks, both physical and transitional. Such measures can also incentivize the private sector to invest more significantly in environmentally friendly projects while avoiding investments in polluting ventures. One mechanism for achieving greener banking supervision involves factoring in climate-related risks when making lending decisions. This may involve reducing risk ratios for loans intended to finance projects with a high carbon footprint when calculating capital adequacy ratios.

In summary, central banks have a vital role to play in addressing the financial implications of climate change by incorporating green practices into their monetary and regulatory activities. This approach not only fosters sustainability but also aligns with the changing landscape of climate-related risks and opportunities.

5.6 Challenges

Climate change challenges have not received the attention they merit in the public policies of many Arab countries, despite the severe threats faced by the Arab region due to climate disruptions. The issue of financing the green transition remains of paramount importance in enhancing the resilience of Arab economies to climate change risks. It is imperative to acknowledge that public financial resources alone will be inadequate to finance the green transition in most countries, given the substantial estimates of funding required for green investments. It is therefore increasingly necessary to mobilize local and foreign private financing, in particular through the non-traditional financial instruments mentioned above. It is important to note that the greening of public finance encounters a host of legislative, regulatory, and human challenges. The mobilization of private capital will also confront various wide-ranging challenges, including the failure to internalize environmental externalities, information asymmetry, and a lack of analytical capacity among issuers and investors. Additionally, the absence of universally accepted definitions and disparities in the maturity level among different stakeholders pose further challenges. For instance, the absence of a precise definition of green finance creates room for "greenwashing," where issuers of "green assets" may make misleading claims about the environmental friendliness of their assets. Moreover, the short-term horizons of savers and investors do not align with the typically long-term nature

of green investment projects, many of which span over a decade.

- **Carbon Pricing:** The external costs of carbon emissions that are not adequately incorporated into prices represent a significant obstacle to the role of financial markets and their various tools in reducing carbon emissions through mechanisms like carbon credits. This situation weakens the appeal of investments in new energy sources and energy efficiency, especially with regard to establishing an attractive and efficient secondary market. Correctly pricing carbon emissions will be essential in the next stage of financial system adaptation in the region. This can be achieved through measures such as eliminating fossil fuel subsidies and introducing carbon credits trading schemes or carbon taxes. This is precisely the direction taken by the Holding Company through its agreement with the Agricultural Bank of Egypt and Libra Capital to establish the first Egyptian company specializing in developing, managing, and issuing carbon credits.
- **Understanding Stakeholder Roles:** It is crucial to comprehend the roles of different stakeholders, particularly major financial intermediaries and institutions driving the greening of the financial system, including banks, major investors, and international financial institutions, as well as regulatory and supervisory authorities and central banks. Regulatory authorities and central banks have a particularly influential role in expediting the transition of the financial system towards sustainability, as the legal and supervisory framework establishes the foundation for the financial system. Banks, for example, play a pivotal role in both national and international financial systems, given their substantial share of savings and financial assets. Arab countries should implement various measures to enhance banks' capacity to mobilize savings, including improving financial access, streamlining lending mechanisms, and enhancing risk assessment. This could be achieved by increasing competition in the banking and financial sector (Abdmoulah, 2022). Measures to enhance bank financing for sustainable development and integrate green financing into the banking system should include priority lending requirements, below-market financing with interest rate support, and the establishment of clear performance indicators for green lending volumes and domains. However, these measures come with inherent risks and potential misallocation of financial resources that must be considered during their design (UNEP, 2016). As for investment institutions, such as pension funds, sovereign wealth funds, and insurance companies, they face various constraints, such as green investments not being incorporated into credit rating agencies' relevant standards and the generally modest scale of green investments from the perspective of these funds. Moreover, the existing regulatory frameworks in countries often hinder even willing institutional investors from allocating substantial investments to long-term and sustainable projects. These regulations typically necessitate cautious and conservative investment strategies.

In conclusion, addressing the financial implications of climate change and transitioning toward a greener financial system involves overcoming several challenges, from regulatory and definitional issues to the alignment of investor timelines with the long-term nature of environmental projects. It necessitates comprehensive and well-considered policy adjustments to ensure the financial sector contributes effectively to sustainability.

5.7 Recommendations

This section offers some recommendations aimed at enhancing countries' capacity to direct financing towards projects that consider environmental requirements and accelerate the green transition:

- **Differential Interest Rates for Financing Green Transition:** Arab central banks should implement policies to reduce carbon emissions in traditional sectors while encouraging environmentally friendly projects. This can be achieved by offering distinct interest rates on borrowing costs from the money market, making green projects more financially attractive.
- **Green Collateral in Refinancing Operations:** Arab central banks are urged to enhance their legislation to expedite the green transition. They can do this by establishing an environmental framework to govern the securities used as collateral for loans provided to banks. This ensures that collateral aligns with environmental goals.
- **Including Carbon Footprint in Capital Adequacy Calculations:** A vital mechanism for greening banking supervision is for banks to consider climate-related risks when making lending decisions. This involves adjusting risk ratios applied to loans intended for projects with a high carbon footprint when calculating the capital adequacy ratio. Such actions encourage banks to invest in projects with a lower environmental impact.
- **Reevaluating Climate Risk Implications on the Banking Sector:** Central banks are specifically called upon to revise their assessment of banking risks to incorporate climate risks, both physical and transitional. This should influence banking stress tests to account for climate risks, motivating the private sector to invest more strongly in eco-friendly projects while avoiding polluting ventures.
- **Revising Financial Guidelines and Regulations:** Financial guidelines and regulations in the banking sector should be updated to prevent competitive distortions stemming from high costs related to green financial activities. Banking supervisory bodies should aim to achieve effective financial leverage for green investments and efficiently assess climate risks associated with assets. Aligning with successful international practices, this may involve the inclusion of environmental, social, and governance aspects in the financial disclosure of the banking sector and the private sector in general.
- **Incorporating Financial Incentives and Environmental Awareness:** Voluntary guidelines alone may not suffice unless complemented by financial and regulatory incentives. Thus, there is an urgent need to develop the capacity for environmental awareness and the technical proficiency required for risk assessment, pricing, and banking instruments in green finance. This approach can help bridge knowledge gaps and promote green investments.
- **Coordination between Monetary and Financial Policy:** Central banks and regulatory bodies operating under the Ministry of Finance should collaborate to promote greater sustainability in financial markets. Central banks should first green their monetary policies, altering how they conduct banking supervision to encourage green financing. This might involve refinancing operations that favor eco-friendly projects due to a lower discount rate compared to traditional securities.
- **Coordination between Finance and Environment Ministries:** Establishing coordinated communication between the Ministries of Finance and the Environment is essential for transparent reporting of environmental risks. Weak disclosure and the inability to assess environmental impact can hinder the integration of material environmental factors into investment decision-making. Improved coordination enhances risk management and encourages allocations to green investments.

Chapter Six

Green Transition Governance and Policy Coordination

6.1 Introduction

With Egypt hosting COP 27 in 2022 and the United Arab Emirates set to host the climate conference in the fall of 2023, climate change has taken center stage in the Arab States region, an area heavily impacted by climate change. On the ground, in the least developed countries of the Arab region, international cooperation programs have expanded their support to help countries address multidimensional risks and build back more robustly amid internal instability. This includes new climate change initiatives in countries like Iraq, Palestine, Somalia, Sudan, Syria, and Yemen. These initiatives assist these nations in implementing their Nationally Determined Contributions (NDCs) and ramping up climate action. Yet, one of the significant challenges in implementing the international climate action agenda on a large scale is the need to provide low-carbon solutions across entire economic sectors. For instance, while the Arab States region boasts the world's highest levels of solar radiation, only about 7 percent of the region's energy is generated from renewable sources, with solar and wind energy accounting for just 1-2 percent. In the years ahead, transitioning from traditional energy sources like oil and gas to clean energy represents a tremendous opportunity for the private sector. Recent indicators show that countries in the region have increased solar and wind energy capacity tenfold, from 0.5 GW in 2008 to approximately 7.2 GW in 2018. These are encouraging developments that the region can further foster through collaborations with the private sector.

Central to this endeavor are the NDCs and National Renewable Energy Action Plans adopted by countries in the region in recent years. These processes have resulted in more ambitious targets and innovative policies, laying the foundation for attracting private investment, reforming energy subsidies, establishing renewable energy institutions and national funds, and piloting renewable energy development zones. The cumulative regional target for renewable energy capacity by 2035 is 190 GW, a 26-fold increase from 2018 levels. Achieving this vision necessitates a strong enabling environment at the country level, featuring policies that reduce investor risks. There is also a need for greater support to help most Arab countries identify barriers and risks associated with private investment in renewable energy, and to develop policies that mitigate these risks and spur large-scale private sector investment.

As the region advances its renewable energy capacity, it's essential to ensure that sustainable energy reaches those living below the poverty line. The number of people in this category has increased significantly in recent years due to geopolitical instability, the economic repercussions of the Covid-19 pandemic, and the war between Russia and Ukraine. To address this issue, it's crucial to expand local partnerships for international development cooperation in sustainable energy, deploying decentralized solutions like solar mini-grids and off-grid solutions to enhance energy access. Increasing financing for climate adaptation programs for countries at risk has remained a central focus at climate conferences, with particular importance in the Arab region. While there has been global progress in mobilizing public and private investments to mitigate the effects of climate change and promote clean energy, progress in climate adaptation has been slower. Most countries in the region require support not only to implement adaptation programs but also to create national adaptation plans and design an expanded generation of climate-resilient development initiatives. Despite the historic decision of COP 27 to establish a loss and damage fund as a mechanism for financing compensation for the countries most in need and most affected by climate change, the intensity of the dispute over financing problems, whether for mitigation or

adaptation, has yet to yield satisfactory solutions. This remains a central point of discussion at COP 28 in the United Arab Emirates, as the Arab region continues to play a prominent leadership role in the realm of climate action. This comes at a critical juncture, as climate impacts are accelerating, the need for climate adaptation is growing, and the path to a clean energy transition is expanding. There's a heightened sense of ambition across the Arab States region to advance a low-carbon, climate-resilient transition, with COP27 and COP28 serving as crucial platforms for advocating transformative actions and broadening the constituency for change.

In summary, the road to COP28, like that to COP27, offers a unique opportunity to spotlight the Arab region as a focal point for global climate risks and a pivotal priority for climate adaptation investments. It also positions the region as an essential partner in the global shift toward clean energy and the green economy. However, this transformation cannot be achieved without a climate action governance framework in the region, one that develops actionable change policies, accounts for uncertainties and transformation risks, and establishes an institutionally flexible structure capable of managing change effectively. The change that's needed doesn't revolve around the climate itself but rather the systems that have contributed to climate change and continue to perpetuate it. Considering this, remainder of this chapter offers the foundational pillars of climate action governance, with a focus on green transition in Arab countries. The discussion begins with the concept of governance and its fundamental principles, highlighting its significance in supporting sustainable development and facilitating transition. It is followed by an examination of the institutional underpinnings of green transition and governance principles. The performance of Arab countries in terms of green transition governance is then analyzed, and finally, lessons are extracted, and proposed policies are presented to enhance climate action governance and the green transition in Arab nations.

6.2 Towards the concept of green governance

Addressing climate change stands out as one of the most critical global challenges today. Countries are grappling with increasingly severe consequences of climate change due to the inefficient utilization of non-renewable energy sources. Consequently, the notion of a green transition has gathered significant international attention, with policymakers actively seeking effective measures to facilitate the shift towards a green economy. This transition is designed to boost economic development while integrating environmental considerations into the equation. To ensure that this transition yields its intended outcomes, a robust framework is essential, characterized by strong and effective institutions at the national level. These institutions are responsible for championing the green transition, formulating and implementing pertinent policies and strategies, and ensuring the participation and coordination of various stakeholders. In recent decades, economic growth has been closely intertwined with the inefficient consumption of non-renewable energy sources, leading to widespread depletion of natural resources, environmental pollution, ecosystem degradation, and the release of harmful emissions like carbon dioxide and greenhouse gases. These factors have exacerbated global warming and ozone layer depletion. Consequently, it is imperative for countries to adhere to international agendas that advocate for the transition towards a green economy. These nations must develop comprehensive strategies at the national level that prioritize the utilization of renewable and clean energy sources across all sectors, concurrently reducing reliance on fossil fuels.

In this context, governance plays a pivotal role in facilitating the transition towards a green economy and achieving sustainable development. Good governance is fundamental for the sustainable management of natural resources (Nahar and Mishra, 2019). It is achieved by establishing robust institutional frameworks that enforce mandatory policies applicable to all sectors within a country. These policies are geared toward the efficient utilization of natural resources and the gradual adoption of renewable and clean energy sources in all economic activities. Furthermore, these frameworks provide the requisite financing to support the transition to a green economy. Institutional frameworks also play a crucial role in assessing the benefits, gains, and losses stemming from climate change, which, in turn, informs the development of suitable policies that safeguard the interests of various groups affected by climate change mitigation measures (Fozzard, 2019). Good governance ensures transparency, defines the roles and responsibilities of various sectors in the transition to a green economy, fosters improved collaboration between sectors, and ensures alignment of plans and policies. Governance additionally establishes an accountability mechanism, holding officials across sectors responsible in the event of non-compliance with climate change policies (UNICEF, 2020).

The significance of institutions and governance in supporting the green transition and mitigating environmental degradation has been underscored in previous literature. Public goods theory, for instance, highlights the inadequacy of the private sector in producing public goods, with the environment itself being considered a public good. Since the private sector tends not to account for the negative externalities (such as harmful emissions) generated by its production activities, government intervention becomes essential to safeguard the environment. This intervention includes enacting legislation to protect the environment from the detrimental emissions linked to private sector activities (Dasgupta and De Cian, 2016). The theory of ecological modernization builds on this notion, suggesting that once a certain threshold of economic growth is reached, the trajectory of economic growth is linked to the adoption of energy-efficient technologies that do not harm the environment (Duit, 2005). Thus, there is no inherent conflict between economic growth and environmental quality, as long as governance ensures the optimal utilization of resources to preserve the environment and protect the rights of present and future generations.

Furthermore, a plethora of applied studies have affirmed the pivotal role of institutions and their quality in addressing climate change. Zalle (2019) has shown that efficient institutions have a positive impact on driving economic growth and promoting the transition to a green economy, particularly in regions prone to ethnic and religious conflicts that hinder economic development. Robust institutional frameworks have been instrumental in addressing these conflicts, supporting the shift to clean and sustainable energy sources, and driving economic growth. Institutions also help fight corruption and enforce the rule of law, enabling the private sector to play an active role in economic development. Governance has proven essential in increasing the efficiency of energy source utilization and promoting the transition to clean and sustainable energy sources in countries with heavy reliance on fossil fuels, leading to a significant reduction in carbon dioxide emissions (Sinha et al., 2019). Institutions play an instrumental role in shaping policies aimed at limiting carbon dioxide emissions, helping countries meet international development goals (Karim et al., 2022).

In conclusion, the effectiveness of governance in minimizing environmental degradation and steering the transition toward a green economy is evident in the body of literature. Both theoretical and

practical perspectives emphasize the role of institutions in maintaining the sustainable use and preservation of natural resources. Moreover, this literature underscores the significance of institutions in devising national strategies for transitioning to a green economy and in implementing policies outlined in international climate change agendas. Thus, the presence of robust institutional frameworks marked by transparency, accountability, sectoral coordination, and clearly defined roles is imperative for successful efforts to reduce environmental degradation at the national level.

6.3 Institutional foundations of green transition and governance principles

This section delves into the foundational elements of the green transition, encompassing the following components: the legislative framework for the green transition, the institutional infrastructure that underpins the execution of green transformation policies at the national level, and the diverse stakeholders affected by climate change. The legislative framework for the green transition entails a collection of international agreements, agendas, and policies designed to bolster the adoption of renewable and sustainable energy sources to drive the process of economic growth.

The transition to a green economy exerts an impact on every sector within a country's economy, presenting both public and private sectors with great challenges. Consequently, it is imperative to establish a proficient and effective domestic institutional framework. This framework is responsible for formulating national policies and strategies that promote the shift towards a green and sustainable economy, accompanied by enforcement mechanisms, including penalties for environmental harm. The transition to a green economy has repercussions for various interest groups. Therefore, it is essential to involve these stakeholders in the development of environmental policies to facilitate coordination and mitigate potential opposition. This section also explores the principles of climate change governance, the adherence to which is pivotal in gathering public trust in nationally formulated climate policies. It highlights the diverse levels and entities engaged in climate change governance and underscores the numerous advantages it offers to enhance the green transition.

6.3.1 Institutional foundations of green transition

6.3.1.1 Legislative framework

The legislative framework for the green transition encompasses a series of procedures, policies, and international agreements designed to facilitate and support the global shift towards sustainability. In this section, three key green transformation agendas put forth by the international community in 2015 are examined. These agendas aim to help countries navigate the opportunities and challenges associated with decarbonization, with a shared goal of mitigating climate change. These pivotal agendas are:

- **The 2030 Sustainable Development Agenda:** Launched by the United Nations, this comprehensive agenda includes seventeen sustainable development goals. It underscores the significant role that climate change plays as one of the foremost challenges to achieving these goals by 2030. Climate change's adverse effects necessitate international collaboration to adapt to

and mitigate these challenges. The United Nations adopted the Sustainable Development Goals through a unanimous resolution, applying them to all countries at various levels, including regional contexts (UNFCC, 2017). The interplay between this agenda and climate actions is extensively discussed in chapter one.

- **Sendai Framework for Disaster Risk Reduction (2015-2030):** This framework succeeds the Hyogo Framework for Action 2005-2015 and builds upon its existing work. It introduces several changes to address consultations and negotiations' evolving needs. Notably, it broadens the scope of disaster risk reduction to encompass natural and manmade hazards, along with associated environmental, technological, and biological risks. The Sendai Framework highlights the close relationship between increased reliance on fossil fuels and the exacerbation of disasters due to climate change. This connection obstructs the path to sustainable development, emphasizing the need for countries to transition to renewable and clean energy sources (UNFCC, 2017).
- **Paris Agreement:** This historic agreement, adopted by 196 countries in 2015 and endorsed by 21 Arab nations as of June 2019, focuses on reinforcing countries' capacity to cope with climate change consequences. It achieves this through financial support and the adoption of innovative technology frameworks to minimize environmental degradation and reduce carbon dioxide emissions (UNECE, 2016). The Paris Agreement sets a series of global goals commencing in 2020 to reduce climate change-related risks. These goals include limiting the increase in Earth's surface temperature to below 2 degrees Celsius and striving to further cap global warming at 1.5 degrees Celsius above pre-industrial levels. The agreement also aims to reach net zero carbon dioxide emissions in the latter half of this century, enhance adaptation to climate change, and promote low-carbon development worldwide by providing the requisite financial support to facilitate environmentally friendly development processes (Al-Sarihi and Luomi, 2019).

These international agreements represent the cornerstone of the green transition, uniting countries and regions in the shared pursuit of a more sustainable and climate-resilient future.

6.3.1.2 Institutional framework

The effective implementation of international agendas at the national level is contingent upon the presence of robust national institutions that not only reinforce commitment to the principles articulated in these agendas but also facilitate the development of domestic policies harmonious with these international imperatives. These domestic policies must extend across all sectors of the economy, furthering the transition toward a green economy and a future characterized by reduced carbon emissions. The challenges posed by climate change underscore the imperative for public institutions to take an active role. The formulation of policies to combat climate change necessitates the creation of binding roadmaps that guide the transition toward renewable and clean energy sources for propelling economic growth. The realization of these goals hinges on seamless coordination among various stakeholders, both within the government and among non-governmental entities. A robust and effective institutional framework plays a pivotal role in addressing these challenges stemming from climate change mitigation policies and facilitating the necessary coordination among affected parties. To establish a strong institutional framework at the national level for designing strategies to mitigate climate change and adapt to its effects, several fundamental elements are indispensable. These elements serve as guiding principles for governments to enact institutional reforms, ultimately yielding a resilient institutional framework capable of shaping strategies to curtail climate change effectively. These key elements encompass:

- **Clear Regulatory Framework:** The institutional framework must be underpinned by a transparent regulatory structure that delineates the responsibilities of different government agencies in addressing climate change. This framework should also promote effective inter-agency coordination and ensure that the necessary technical expertise is available to facilitate the green transition.
- **Comprehensive Climate Change Plans:** Robust plans to combat climate change should be formulated. These plans must encompass in-depth assessments of climate-related risks and vulnerabilities inherent in current systems. Furthermore, they should clearly articulate the necessary policy actions to transition toward a sustainable future.
- **Mobilization of Financial Resources:** To address climate change effectively, financial resources need to be mobilized. This can be achieved by embedding green transition plans and strategies into the overarching management of the state's general budget.
- **Inter-Agency Coordination:** It is crucial to establish mechanisms that facilitate coordination between local and national governments and various state-owned institutions. This will be instrumental in reinforcing support for the green transition.
- **Accountability and Stakeholder Participation:** The institutional framework should include mechanisms for holding officials accountable, framed within a backdrop of transparency. Furthermore, it should ensure active participation from civil society, the private sector, and relevant stakeholders in the formulation of policies aimed at mitigating climate change (World Bank Group, 2021).

6.3.1.3 Stakeholders

Policies aimed at mitigating climate change inevitably impact the interests of diverse economic and social groups. To prevent potential conflicts among these groups, it is imperative to establish institutional mechanisms that foster coordination, encourage dialogue, and foster consensus among all parties affected by climate change. Such measures significantly enhance the state's capacity to transition toward a green economy in an inclusive and equitable manner. While the green transition brings about a multitude of benefits, it may, at least in the short term, impose substantial costs and negative consequences that could disproportionately affect specific economic and social sectors. Thus, it becomes vital to mitigate these short-term adverse impacts transparently and expediently to reinforce the credibility of government actions. Policymakers must take into consideration the interests of various groups affected by climate policies when formulating and implementing actions to facilitate the green transition, rendering the process both feasible and equitable. A pivotal strategy involves engaging stakeholders from the outset in the development of strategies to mitigate climate change. This proactive inclusion of stakeholders not only averts potential opposition but also allows for a deeper comprehension of the social and political landscape. This, in turn, ensures the prudent management of the green transition. Furthermore, it necessitates the establishment of a transparent communication mechanism among the diverse groups and mandates the design of a comprehensive suite of policies to support all segments affected by climate change mitigation strategies (CEPAL, 2022).

6.3.2 Climate change governance

In addition to the institutional foundations that underpin the green transition, a specific set of principles plays a crucial role in effective climate change governance. The climate change governance process is inherently multi-level, involving numerous stakeholders. This approach offers several advantages, as it facilitates the formulation of effective policies for transitioning to a green economy. In this section, we delve into the principles of climate change governance, the levels and parties involved, and the benefits derived from the participation of various stakeholders in shaping climate policies.

6.3.2.1 Principles underlying climate change governance

For effective climate change governance, a set of principles and foundations must form the basis. These principles, while fundamentally aligned with conventional governance principles, are specially tailored to the context of climate change. These foundational principles include:

- **Transparency:** Transparency is a fundamental aspect of the climate change governance process. It fosters political and social consensus on climate policies and can be further supported by improving access to information systems and granting media access to climate policies.
- **Accountability:** Establishing a robust mechanism for holding policymakers accountable to citizens enhances the integrity of climate change policies and procedures.
- **Rule of Law:** Adherence to the rule of law entails the participation of all parties in shaping climate change policies and resolving disputes that may arise among different interest groups. This, in turn, enhances citizens' confidence in public policies.

OECD et al. (2022) recommendation includes provisions that advocate for citizen and stakeholder participation in shaping climate policies and accessing information related to policy procedures, thereby enhancing policy transparency. OECD has proposed a ten-step path to support effective citizen participation in the policymaking process, founded on eight guiding principles, including goal setting, accountability, transparency, inclusivity, accessibility, integrity, privacy, information availability, and evaluation (OECD et al., 2022).

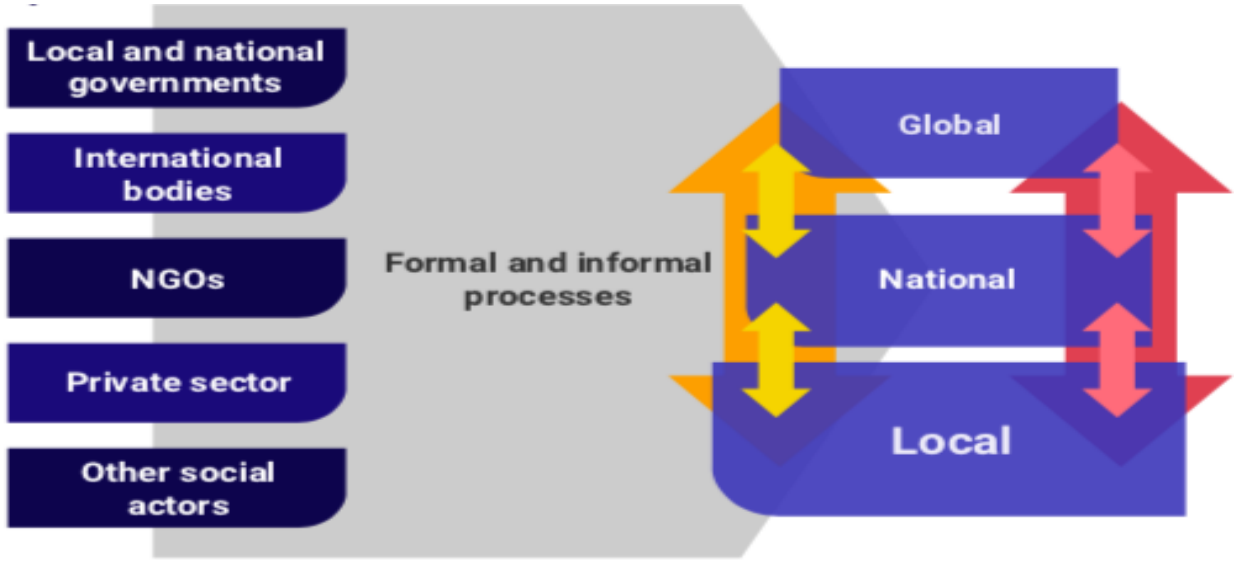
6.3.2.2 Multi-level climate change governance

The climate change governance process is inherently multi-level, involving a myriad of discussions and negotiations among various stakeholders, including local and national governments, international organizations, the private sector, non-governmental organizations, and more (UNICEF, 2020). The principles of the rule of law and democracy, which are integral to effective governance, promote coordination among these diverse stakeholders, thereby enhancing the effectiveness of green transformation strategies. The negotiations and discussions among these parties aim to take immediate action to combat climate change and may be both formal and informal. This process is characterized by flexibility and adaptability to changing circumstances and unfolds at various levels: local, national, regional, or international (Figure 6.1). The multi-level climate change governance process offers numerous advantages, including ensuring consistency between local, national, and international plans and policies, fostering cooperation and innovation across different levels and entities, integrating the ideas, experiences, and perspectives of various segments of society, and identifying mechanisms,

goals, and proposed solutions to collaboratively address climate change. This process ensures coherence and interconnectedness among different elements, establishes structures and tools for information exchange and report preparation to monitor the implementation of decisions and proposed solutions for climate change mitigation, and clarifies the roles and responsibilities of stakeholders at different levels. These efforts result in enhanced collaboration among different actors (UNICEF, 2020).

Recognizing the pivotal role of the multi-level climate change governance process, the Paris Agreement underscores the effective contribution of local and regional governments in addressing climate change. This support takes various forms, including encouraging energy self-consumption and the decentralization of energy production, managing smart networks, creating an investment-friendly environment for energy sources, establishing standards and indicators to measure energy poverty, and incorporating environmental considerations into urban planning and land use. The European Union's regulatory policy on renewable energy sources and electricity market design likewise underscores the role of local and regional communities in advancing the transition to a green economy. As a result, the European Union's regulatory policy recommends streamlining market entry procedures for local and regional communities in the renewable energy sector by removing legal and administrative obstacles. This approach stimulates the shift toward the use of renewable and clean energy sources, reducing environmental degradation (UNFCC, 2018).

Figure 6.1: Multilateral climate change governance process



Source:UNICEF, 2020

6.4 The state of green transition governance in Arab countries

Arab countries are actively moving towards a low-carbon economy by adhering to international climate change policies, formulating national strategies, and initiating various sustainable energy projects for economic development. This shift is particularly significant due to the need to mitigate the adverse impacts of climate change in the region, including drought and resource depletion that have plagued the Arab world for decades. Transitioning to renewable and clean energy sources to stimulate green economic growth in the Arab region comes with multifaceted challenges. These encompass political, legislative, regulatory, and institutional obstacles, along with economic and financial hurdles, as well as technological limitations, human resource constraints, and infrastructure shortcomings. Despite these challenges, Arab countries are taking steps and implementing effective policies to support the governance of the green transition.

6.4.1 Key challenges in Arab green transition

6.4.1.1 Political, legislative, regulatory, and institutional challenges

Effective green transition in the Arab world hinges on political commitment to the utilization of renewable and clean energy sources for economic development. To accomplish this, nations must develop renewable energy strategies that encompass specific, credible goals, a transparent legislative framework, streamlined administrative processes, and financial incentives. These strategies offer a long-term vision for the shift to a green economy. A lack of a clear and comprehensive vision can lead to uncoordinated growth of renewable energy projects, with an overemphasis on state-backed projects at the expense of private sector investments. It is imperative to establish a legislative framework conducive to the adoption of sustainable energy sources. This framework should encompass laws that promote the transition to clean energy sources. Such legislation helps delineate the roles and responsibilities of various stakeholders, establishes the groundwork for future regulatory measures, and simplifies administrative processes to encourage investment in clean energy sources. The absence of laws promoting clean energy investment fosters investor uncertainty in some Arab countries. An effective institutional framework that facilitates investment in renewable energy sources, while considering input from different stakeholders, is crucial for formulating effective climate policies.

6.4.1.2 Economic and financial challenges

Investing in renewable and clean energy sources incurs higher costs compared to traditional fossil fuel energy sources. Renewable energy projects require significant capital investment and often demand higher returns due to regulatory and legislative constraints. In many Arab countries, renewable energy investments remain economically uncompetitive, necessitating financial support to spur sustainable energy investments. Governments must reduce regulatory and legislative restrictions and provide essential financing through local financial institutions. Most Arab countries have financial institutions that do not support renewable energy projects, except for a few like Morocco (Bentouati, 2019). Tax exemptions,

reductions, and customs duty waivers can create an investment-friendly environment.

6.4.1.3 Technology, human capabilities, and infrastructure challenges

Technology plays a pivotal role in encouraging investments in renewable and clean energy sources like solar and wind power. However, many Arab countries confront significant challenges stemming from a lack of technical knowledge. Most Arab countries suffer from a deficiency in research and development investments, which are crucial for supporting the transition to renewable energy sources. The Arab region also faces obstacles related to selecting the most suitable technology considering the prevailing climatic conditions, such as the region's high temperatures. Infrastructure challenges are widespread, as most Arab countries lack the requisite infrastructure to support renewable energy projects. Regional network interconnection processes are also hampered by inadequacies, which limit Arab countries' capacity to establish a unified market for renewable energy. Despite the technological and infrastructural challenges facing the Arab region, there has been a notable enhancement in human capabilities. This improvement is attributed to the abundance of highly qualified human resources within Arab countries. These countries have invested in training and nurturing this human capital, along with the successful implementation of large-scale renewable energy projects in countries such as Egypt, Morocco, Tunisia, and the United Arab Emirates.

6.4.2 Arab countries commitment to green transition

In spite of the considerable challenges in transitioning toward a green economy within the Arab region, as previously outlined, Arab nations have made significant strides in enhancing the governance of this transition. Their efforts are focused on supporting the utilization of renewable and clean energy sources in economic development while curbing harmful GHG emissions to foster sustainable production and consumption. These endeavors encompass several critical areas, including the provision of energy services and infrastructural development to facilitate renewable energy projects, the generation of employment opportunities in the renewable energy sector, and resource conservation by employing sustainable consumption practices. Arab countries have placed particular emphasis on the development of alternative energy sectors, such as solar and wind energy, given the abundant availability of renewable energy resources across the Arab region. Additionally, water management, an essential concern for water-scarce Arab nations, is receiving attention through initiatives involving rainwater harvesting and water recycling.

Efforts are also dedicated to waste management, as the recycling of hazardous waste is recognized for its role in improving environmental quality. It is worth noting that global waste production continues to rise, with an anticipated increase from 1.3 billion tons to 2.2 billion tons by 2025. Recycling toxic waste is a significant contributor to environmental enhancement and the advancement of green economy objectives. The transportation sector is being transformed with support for the manufacturing of partially electric vehicles, coupled with improvements in public transportation services. This approach serves as a vital element in promoting the green transformation. Arab countries are equally engaged in the development of land management by focusing on organic agriculture and reforestation. These efforts are seen as pivotal components in environmental conservation and the pursuit of a sustainable future.

Arab nations have also collaborated to improve regional environmental quality. The Organization of Arab Petroleum Exporting Countries has sought to coordinate climate policies across the Arab region to foster sustainable development. While financing challenges persist in the shift to renewable and sustainable energy sources, the Organization of Islamic Cooperation (OIC) has formulated various strategies to address climate change, promote sustainable energy use, and mitigate climate change-induced disasters. The 2025 OIC Program of Action, for example, prioritizes environmental and climate change issues (Al-Sarihi and Loumi, 2019).

Several Arab countries have adopted national strategies for green transition. These strategies aim to gradually transition all sectors of the economy to clean energy sources while fostering cooperation among diverse stakeholders and aligning with international agendas. Recognizing the significance of a supportive legislative framework, numerous Arab countries, including Algeria, Jordan, Morocco, Syria, and Tunisia, have enacted renewable energy laws to stimulate investment in sustainable energy sources. For instance, Morocco has legislated support to achieve a 50 percent share of renewable energy in total energy consumption by 2030 (Morocco Renewable Energy Policy Handbook, 2022; and Al-Qaraish, 2022). Amendments to existing laws, such as Egypt's Electricity Law, have been introduced to accommodate renewable energy provisions (IRENA, 2014).

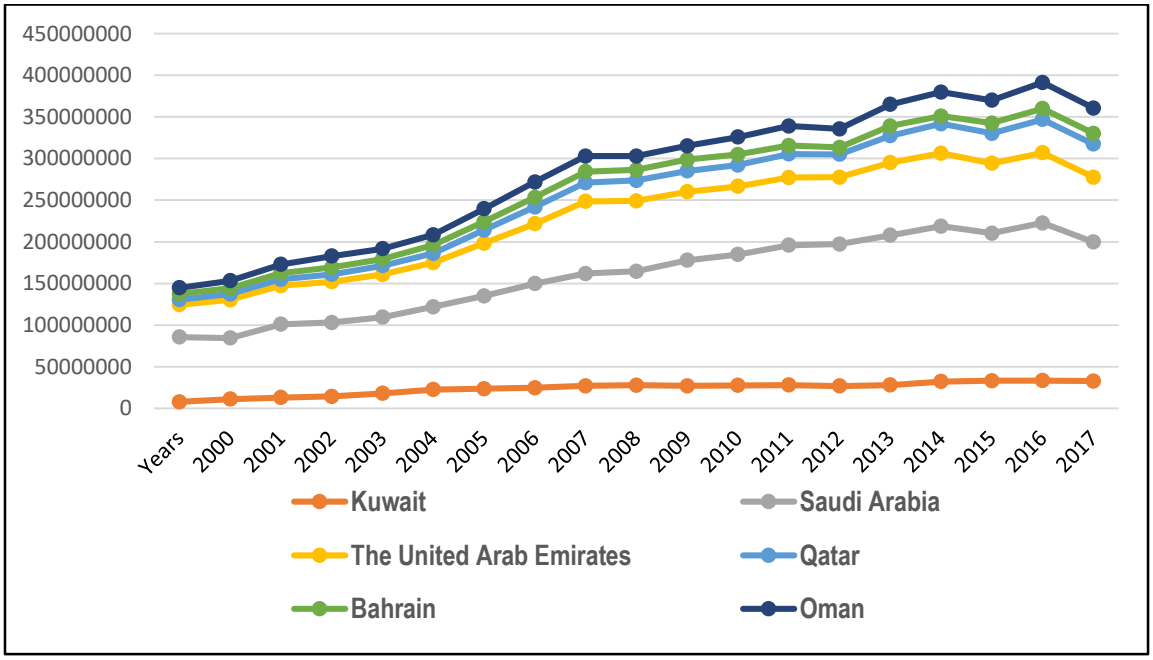
The most noteworthy initiatives within the Arab region toward a green economy transition are presented below and categorized into two groups: oil-exporting countries, with a strong representation from GCC states, and non-oil-exporting countries.

6.4.2.1 Efforts of oil-exporting countries (mainly GCC) to achieve green transition

The Gulf Cooperation Council countries are noteworthy for their substantial emissions of harmful gases, primarily due to their heavy reliance on fossil fuel energy sources to drive economic development. Environmental assessments, such as the Environmental Footprint Report of the Arab Forum for Environment and Development, reveal a high environmental footprint across all GCC countries, as depicted in Figure (6.2) (Saab, N., & Muntadá al-‘Arabī lil-Bī’ah wa-al-Tanmiyah, 2012). These nations have embarked on the path of limiting climate change and advancing towards a low-carbon economy. To achieve this, GCC countries have adopted effective measures to increase the utilization of renewable energy sources in their economic development, thereby reducing their dependence on oil and gas. They are committed to elevating the share of renewable energy sources in the primary energy mix, electric power generation mix, and final energy use mix. For instance, Saudi Arabia has prioritized addressing climate issues, diversifying its energy mix, and reducing reliance on oil and gas. Riyadh has incorporated hydrogen energy, renewable energy, and nuclear energy into its energy portfolio. Saudi Arabia has launched numerous programs and projects promoting solar energy, wind energy, and nuclear energy, and it has enacted legislation with the goal of achieving a 50 percent share for renewable energy sources in the total final energy consumption by 2030. Furthermore, Saudi Arabia introduced initiatives such as the Green Middle East and Green Saudi Arabia to improve environmental quality, including reducing carbon dioxide emissions, planting ten billion trees across the Kingdom, and deploying carbon reduction technologies.

Similarly, the United Arab Emirates has undertaken extensive measures to transition towards a green economy. The Emirates Green Development Strategy aims to bolster the UAE's competitive position in global markets, particularly in clean energy-related technologies. This strategy focuses on using renewable energy sources in economic development, increasing energy consumption efficiency across all sectors, and formulating policies that promote investment in renewable energy while fostering job creation. Additional efforts include the reduction of carbon emissions from industrial and commercial facilities and the encouragement of organic agriculture (Al-Qaraish, 2022).

Figure 6.2: Environmental footprint in GCC countries during the period (2000-2017)



Source: Global Footprint Network, 2023

6.4.2.2 Efforts non-oil exporting Arab countries in achieving green transition

In recent decades, many Arab governments have been dedicated to advancing their economies. This economic growth, however, has resulted in increased harmful gas emissions, adversely impacting environmental quality in the Arab region. Alongside the efforts of GCC countries to transition to a low-carbon economy, non-oil exporting Arab countries have also taken steps to support the green transition. Their initiatives encompass environmentally friendly investments, a review of environmental laws, the development of strategies to transition certain sectors of their economies into green sectors, and various policies to enhance environmental quality. For example, Jordan, which faces limited natural resources and growing demand for them, has pursued a green economy to manage resource consumption efficiently and ensure environmental sustainability. It became the first Arab country to study the economic and environmental landscape with the objective of supporting the green transition. The Jordanian Competitiveness Project, implemented by the United States Agency for International Development, seeks

to boost renewable energy projects like solar and wind energy, transition certain sectors of the Jordanian economy into green sectors, and create new job opportunities. It also aims to manage water consumption, waste, support green building construction, and develop environmentally friendly transportation. Additionally, in 2015, the European Union provided Jordan with financial support of €78 million to advance various sectors, including renewable energy, while maintaining environmental sustainability (Union of Arab Banks, 2023).

Tunisia is another Arab country that has launched numerous initiatives for transitioning to a green economy. Initiatives like "Eco-Lef" for plastic waste in 2001, "Eco-Piles" for electric batteries in 2005, and "Eco-Zit" for lubricants in 2008 showcase the country's dedication. In 2010, Tunisia introduced a Clean Production project aiming to increase energy efficiency, rationalize water consumption, and ensure adherence to global environmental standards, facilitating Tunisian exports to European markets. In 2015, Tunisia unveiled a national strategy focused on achieving sustainable development, with a particular emphasis on sectors like renewable energy and transportation. In 2016, the Tunisian Solidarity Bank entered a partnership agreement with the Confederation of Tunisian Citizen Enterprises and the Tunisian International Center for Environmental Technology to encourage young entrepreneurs to embark on small projects in the renewable energy sector (Union of Arab Banks, 2023). These efforts collectively represent a growing commitment to green transition to among non-oil exporting Arab countries.

6.5 Evaluating Arab regional climate governance and proposed recommendations

Regional climate governance involves the establishment of official mechanisms and strategies at various levels, promoting collaboration among all pertinent stakeholders within a regional framework. This not only includes governments but also the active participation of the private sector and civil society. Across the Arab region, countries have been dedicating varying levels of commitment and engagement to support the implementation of critical global agreements, particularly the 2015 Paris Agreement and the Sustainable Development Goals. The majority of efforts have primarily focused on international negotiations and the national sphere. Regrettably, regional cooperation within the Arab community often falls short of expectations, despite the compelling need for collective action, considering the transnational nature of climate change impacts and consequences. There exist untapped economic opportunities that can be harnessed to lower GHG emissions and boost climate resilience at the national level, with a more favorable cost-benefit ratio. These opportunities encompass projects relating to electric power transmission, clean energy corridors, intelligent and sustainable agriculture, addressing water scarcity, early warning systems, and fostering a skilled workforce. Active participation in addressing climate challenges, along with the implementation of effective strategies collectively, can amplify the influence of the Arab countries in international climate negotiations. This cooperation facilitates knowledge and experience exchange, streamlines financing mechanisms, promotes intra-regional trade, facilitates the movement of capital and labor, and establishes effective platforms for addressing climate-related conflicts.

Table 6.1: Green transition governance criteria in Arab countries

	Develop national strategies for green transformation	Reducing harmful gas emissions	Preparing green transition supporting laws	Promoting the role of private sector in green transformation process	Adequate investment in research and development in the field of renewable energy	Participation of stakeholders in formulating climate policies
Algeria	✓	X	✓	X	X	X
Bahrain	✓	X	✓	X	X	X
Comoros	✓	X	X	X	X	X
Djibouti	✓	X	X	X	X	X
Egypt	✓	X	✓	X	X	X
Iraq	✓	X	X	X	X	X
Jordan	✓	✓	✓	✓	X	X
Kuwait	✓	X	X	X	X	X
Lebanon	✓	X	✓	X	X	X
Libya	✓	X	✓	X	X	X
Mauritania	✓	X	X	X	X	X
Morocco	✓	X	✓	✓	X	X
Oman	✓	X	X	X	X	X
Qatar	✓	X	X	X	X	X
Saudi Arabia	✓	X	✓	X	X	X
Somalia	X	X	X	X	X	X
Sudan	X	X	X	X	X	X
Syria	✓	X	✓	✓	X	X
Tunisia	✓	X	✓	✓	X	X
UAE	✓	X	✓	X	X	X
West Bank and Gaza Strip	X	X	X	X	X	X
Yemen	X	X	X	X	X	X

Source: Developed by Authers

6.5.1 The current status of Arab regional climate governance

The landscape of climate governance, both generally and within the Arab region specifically, suffers from a lack of applied research and studies. This deficiency arises from the novelty of the subject, the absence of consensus on specific approaches or models, and a scarcity of lessons learned from practical application. One of the pioneering studies in Arab climate governance has identified the following components of the current Arab climate governance framework (Al-Yahya & Lumi, 2019):

- The League of Arab States: In 1986, the League established the Council of Ministers Responsible for the Environment, followed by the Council of Arab Ministers concerned with meteorological and climate affairs in 2016. The former focuses on environmental matters and sustainable development, while the latter centers around meteorology and climate change. The Arab Group for Climate Negotiations emerged as a coordination and reconciliation mechanism, with the primary task of coordinating and collaborating on assigned issues.
- The United Nations Economic and Social Commission for Western Asia provides technical support to all Arab countries for the sustainable management of natural resources at both national and regional levels.
- Various sub-regional organizations and entities exist, including certain Arab countries specializing in the coordination of climate-related topics, whether directly or indirectly. These include the Cooperation Council for the Arab Gulf States, the Regional Authority for the Conservation of the Environment of the Red Sea and the Gulf of Aden, the Regional Organization for the Protection of the Marine Environment, and the Arab Maghreb Union.

6.5.2 Key challenges in the current framework of Arab regional climate governance

Despite substantial progress in many Arab countries in developing climate governance elements at the national level, such as legislative frameworks, political commitment, and integration into economic development plans, challenges persist at the regional level, even with the presence of a reasonably robust institutional framework. These challenges are best summarized as follows:

- **Low Political Priority:** Climate change's priority is often overshadowed by other concerns, despite a growing interest in the matter. This interest is primarily linked to international commitments, changing balances, and climate events in certain Arab countries. What is needed is a sustained, rather than sporadic, interest and a commitment that translates into comprehensive policies, clear strategies, and governance systems that ensure participation and accountability.
- **Lack of Effective Governance:** Real governance, both regionally and nationally, is often lacking due to the absence of essential mechanisms for participation, accountability, and transparency.
- **Divergent Climate Interests:** The differing interests of Arab countries regarding mitigation and adaptation have prevented the formation of a common ground around which most Arab nations can unite. Consequently, this has led to variations in climate negotiation stances among Arab countries.
- **Competition Among Green Projects:** Competition between climate-focused green economy projects, such as those related to green hydrogen, can impede regional collaboration.
- **Inadequate Research Funding:** Insufficient participation in funding scientific research, innovation, and technology transfer hampers progress in addressing climate change.

6.5.3 Recommendations to deepen Arab regional climate governance

Addressing contemporary challenges in climate governance within the Arab region necessitates the creation of a unified stance in climate negotiations, improved coordination between climate policies, access to sufficient funding sources, and the development of expertise while capitalizing on existing knowledge and information. Additionally, it is crucial to establish a conducive environment for private sector involvement in the energy transition and the enhancement of climate resilience. The following are some recommendations aimed at providing a clear vision for refining existing models of Arab regional governance:

- **Agreed Mitigation and Adaptation Projects:** It is imperative to reach a consensus on packages of mitigation and adaptation projects and formulate initiatives for their joint implementation among a group of interested and concerned countries. This agreement should be facilitated through sub-regional organizations and entities, operating under the auspices of the League of Arab States, with joint financing from Arab development banks.
- **Customized Governance Models:** The implementation of the aforementioned projects and initiatives should be used to enrich climate governance practices. A governance model should be developed that aligns with the national and local characteristics of the political, economic, and social systems to ensure effective implementation. Key components of this model should include land tenure and ownership systems for climate-vulnerable areas, demographic and social considerations, the nature of the political system, and decision-making processes. These elements must be integrated to ensure accountability, transparency, and the dissemination of lessons learned from successful endeavors.
- **Support for Collective Action:** Establish mechanisms for building and supporting a collective position of Arab countries, either as a whole or in sub-groups, during climate negotiations. Develop a simulation model that enables the formulation of consensus-based solutions in cases of diverging interests.
- **Enhanced Transparency Mechanisms:** Create mechanisms to ensure transparency and governance in climate activities, leveraging the latest electronic applications and artificial intelligence capabilities.
- **Strengthened Communication Networks:** Foster communication networks among Arab countries to exchange knowledge, build expertise, enhance skills, and share information. These networks are advantageous for building consensus among countries with similar climate priorities, both in terms of mitigation, including energy mix and related tools, and adaptation, particularly in addressing water scarcity, desalination challenges, sustainable agricultural practices, and the activation of the Loss and Damage Fund.
- **Harmonized National Climate Legislation:** Encourage Arab nations to harmonize national climate legislation to ensure the implementation of best practices for confronting climate change, bolstering climate resilience, and transitioning to clean energy sources.

Enhancing Arab regional climate governance is a multifaceted endeavor that demands a collaborative, innovative, and comprehensive approach. Overcoming the challenges currently faced in the region and capitalizing on the economic opportunities available require a sustained commitment to climate action, a cohesive governance framework, and harmonized efforts across national and regional boundaries. These recommendations provide a roadmap for Arab nations to forge a more effective, integrated, and sustainable approach to addressing the pressing challenges of climate change in the region and achieve sustainable development.

Appendix 1: The sustainable development goals implementation progress in Arab countries Sustainable Development Solutions Network UN & Mohammed bin Rashed School of Government, Anwar Gargash Diplomatic (2022)

Country	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17
United Arab Emirates	↑	↗	↗	↑	↗	↗	↱	↗	↑	..	↗	↑	↗	↑	↓	↗	↑
Jordan	↗	→	↗	→	→	↗	↑	→	↑	..	↗	→	↗	→	↗	↗	→
Bahrain	..	..	↗	↑	→	→	↑	↗	↗	..	↓	↑	→	→	↓	→	→
Algeria	..	..	↗	↑	→	→	↑	↗	↗	..	↓	↑	→	→	↓	→	→
Saudi Arabia	..	↗	↗	↑	→	→	↑	→	↗	..	↗	↑	↗	→	↗	→	↗
Sudan	↓	→	↗	↑	→	→	↑	↗	↗	..	↓	→	↑	↗	↗	↗	↓
Somalia	↓	↗	→	..	↗	↗	..	↗	→	..	↓	..	↑	→	↗	→	↗
Iraq	→	→	↗	..	↓	↑	↗	→	→	..	→	↓	→	→	↓	→	↓
Kuwait	..	→	↗	→	→	↗	↑	→	↗	..	→	↑	↓	→	↗	→	↑
Morocco	↗	↗	↗	→	→	↑	↗	→	↗	..	↓	→	↑	↓	↗	↗	→
Yemen	..	→	→	..	→	→	↓	→	→	..	↗	→	↑	→	↓	→	↓
Tunisia	↗	→	↗	↑	→	↗	↗	→	↗	..	↓	→	→	↗	↗	→	↗
Comoros	→	→	→	↓	→	↓	..	↗	→	..	→	..	↑	→	↓	↓	↓
Djibouti	↗	→	↗	→	↗	↗	..	→	↗	..	↓	→	↑	→	↓	→	→
Syrian Arab Republic	..	↓	↗	..	→	↗	→	→	→	..	↓	..	↑	↓	↗	→	↗
Oman	..	→	↗	↑	→	↗	↗	↗	↗	..	↓	→	→	→	↓	↗	↗
Palestine	↗	→	↗	↑	→	↑	..	→	↗	..	↗	..	..	↑	↗	↗	..
Qatar	..	..	↗	↑	→	↗	↗	↗	↗	..	→	↑	→	↗	↓	↗	→
Lebanon	↑	→	↗	..	→	→	↑	→	→	..	↓	↓	→	→	↗	↓	↓
Libya	..	↓	→	..	→	↑	↓	→	→	..	↓	→	↗	↓	↗	↓	↓
Egypt	→	→	↗	↑	→	↗	↗	↗	→	..	↓	→	→	→	↗	↗	↓
Mauritania	→	↓	→	↗	→	↗	..	→	→	..	→	→	↑	→	↗	→	→

↑ On track or maintaining SDG achievement ↗ Moderaty improving → Stagnating ↓ Decreasing .. Data unavailable

Appendix 2: Measuring structural transformation

A comprehensive review of the literature reveals a distinctive approach to interpreting and quantifying structural transformation. The Lewis and Chenery methodology focus on gauging structural transformation by assessing productive sectors and their contribution to GDP in terms of employment or output. This perspective underscores that structural transformation is intricately tied to the shift from agriculture and its associated activities to industry and subsequently to services. It's not just about transitioning from one sector to another or one activity to another; the essence lies in enhancing productivity and its growth rate. Productivity serves as the bedrock of transformation and long-term growth.

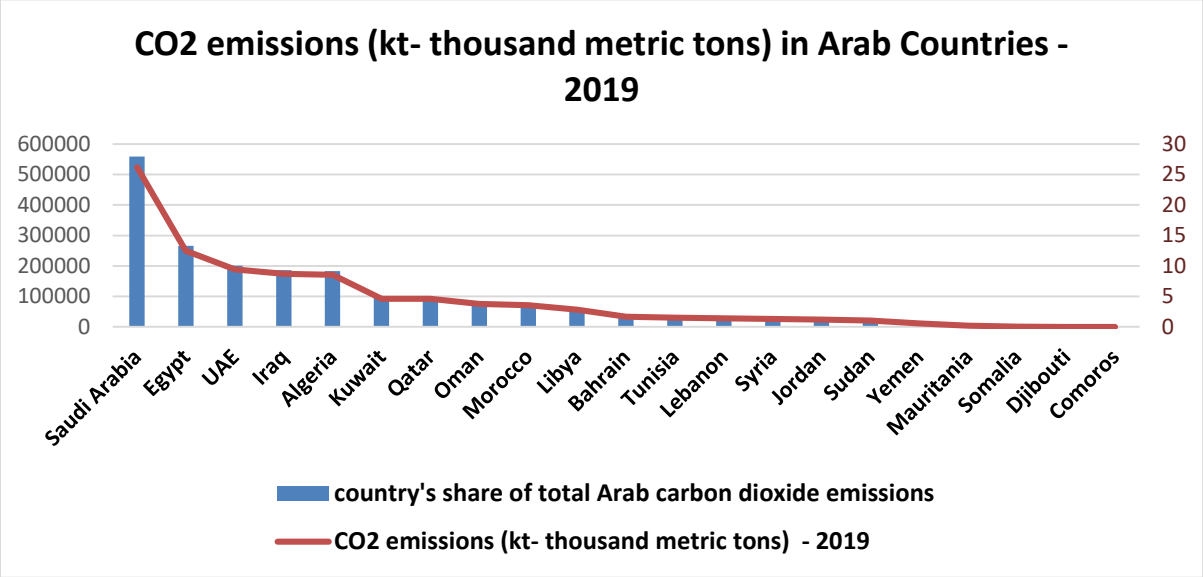
In the existing body of work, various studies have aimed to elucidate structural transformation based on the quality of activities and products and the transition to higher levels of technical or cognitive sophistication. Pioneering contributions from scholars such as Hausmann and Redrick have shed light on this facet (Hausmann et al., 2022). The multifaceted nature of measuring structural transformation encompasses two fundamental approaches. The first seeks to quantify structural transformation through shifts in the structure of supply (production), utilizing labor shares in production or value-added shares for productive sectors. The second approach endeavors to gauge structural transformation through alterations in the structure of demand, encompassing changes in consumption patterns, investment trends, and foreign trade dynamics. Measuring structural transformation is further influenced by three pivotal factors: the levels of sectoral or industrial classification, the duration over which structural transformation occurs, and the values of variables, whether assessed at current or fixed prices.

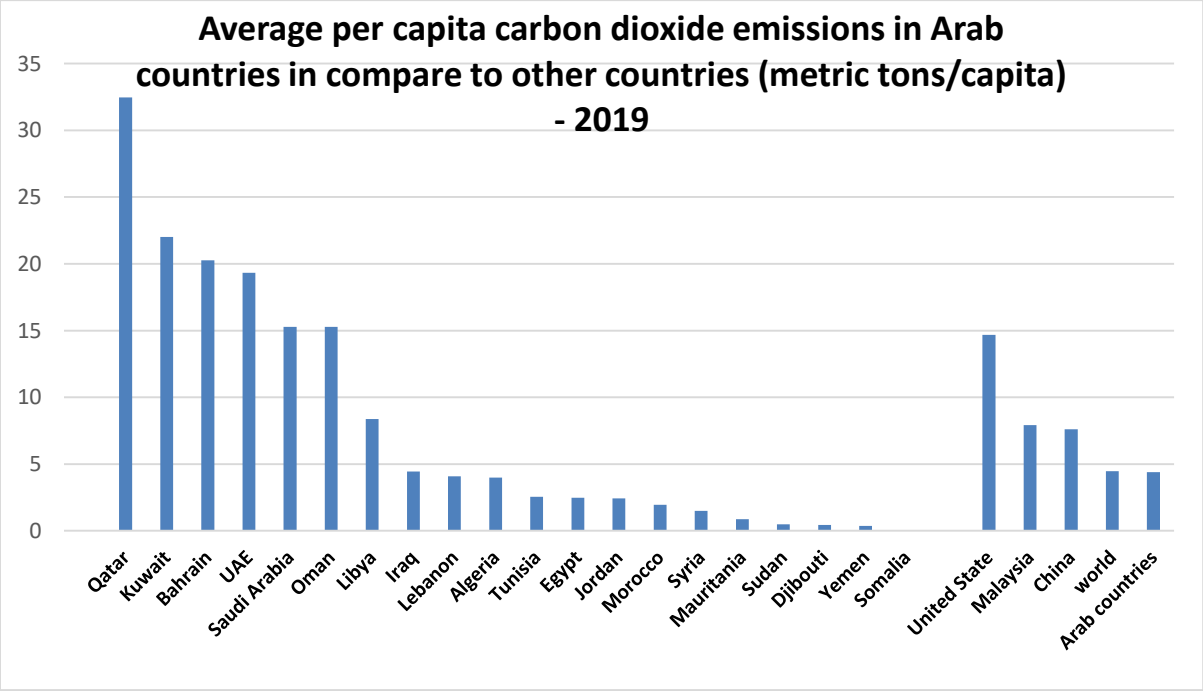
Given the preceding considerations and the availability of data, our approach to measuring structural transformation in Arab countries will hinge on changes in supply, specifically using value-added shares at current prices. In this context, a commonly employed method for quantifying structural transformation in terms of output (and employment) is the Structural Change Index (SCI). SCI, often referred to as the "rate of structural change," can be defined as half the sum of the absolute differences between the value-added shares between two distinct time points. This is expressed through the following formula (OECD, 1994, 2014):

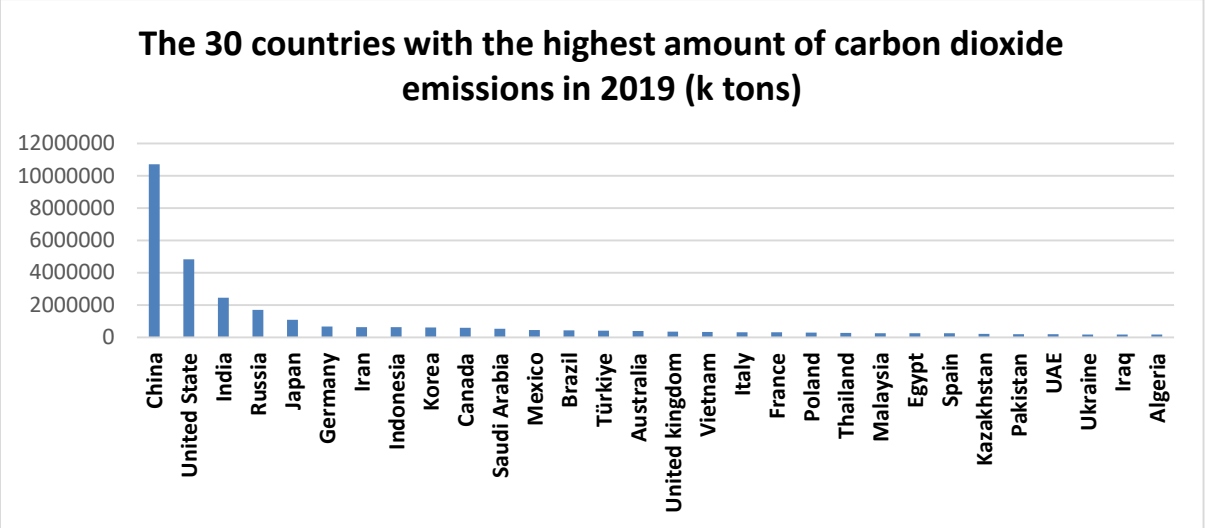
$$SCI = \frac{1}{2}\Sigma|x_{i\cdot t} - x_{i\cdot t-1}|$$

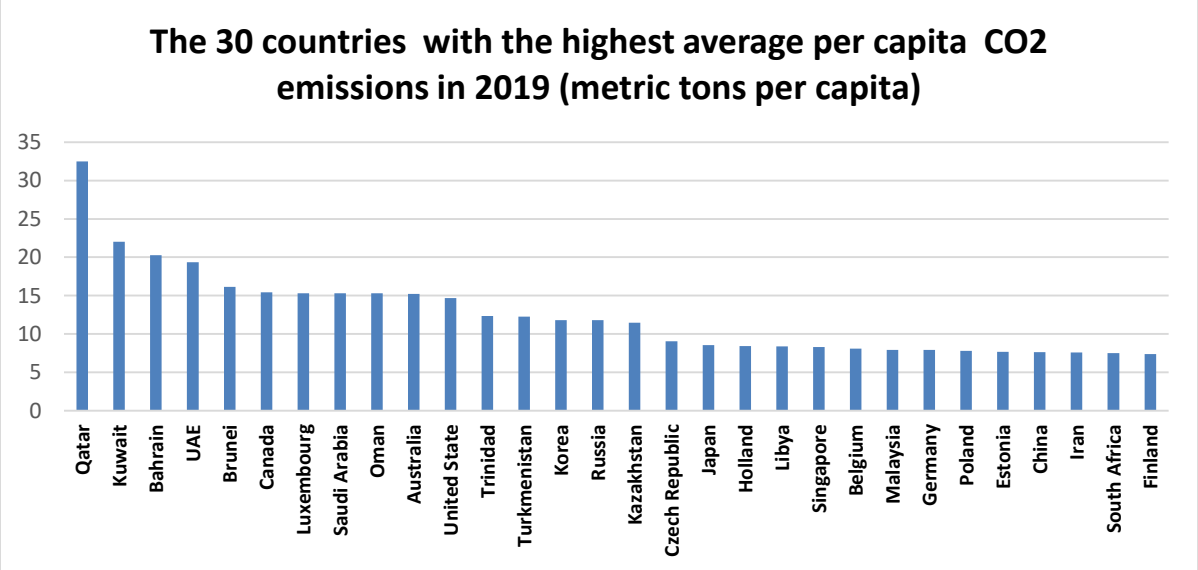
Where, *SCI* represents the Structural Change Index, $x_{i,t}$ signifies the percentage of value added for sector *i* at time point *t*, and $x_{i,t-1}$ denotes the percentage of value added for sector *i* at time point *t-1*. The use of absolute values in this calculation ensures that both positive and negative changes in sector shares are considered without canceling each other out when aggregating values across sectors. The resulting SCI value ranges between 0 and 100, with zero indicating the absence of structural change or transformation and 100 representing complete structural change or transformation.

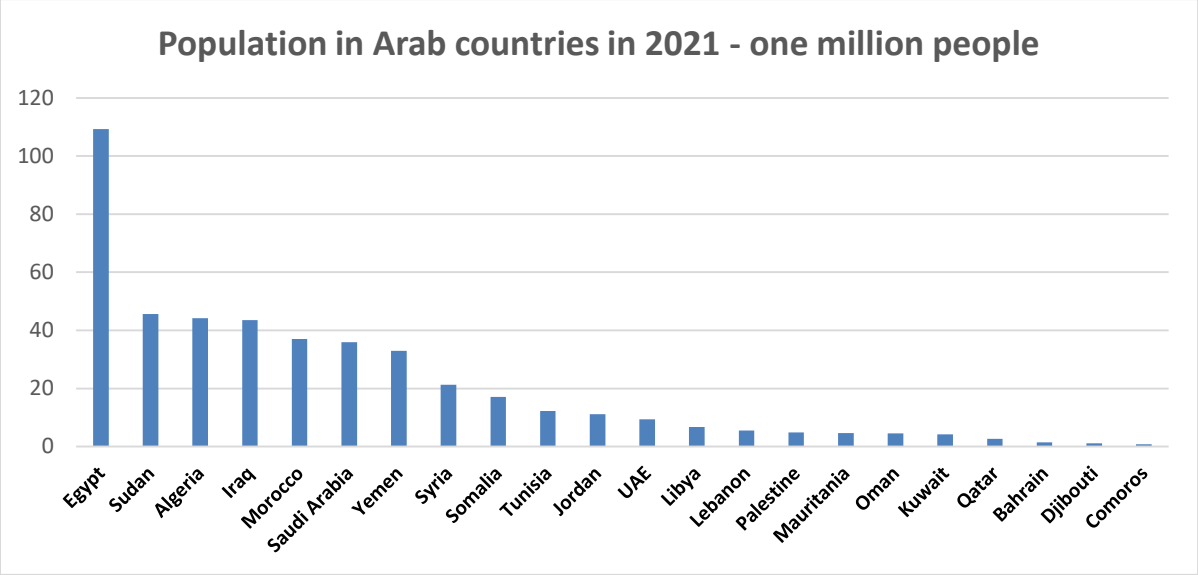
Appendix 3: Snapshot of carbon emissions in Arab countries and a number of comparative countries and regions





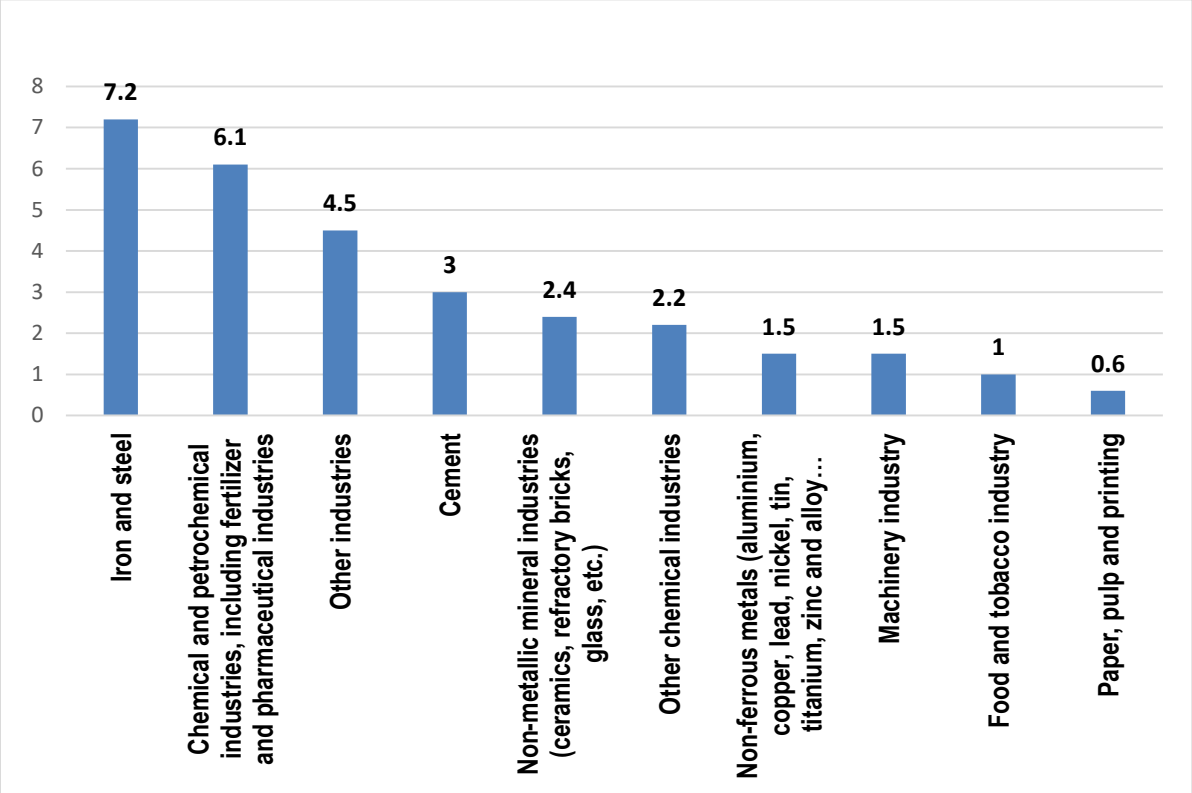

The 30 countries with the highest amount of carbon dioxide emissions in 2019 (k tons)
12000000
10000000
8000000
6000000
4000000
2000000
0
China
United State
India
Russia
Japan
Germany
Iran
Indonesia
Korea
Canada
Saudi Arabia
Mexico
Brazil
Türkiye
Australia
United kingdom
Vietnam
Italy
France
Poland
Thailand
Malaysia
Egypt
Spain
Kazakhstan
Pakistan
UAE
Ukraine
Iraq
Algeria


The 30 countries with the highest average per capita CO2 emissions in 2019 (metric tons per capita)
35
30
25
20
15
10
5
0
Qatar
Kuwait
Bahrain
UAE
Brunei
Canada
Luxembourg
Saudi Arabia
Oman
Australia
United State
Trinidad
Turkmenistan
Korea
Russia
Kazakhstan
Czech Republic
Japan
Holland
Libya
Singapore
Belgium
Malaysia
Germany
Poland
Estonia
China
Iran
South Africa
Finland



Source: Prepared by the researcher based on World Bank, 2023 . (https://data.worldbank.org/indicator/EN.ATM.CO2E.PC)

Appendix 4 : Contribution of industrial activities to greenhouse gas emissions in 2021



Source: Prepared by the researcher based on OWID,2023; IEA,2023, Our world indata,2023, Climate watch, 2023

Arabic references

- اتحاد المصارف العربية، 2023: "آفاق الاقتصاد الأخضر في المنطقة العربية"، مجلة اتحاد المصارف العربية، العدد رقم 429.. https://uabonline.org/ar/آفاق-الإقتصاد-الأخضر-في-المنطقة-العرب/
- إيهاب جناد وآخرون، 2017: "إدارة الموارد المائية، مجلة الزراعة والمياه في الوطن العربي"، العدد 31. سوريا. المركز العربي لدراسة المناطق الجافة والأراضي القاحلة.
- برنامج الأمم المتحدة الإنمائي، 2014): "حوكمة المياه في المنطقة العربية: إدارة الندرة وتأمين المستقبل"، المكتب الإقليمي للدول العربية. لبنان. https://www.undp.org/content/dam/rbas/doc/Energy%20and%20Environment/water%20governance_Ar_Full_Final-Web%20ver.pdf
- بيسودي، آدم، 2021: "الحد من تغير المناخ مقابل التكيف معه"، مجلة التمويل والتنمية، عدد سبتمبر 2021، صندوق النقد الدولي
- تاج الدين، عبد العزيز إبراهيم، 2022: "الآثار المتبادلة بين التغيرات المناخية والمياه والزراعة والطاقة في مصر وسبل المواجهة"، كتاب المؤتمر الدولي لمعهد التخطيط القومي.
- الجريدة الرسمية للمملكة المغربية، 2016: "قانون الماء 36-15"، عدد 6494 بتاريخ 25 من أغسطس، المغرب.
- سمير، القرعيش، 2022: "تجارب الدول العربية في التحول الأخضر"، مجلة السياسة الدولية، عدد رقم 230 أكتوبر 2022، مؤسسة الأهرام . متاح على الرابط: http://www.siyassa.org.eg/News/18402/من-المجلة/تجارب-الدول-العربية-فى-التحول-للاقتصاد-الأخضر.aspx
- فتح الرحمن، فهمان وآخرون، 2021: "تقرير منظمة التعاون الإسلامي حول المياه 2021 نحو تحقيق إدارة مستدامة للموارد المائية"، مركز الأبحاث الإحصائية والاقتصادية والاجتماعية والتدريب للدول الإسلامية (سيسرك).
- صندوق النقد العربي، 2016: "التقرير الاقتصادي العربي الموحد: قطاع الزراعة والمياه"، أبو ظبي، الإمارات العربية المتحدة.
- صندوق النقد العربي، 2021: "التقرير الاقتصادي العربي الموحد"، العدد 41، الدائرة الاقتصادية بصندوق النقد العربي.
- صندوق النقد العربي، 2022: "التقرير الاقتصادي العربي الموحد"، العدد 42، الدائرة الاقتصادية بصندوق النقد العربي. https://www.amf.org.ae/en/publications/reports/joint-arab-economic-reports
- عاشور، سالي، 2023: "الآثار الاجتماعية لتغير المناخ على الشعوب العربية"، آفاق عربية وإقليمية، العدد الحادي عشر الهيئة العامة للاستعلامات www.sis.gov.eg/UP/2021/final11.pdf
- فرج الله، نديم وآخرون، 2015: "في سبيل الحفاظ على المياه في لبنان: التقييم الوطني الشامل لنزاهة إدارة المياه"، برنامج تغيّر المناخ والبيئة في العالم العربي (معهد عصام فارس للسياسات العامة والشؤون الدولية، بيروت.
- فريق الخبراء المعني بأقل البلدان نموًا، 2012: "خطة التكيف الوطنية: المبادئ التوجيهية التقنية لعملية خطة التكيف الوطنية"، أمانة الاتفاقية الإطارية بشأن تغير المناخ. بون، ألمانيا. https://unfccc.int/files/adaptation/application/pdf/50301-

unfccc_nap_technical_guidelines_arabic-web-lr.pdf

- الكواز، أحمد، 2014: "الاقتصاد الأخضر والبلدان العربية"، مجلة جسر التنمية العدد 118، المعهد العربي للتخطيط، http://www.arab-api.org/images/publication/pdfs/416/416_118.pdf
- اللجنة الاقتصادية والاجتماعية لغربي آسيا (الإسكوا)، 2011: " تقييم أثر تغيّر المناخ على الموارد المائية وقابلية تأثر القطاعات الاجتماعية والاقتصادية في المنطقة العربية: إطار منهجي لإجراء تقييم متكامل"، www.unescwa.org/ar/publications
- اللجنة الاقتصادية والاجتماعية لغربي آسيا (الإسكوا)، 2013: "رصد الانتقال إلى الاقتصاد الأخضر في المنطقة العربية: المشروعات الصغيرة والمتوسطة"، E/ESCWA/SDPD/2013/1. https://archive.unescwa.org/ar/node/14824
- اللجنة الاقتصادية والاجتماعية لغربي آسيا (الإسكوا)، 2017: "تطوير قدرات البلدان العربية للتكيف مع تغير المناخ باستخدام أدوات الإدارة المتكاملة للموارد المائية"، https://www.unescwa.org/sites/default/files/pubs/pdf/developing-capacities-integrated-water-resources-management-arabic.pdf
- اللجنة الاقتصادية والاجتماعية لغربي آسيا (الإسكوا)، 2018: "تقرير المياه والتنمية السابع: تغير المناخ والحد من مخاطر الكوارث في المنطقة العربية"، www.unescwa.org/ar/publications
- مجموعة البنك الدولي، 2021: "مذكرات تحقيق النمو العادل وتوفير التمويل وبناء المؤسسات"، متاح على الرابط https://openknowledge.worldbank.org/bitstream/handle/10986/35438/EFI%20Note-Climate%20Change%20ARABIC.pdf?sequence=5&isAllowed=y
- المركز الدولي للزراعة الملحية، 2016: "التكيف مع التغير المناخي"، www.biosaline.org/sites/default/files/publicationpdfarabic/climatechange_op2_final_ar_web.pdf
- المعهد الدولي للتنمية المستدامة (سنوات متعددة) نشرة مفاوضات الأرض، المجلدات (7,8,9,10,11,12…19) http://WWW.IISD.ORG .
- المعهد العربي للتخطيط، 2015: "تقرير التنمية العربية: الإدارة الاقتصادية والاجتماعية للنمو الشامل التشغيلي".
- المعهد العربي للتخطيط ومعهد التخطيط القومي، 2021: "تقرير التنمية العربية الإصدار الخامس: مديونية الدول العربية الواقع والمخاطر وسبل المواجهة"، www.arab-api.org/Files/Publications/PDF/776/776_19122022.pdf
- منظمة الأغذية والزراعة للأمم المتحدة، 2022: "المنطقة العربية معرضة لخطر تأثيرات تغير المناخ"، https://www.fao.org/fileadmin/user_upload/rne/docs/Brochure_COP22_AR.pdf
- منظمة الأقطار العربية المصدرة للبترول(أوابك)، 2015: "سياسات دعم الطاقة في الدول الأعضاء وانعكاساتها على

الاقتصادات الوطنية".

- منظمة الأقطار العربية المصدرة للبترول(أوابك)، 2022: "تقرير الأمين العام السنوي" الـ 49.(تحت النشر).
- المنظمة العربية للتنمية الزراعية، 2021: "أوضاع الأمن الغذائي العربي"، جامعة الدول العربية.
- المنظمة العربية للتنمية الزراعية، 2022: "إستراتيجية التنمية الزراعية العربية المستدامة 2020 – 2030"، جامعة الدول العربية.
- وزارة الزراعة واستصلاح الأراضي، 2018: "استراتيجية التنمية الزراعية المستدامة حتى عام 2030"، مصر، http://www.arc.sci.eg/img/ar_strategy.doc
- وليد. خليل زباري، 2008: "قضايا وتحديات المياه في دول مجلس التعاون لدول الخليج العربية". قطرات خليجية. جامعة الخليج العربي، البحرين.

English references

- Abdmoulah, W, 2021: “Competition and financial institutions and markets development”, a dynamic panel data analysis. Journal of Financial Economic Policy, Vol 13, 5, 2021. https://doi.org/10.1108/JFEP-05-2020-0106.
- Aligishiev, Z., M. Bellon, and E. Massetti, 2022: “Macro-Fiscal Implications of Adaptation to Climate Change”, IMF Staff Climate Note 2022/002, International Monetary Fund, Washington, DC. ISBN: 979-8-40020-171-4 (PDF).
- Al-Safar A, Van der Beeuren M, 2020: “The case for energy transitions in major oil- and gas-producing countries”, IEA, Paris, https:// www.iea.org/commentaries/the-case-for-energy-transitions-inmajor-oil-and-gas-producing-countries.
- Al-Sarihi, A., & Luomi, M, 2019: “Climate change governance and cooperation in the Arab Region”. Emirates diplomatic academy. EDA Insight: Research & analysis.
- Amran YA, Amran YM, Alyousef R, Alabduljabbar H, 2020: “Renewable and sustainable energy production in Saudi Arabia according to Saudi Vision 2030”, current status and future prospects. J Clean Prod 247:119602.
- Arab Development Portal, 2018: “Arab Region in Review 2017,” Arab Development Portal, Arab AID and UNDP.
- Arab Monetary Fund (AMF), 2023: “Joint Arab Economic report”, https://www.amf.org.ae/en/publications/reports/joint-arab-economic-reports.
- Barro, R. J. and Sala-I-Martin, X, 1992: “Convergence. Journal of Political Economy”, 100(2):223–251. https://doi.org/10.1086/261816.
- Barro, R. J., Xavier Sala-I-Martin, Blanchard, O. J., & Hall, R. E, 1991: “Convergence

Across States and Regions", Brookings Papers on Economic Activity, 1991(1), 107–182. https://doi.org/10.2307/2534639.

- Bentouati, 2019: "Green Investment in the Arab Region", https://www.unescwa.org/sites/default/files/event/materials/s4-1.pdf.
- Berensmann, k. and Lindenberg, N, 2016: "Green Finance: Actors, Challenges and Policy Recommendations", DIE, briefing paper 23/2016.
- CEPAL, N, 2022: "Latin American Economic Outlook 2022: Towards a Green and Just Transition", ECLAC.
- CGIAR Research Program on Climate Change, 2012: "Achieving food security in the face of climate change: Final report from the Commission on Sustainable Agriculture and Climate Change", https://cgspace.cgiar.org/handle/10568/35589.
- Chenery, H, 1986: "Growth and transformation", in H. Chenery, S. Robinson and M. Syrquin (eds.), Industrialization and Growth: A Comparative Study, Washington, D.C., Oxford University Press (for the World Bank), pp. 13-36.
- Clark, Colin, 1957: "The Conditions of Economic Progress", third ed. Macmillan, London.
- Dadashi, Z., Mahmoudi, A., & Rashidi, S, 2022: "Capacity and strategies of energy production from renewable sources in Arab countries until 2030: a review from renewable energy potentials to environmental issues", Environmental Science and Pollution Research, 29(32), 47837-47866.
- Dafermos, Y., D. Gabor, M. Nikolaidi, and Van Lerven F, 2022: "Greening collateral frameworks", The INSPIRE Sustainable Central Banking Tool Box, Policy Briefing Paper 07, August.
- Dani, Rodrik, Margaret, McMillan & Claudia, Sepúlveda(Ed), 2016: "Structural Change, Fundamentals", and Growth- A Framework and Case Studies ISBN 9780896292147. DOI: http://dx.doi.org/10.2499/9780896292147.
- Dasgupta, S., & De Cian, E, 2016: "Institutions and the environment: existing evidence and future directions", (No. 603942).
- Duit, A, 2005: "Understanding environmental performance of states: An institution-centered approach and some difficulties" (No. 2005:7).
- Economic and Social Commission for Asia and the Pacific, 2021: "Debt-for-Climate Swaps as a Tool to Support the Implementation of the Paris Agreement", Available at https://www.unescap.org/sites/default/d8files/knowledge-products/PB_Debt-

forClimate%20Swaps_final.pdf.

- Economic and Social Commission for Western Asia (ESCWA), 2021b: Climate/SDGs debt swap mechanism.
- ESCWA, 2020: "Climate/SDGs debt swap mechanism", https://www.unescwa.org/sites/default/files/pubs/pdf/climate-sdgs-debt-swap-mechanism-english_0.pdf.
- F. Machlup, 1962: "The production and Distribution of knowledge in the United States", Princeton: Princeton University press.
- Fattouh, B. and El-Katiri, L, 2012: "Energy and Arab economic development", United Nations Development Programme, Regional Bureau for Arab States, Arab Human Development Report Research Paper Series.
- FAO and IBRD, 2018: "Water management in fragile systems building resilience to shocks and protracted crises in MENA". http://www.fao.org/3/i9730en/I9730EN.pdf.
- Fozzard, A, 2019: "Climate Change and Governance: Opportunities and Responsibilities", (No. 136098, pp. 1-4). The World Bank.
- Ghosh, R. N. & Siddique, M. A. B. (Eds.), 2015: "Corruption, good governance and economic development: Contemporary analysis and case studies", (Vol. 28). World Scientific.
- Grindle, M. S, 2017: "Good Governance, R.I.P.: A Critique and an Alternative", Governance, 30(1), 17-22.
- Hausmann, R. and D. Rodrik, 2003: "Economic development as self-discovery", Journal of Development Economics, 72: 603-633. https://doi.org/10.1016/S0304-3878(03)00124-X>
- Hausmann, R., Diodato, D.,. & Schetter, U, 2022: "A Simple Theory of Economic Development at the Extensive Industry Margin", Copy at http://www.tinyurl.com/2zlsvx66.
- Hausmann, R., et al, 2023: "The Economic Complexity of Kazakhstan: A Roadmap for Sustainable and Inclusive Growth", Copy at http://www.tinyurl.com/2fzwgrpt.
- Hausmann,R and Klinger, B, 2006: "Structural Transformation and Patterns of Comparative Advantage in the Product Space", Center for International Development Kennedy School of Government, Harvard University.(https://growthlab.cid.harvard.edu/files/growthlab/files/128.pdf).
- IFC, 2022: "Emerging Market Green Bonds Report 2021", https://www.ifc.org/content/dam/ifc/doc/mgrt/202206-emerging-market-green-bonds-report-

2021-vf-2.pdf.

- IFPRI, 2021: "Climate change and Egypt's agriculture", https://www.ifpri.org/publication/climate-change-and-egypts-agriculture.

- ILO, 2023: "Enabling success: Supporting Youth in MENA in their Transition from Learning to Decent Work", Available at: https://www.ilo.org/beirut/publications/WCMS_877345/lang--en/index.htm0 .
- IMF, 2022: "Feeling the Heat - Adapting to Climate Change in the Middle East and Central Asia",www.imf.org/en/Publications/Departmental-Papers-Policy-Papers/Issues/2022/03/25/Feeling-the-Heat-Adapting-to-Climate-Change-in-the-Middle-East-and-Central-Asia-464856.
- International Energy Agency (IEA), 2018: "World Energy Outlook".
- International Energy Agency (IEA), 2023: "World Energy Investment 2023 Report, International Energy Agency", www.iea.org.
- International Renewable Energy Agency (IRENA), 2023: "World Energy Transitions Outlook 2023: 1.5°C Pathway", International Renewable Energy Agency, Abu Dhabi.
- International Renewable Energy Agency (IRENA), 2014: "Pan-Arab Renewable Energy Strategy 2030", www.irena.org/-/media/Files/IRENA/Agency/Publication/2014/IRENA_Pan-Arab_Strategy_June-2014.pdf .
- IPCC, 2018: Global warming of 1.5 C, https://www.ipcc.ch/sr15/.
- IPCC, 2022: "Climate Change 2022: Impacts, Adaptation and Vulnerability", Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [H.-O. Pörtner, D.C. Roberts, M. Tignor, E.S. Poloczanska, K. Mintenbeck, A. Alegría, M. Craig, S. Langsdorf, S. Löschke, V. Möller, A. Okem, B. Rama (eds.)]. Cambridge University Press. Cambridge University Press, Cambridge, UK and New York, NY, USA, 3056 pp., doi:10.1017/9781009325844.
- Johnston, M, 2002: "Good Governance: Rule of Law, Transparency, and Accountability".
- Karim, S., Appiah, M., Naeem, M. A., Lucey, B. M., & Li, M, 2022: "Modelling the role of institutional quality on carbon emissions in Sub-Saharan African countries", Renewable Energy, 198, 213-221.
- Kaufmann, D., Kraay, A. & Zoido-Lobatón, P, 1999: "Aggregating Governance Indicators", Policy Research Working Paper. Washington, DC: The World Bank Development Research

Group.

- Koc A, Turk S, Şahin G, 2019: "Multi-criteria of wind-solar site selection problem using a GIS-AHP-based approach with an application in Igdir Province/Turkey", Environ Sci Pollut Res 26(31):32298–32310.
- Kuznets, S, 1971: "Economic Growth of Nations, Total Output and Productive Structure", Harvard University Press, Cambridge. https://doi.org/10.4159/harvard.9780674493490.
- Labidi, M, 2022: "Debt Sustainability and Debt Management in the Arab Region", UN-ESCWA.
- Mahmoud, Maged & Habib, Ali, 2019: "Arab Future Energy Index (AFEX) Renewable Energy 2019", Regional Center for Renewable Energy and Energy Efficiency (RCREEE), Cairo, Egypt. www.arabdevelopmentportal.com/sites/default/files/publication/final_afex_re_2019_final_version-1.pdf.
- Masson-Delmotte, V., Zhai, P., Pörtner, H. O., Roberts, D., Skea, J., & Shukla, P. R, 2022: "Global Warming of 1.5 C: IPCC special report on impacts of global warming of 1.5 C above pre-industrial levels in context of strengthening response to climate change", sustainable development, and efforts to eradicate poverty. Cambridge University Press.
- McNerney, J., et al, 2021: "Bridging the short-term and long-term dynamics of economic structural change". Working papers, Harvard University, Center for International Development. (http://www.tinyurl.com/yxpdobp4).
- Ministry of Electricity and Renewable Energy, 2022: "Unpublished presentation on energy investment in Egypt: Opportunities of Egypt energy transition".
- Mohideen, M.M., Subramanian, B., Sun, J., Ge, J., Guo, H., Radhamani, A.V., Ramakrishna, S. and Liu, Y, 2023: "Techno-economic analysis of different shades of renewable and non-renewable energy-based hydrogen for fuel cell electric vehicles", Renewable and Sustainable Energy Reviews, 174, p.113153.
- Molden, D., Vithanage, M., de Fraiture, C., Faures, J. M., Gordon, L., Molle, F., & Peden, D, 2011: "Water availability and its use in agriculture", Treatise on Water Science, 707–732. https://doi.org/10.1016/b978-0-444-53199-5.00108-1 .
- Morocco, 2030: "Renewable Energy Policy Handbook,(2022)", https://www.globaldata.com/store/report/morocco-renewable-energy-government-regulation-policy-analysis/ .

- Nahar, A., & Mishra, A. K, 2019: "Green governance-a steppingstone for sustainable development", Think India Journal, 22(33), 237-244.
- OECD , 1994: "Manufacturing Performance: A Scoreboard of Indicators", ISBN: 92-64-14126-X, Paris.
- OECD, 2014: "Policy Challenges for the Next 50 Years- OECD economic Policy paper", Parise, July 2014 No. 9 https://www.oecd.org/economy/Policy-challenges-for-the-next-fifty-years.pdf .
- OECD, 2020: "Green Budgeting Framework", https://www.oecd.org/environment/green-budgeting/OECD-Green-Budgeting-Framework-Highlights.pdf.
- OECD, 2022: "Aggregate Trends of Climate Finance Provided and Mobilized by Developed Countries in 2013-2020, Climate Finance and the USD 100 Billion Goal", OECD Publishing, Paris, https://doi.org/10.1787/d28f963c-en.
- OECD et al, 2022: "Latin American Economic Outlook 2022: Towards a Green and Just Transition", OECD Publishing, Paris, https://doi.org/10.1787/3d5554fc-en.
- Ott, J, 2013: "Greater happiness for a greater number: Some non-controversial options for governments". The Exploration of Happiness: Present and Future Perspectives, 321-340.
- Productivity Commission, 1998: "Aspects of Structural Change in Australia- Research paper", Commonwealth of Australia, December 1998. (https://www.pc.gov.au/research/completed/structural-change/strctchg.pdf).
- Rose-Ackerman,S, 2017: What does "governance" mean?. Governance, 30(1), 23-27.
- Rothstein, B. O., & Teorell, J. A, 2008: "What is quality of government? A theory of impartial government institutions", Governance, 21(2), 165-190.
- Saab, N., & Muntadá al-'Arabī lil-Bī'ah wa-al-Tanmiyah, 2012: "Arab environment 5: Survival options: ecological footprint of Arab countries", Beirut, Lebanon: Arab Forum for the Environment and Development.
- Saab, Najib & SADIK, ABDUL-KARIM (Ed), 2016: "Sustainable Development in a Changing Arab Climate: How Can Arab Countries Achieve Sustainable Development Goals by 2030", Arab Forum for Environment and Development (AFED) www.academia.edu/38680110/Sustainable_development_in_a_changing_arab_climate?auto=download&email_work_card=download-paper.
- Salazar-Xirinachs, José Manuel; Nübler, Irmgard & Kozul-Wright, Richard(Ed), 2014: "TRANSFORMING ECONOMIES Making industrial policy work for growth, jobs and

development", UNCTAD and ILO, ISBN 978-92-2-128566-3 https://www.ilo.org/wcmsp5/groups/public/@dgreports/@dcomm/@publ/documents/publication/wcms_242878.pdf.

- Schechla, J, 2022: "Going Green: Monitoring the Green Transition in the Arab Region", https://annd.org/uploads/publications/Going_Green_Monitoring_the_Green_Transition_in_the_Arab_Region_EN.pdf.
- Selvaraju, R, 2013: "Implications of Climate Change for Agriculture and Food Security in the Western Asia and Northern Africa Region", In: Sivakumar, M., Lal, R., Selvaraju, R., Hamdan, I. (eds) Climate Change and Food Security in West Asia and North Africa. Springer, Dordrecht. https://doi.org/10.1007/978-94-007-6751-5_2.
- Seta Tutundjian, Dima Maroun, 2022: "Climate Action in the Arab Region: White Paper on The Nationally Determined Contributions of Middle East and North Africa Countries", Thriving Solutions L.L.C.
- Sinha, A., Gupta, M., Shahbaz, M., & Sengupta, T, 2019: "Impact of corruption in public sector on environmental quality: Implications for sustainability in BRICS and next 11 countries", Journal of Cleaner Production, 232, 1379-1393. https://doi.org/10.1016/j.jclepro.2019.06.066.
- Sivakumar, M. V., Lal, R., Selvaraju, R., & Hamdan, I. (Eds.), 2013: "Climate change and food security in West Asia and North Africa", Springer Netherlands. https://doi.org/10.1007/978-94-007-6751-5.
- Syrquin, M, 1988: "Patterns of Structural Change", In: Chenery, H. and Srinivasan, T.N., Eds., Handbook of Development Economics, Elsevier, New York, 203-273.
- Tolba, Mostafa K. & Saab, Najib W. (Ed), 2009: "Arab Environment: Climate Change - Impact of Climate Change on Arab Countries", Arab Forum for Environment and Development (AFED). www.afedonline.org/uploads/afed_reports/Full_English_Report2009.pdf.
- Twining-Ward, T., Khoday, K., Tobin, C., Baccar, F., Mills, J. T., Ali, W., & Murshed, Z, 2018: "Climate change adaptation in the Arab states: best practices and lessons learned", United Nations Development Programme (UNDP): New York, NY, USA. https://www.undp.org/sites/g/files/zskgke326/files/publications/Arab-States-CCA.pdf

Mirkin, B. (2010). Population levels, trends and policies in the Arab region: challenges and opportunities. USA: United Nations Development Programme, Regional Bureau for Arab States. Arab Human Development Report Research Paper Series.

- World bank, 2016: "High and Dry: Climate Change, Water, and the Economy", http://www.worldbank.org/en/topic/water/publication/high-and-dry-climate-change-water-and-the-economy.
- UNECE, 2016: "Summary of the Paris Agreement", https://unece.org/fileadmin/DAM/stats/documents/ece/ces/2016/mtg/Session_1_Bigger_picture_of_COP21.pdf .
- UNEP, 2016: "Green Finance for developing countries", Needs Concerns and Innovations.
- UN-ESCWA, 2022: "Water Development Report 9-Groundwater in the Arab region", https://www.unescwa.org/publications/water-development-report-9.
- UNFCCC; UNFCCC, 2015: "Paris Agreement Status of Ratification".
- UNPFA, 2022: "Through their eyes: Climate change and economic inequality in the MENA region," November, Available at: https://www.unescwa.org/publications/climate-change-economic-inequality-mena-region.
- UN-Habitat, 2022: "Climate Change Strategy for Arab States 2022 – 2025", https://unhabitat.org/sites/default/files/2022/10/ccs_-_roas_-_final_-_a4_sheets.pdf
- United Nations, 2016: "Integrated Technical Guidance Notes on Transnational Organized Crime and Security Sector Reform", United Nations SSR Task Force, https://www.unodc.org/documents/organized-rime/SSR_TOC_ITGN_2016_WEB.pdf
- United Nations Children's Fund (UNICEF), 2020: "What is Climate Governance?", https://www.unicef.org/lac/sites/unicef.org.lac/files/2021-07/what-is-climate-governance.pdf
- United Nations Climate Change Secretariat (UNFCC), 2017: "Opportunities and options for integrating climate change adaptation with the Sustainable Development Goals and the Sendai Framework for Disaster Risk Reduction 2015–2030", https://unfccc.int/sites/default/files/resource/techpaper_adaptation.pdf .
- United Nations Climate Change Secretariat (UNFCC), 2018: "Climate governance after 2020: a European and global perspective – a contribution to the UNFCCC COP24", https://unfccc.int/sites/default/files/resource/296_COR-2018-00923-00-01-AC-TRA-EN%20%281%29.pdf .
- United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP), 2009: "What is Good Governance?", https://repository.unescap.org/bitstream/handle/20.500.12870/3794/ESCAP-2009-PB-what-good-governance.pdf?sequence=1&isAllowed=y.

- United Nations Economic and Social Commission for Western Asia (ESCWA (ESCWA), 2020: Arab Sustainable Development Report2020 E/ESCWA/SDD/2019/2.
- United Nations Office on Drugs and Crime (UNDOC), 2021: "Corruption and Good Governance", Knowledge tools for academics and professionals, Module Series on Anti-Corruption, Module 2. https://grace.unodc.org/grace/uploads/documents/academics/Anti-Corruption_Module_2_Corruption_and_Good_Governance.pdf .
- Verner, Dorte, ed, 2012: "Adaptation to a Changing Climate in the Arab Countries", Washington, DC: World Bank. DOI: 10.1596/978-0-8213-9458-8.
- World Bank, 2016: "High and Dry: Climate Change, Water, and the Economy", http://www.worldbank.org/en/topic/water/publication/high-and-dry-climate-change-water-and-the-economy.
- Zallé, O, 2019: "Natural resources and economic growth in Africa: The role of institutional quality and human capital", Resources Policy, 62, 616-624. https://doi.org/10.1016/j.resourpol.2018.11.009.

Websites

- Arab Development Portal (November 2020) Trade, Arab Aid and UNDP. [Accessed June 2022]. Available: www.arabdevelopmentportal.com/indicator/trade.
- Arab Development Portal (February 2021) Arab Development Portal, UNDP[Accessed June 2022]. Available: www.arabdevelopmentportal.com/indicator/ demography.
- EDGAR (2023) Emissions Database for Global Atmospheric Research. "CO2 emissions of all world countries". European commission. Available: https://edgar.jrc.ec.europa.eu/report_2022#emissions_table
- FAO(2023) FAO's Global Information System on Water and Agriculture(AQUASTAT) Available: https://www.fao.org/aquastat
- Footprint Data Foundation(2023) National Footprint and Biocapacity Accounts, York University Ecological Footprint Initiative, and Global Footprint Network, 2023 edition. Available: https://data.footprintnetwork.org.
- H. Aboelnga and A. Soliman, (March 2018) Coming to grips with urban water security in the face of climate change in the Arab World, No. 1 Vol. LV 2018, The Quest for Water Smart Water Magazine, [Accessed 2 February 2022] Available: www.un.org/en/chronicle/article/coming-grips-water-security-face-climate-change
- IEA,2023, (https://www.iea.org/reports/industry),
- ILO (2023) Enabling success: Supporting Youth in MENA in their Transition from Learning to Decent Work, Available: https://www.ilo.org/beirut/publications/WCMS_877345/lang--en/index.htm0
- IMF(2023) IMP climate related Dashboard - Cross Border Indicators, Available: https://climatedata.imf.org/pages/bp-indicators
- ITC(2023) Trade Map, Available: www.trademap.org/Index.aspx

- Net Zero Tracker (2022) Net Zero Tracker [Accessed on 24 July 2023] Available: www.zerotracker.net
- Organization of the Petroleum Exporting Countries (OPEC) (2023) Data/Graphs [Accessed 23 July 2023]. Available: www.opec.org/opec_web/en/data_graphs/330.htm
- The World Bank (2021) World Development Indicators [Accessed June 2022] Available: https://databank.worldbank.org/source/world-development-indicators..
- The Global Change Data Lab- (2023) Our world in data "Emissions by sector", Available: https://ourworldindata.org/emissions-by-sector
- The Global Change Data Lab (2023) Our world in data -Electricity production from fossil fuels, nuclear and renewables Available: https://ourworldindata.org/grapher/elec-fossil-nuclear-renewables?country=~MAR
- UNCTAD(2023) UNCTADSTATA.
- Available: https://unctadstat.unctad.org/wds/TableViewer/tableView.aspx?ReportId=95.
- UNCTAD-Eora (2023). "Global Value Chain Database" https://worldmrio.com/unctadgvc/
- UNFPA Regional Office for Arab States (May 2020, 28) "Migration," UNFPA, [Accessed 13 June 2022] Available: https://arabstates.unfpa.org/en/topics/migration-1.
- UN-Habitat (October 2021, 30) "World Cities Day celebrations at Expo 2020 Dubai," UN-Habita [Accessed June 2022] Available: https://unhabitat.org/world-cities-daycelebrations-at-expo-2020-dubai.
- UNIDO 2023) "World Manufacturing Production "Available: https://stat.unido.org/content/publications/world-manufacturing-production-in-november-2022;jsessionid=89F3439AE3E58B7A7F8CE011E3CDC027
- United Nations Statistics Division (2021) Statistical Database [Accessed June 2022] Available: https://unstats. un.org/home/ .
- University of Groningen, 2023. Groningen Growth and Development Centre- Faculty of Economics and Business (https://www.rug.nl/ggdc/productivity/pld/)
- University of Notre Dame (2023) Notre Dame Global Adaptation Initiative, Available: https://gain.nd.edu/
- (2020) Notre Dame Global Adaptation Initiative, Available: https://gain.nd.edu/
- World Bank (2023) "Exports of low carbon technology products as share of total exports %" Available:https://data.worldbank.org/indicator/EN.ATM.CO2E.PC).
- World Bank (2023) world development indicators, Available: https://data.worldbank.org/indicator/SP.POP.TOTLworld
- World Bank (2023)"Manufactures exports -% of merchandise exports". Available: https://data.worldbank.org/indicator/TX.VAL.MANF.ZS.UN
- World Bank (2023) The World Integrated Trade Solution (WITS) Available:http://wits.worldbank.org/
- World Bank (2023)Merchandise exports Available: https://data.worldbank.org/indicator/TX.VAL.MRCH.CD.WT
- World Resource Institute (2023) Climate watch - Historical GHG Emissions. Available: www.climatewatchdata.org/ghg-emissions?breakBy=sector&end_year=2019

- الاتحاد الأوروبي(2023) مشروع دعم الخطة القومية للموارد المائية الممول من الاتحاد الأوروبي يعرض نتائج أعماله: www.eeas.europa.eu/eeas/مشروع-دعم-الخطة-القومية-للموارد-المائية-الممول-من-الاتحاد-الأوروبي-يعرض-نتائج-أعماله_ar
- الاتحاد الدولي لجمعيات الصليب الأحمر والهلال الأحمر (2023) https://www.ifrc.org/ar
- الأمم المتحدة، 2022: "تقرير "الحرارة الشديدة: الاستعداد لموجات الحر في المستقل". أكتوبر 2022. https://news.un.org/ar/story/2022/10/1113752
- برنامج الأمم المتحدة للبيئة (2020). مع تزايد أزمة المناخ، يعد التكيف مع تداعياتها أمرًا ضروريًا . https://www.unep.org/ar/alakhbar-walqss/alqst/m-tzayd-azmt-almnakh-yd-altkyf-m-tdayatha-amraan-drwryaan
- البنك الدولي (نوفمبر 2012، 30) مدونات. تغير المناخ في العالم العربي، كما يرونها. https://blogs.worldbank.org/ar/arabvoices/through-their-eyes-climate-change-arab-world-arabic
- البنك الدولي (يناير 2012، 18) مدونات. كيف يمكن التكيف مع مناخ متغير في الشرق الأوسط وشمال أفريقيا؟ https://blogs.worldbank.org/ar/arabvoices/kyf-ymkn
- البنك الدولي (مارس 2015، 19) مدونات. بالأرقام: حقائق عن أزمة المياه في العالم العربي. https://blogs.worldbank.org/ar/arabvoices/numbers-facts-about-water-crisis-arab-world
- البنك الدولي (أبريل 2022، 8) تغير المناخ: www.albankaldawli.org/ar/topic/climatechange/overview#1
- البنك الدولى (أكتوبر 2022، 17). ما يجب معرفته عن الأمن الغذائي وتغيّر المناخ. www.albankaldawli.org/ar/news/feature/2022/10/17/what-you-need-to-know-about-food-security-and-climate-change
- بوابة التنمية العربية (2023) https://www.arabdevelopmentportal.com
- البوابة الرسمية لحكومة الإمارات العربية المتحدة(2023) المبادرة الاستراتيجية للحياد المناخي 2050. تصدي دولة الإمارات للتغير المناخي https://u.ae/ar-ae/information-and-services/environment-and-energy/climate-change/theuaesresponsetoclimatechange/uae-net-zero-2050
- بوابة جريدة الشرق الأوسط (أكتوبر 2020، 11). التكيف مع تغير المناخ أولوية، نجيب صعب، الأمين العام للمنتدى العربي للبيئة والتنمية (أفد) ورئيس تحرير مجلة البيئة والتنمية https://aawsat.com/home/article/2557656/
- جهاد أزعور وكريستوف دوينوالد (مارس2022، 30) "دون إجراءات للتكيف، تواجه منطقة الشرق الأوسط وآسيا

الوسطى خسائر مناخية فادحة". صندوق النقد الدولي.
- رئيس الحكومة بالمغرب المقدم بمجلس النواب: "السياسة المائية بالمغرب". 12 من ديسمبر 2022. https://www.cg.gov.ma/ar/node/10914
- ساروج كومار جاه، (أكتوبر 2012) " المياه: مسرع للنمو الأخضر والشامل والقادر على الصمود".. البنك الدولي. https://blogs.worldbank.org/ar/voices/almyah-msr-llnmw-alakhdr-walshaml-walqadr-ly-alsmwd?cid=ECR_E_NewsletterWeekly_AR_EXT&deliveryName=DM160307
- كلوديا سادوف، أندرس جاجيرسكوج،(نوفمبر 2017، 22) "حلول المياه في منطقة الشرق الأوسط وشمال أفريقيا". https://blogs.worldbank.org/ar/arabvoices/game-changing-water-solutions-middle-east-and-north-africa
- محطة الجزيرة (مارس 2021، 22) في اليوم العالمي.. بالأرقام تعرف عن وضع المياه في العالم العربي. https://1-a1072.azureedge.net/ebusiness/2021/3/22/
- المركز العربي لدراسات المناطق الجافة والأراضي القاحلة (أكساد) (2010). سورية. https://acsad.org
- مكتب الأمم المتحدة لتنسيق الشؤون الإنسانية (أوتشا).https://www.ochaopt.org/ar
- الموقع الإلكتروني لرؤية المملكة 2030 ، المملكة العربية السعودية: www.vision2030.gov.sa
- الموقع الإلكتروني لمبادرتي السعودية الخضراء والشرق الأوسط الأخضر .www.greeninitiatives.gov.sa
- وزارة الفلاحة والصيد البحري والتنمية القروية والمياه والغابات (2022) تغير المناخ والقدرة على التكيف . المغرب.
- وزارة الفلاحة والصيد البحري والتنمية القروية والمياه والغابات(2022) "تغير المناخ والقدرة على التكيف". .https://www.agriculture.gov.ma/ar/programme/changements-climatique-et-resilience
- وزارة الفلاحة والصيد البحري والتنمية القروية والمياه والغابات. https://www.agriculture.gov.ma
- وزارة الموارد المائية والري – الحكومة المصرية، متاح :www.mwri.gov.eg
- وزارة المياه والري الأردنية (2017) "سياسة ادارة الطلب على المياه". الأردن. http://www.mwi.gov.jo
- اليونيسيف (2022) الإجهاد المائي في الأردن- التكاليف الاقتصادية والاجتماعية للإجهاد المائي في الأردن وفرص معالجة الأزمة. https://www.unicef.org/jordan/ar/الإجهاد-المائي-في-الأردن

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