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Economics of climate change

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Introduction:

Climate change has emerged as one of the most pressing and unsettling concerns of our time, drawing significant attention from scholars, experts, and specialized international bodies. It is recognized not only as a major environmental challenge but also as an established scientific reality and a long-term global issue marked by intricate interactions with far-reaching political, social, environmental, and economic consequences. The phenomenon is primarily attributed to excessive human activity and the unsustainable exploitation of natural resources, which have disrupted ecological balance, in addition to various natural factors that further intensify the situation.

The changes confronting the world today pose a critical challenge, particularly in light of the widespread repercussions of global warming across multiple domains of human life. The misuse of natural resources and the accelerating degradation of environmental systems have visibly weakened economic development. Numerous specialized studies—most notably the Stern Review—have highlighted the adverse effects of global warming on economic performance and development prospects. These studies affirm that climate change disproportionately threatens poorer nations, despite their minimal contribution to global greenhouse-gas emissions. This vulnerability stems from the structural fragility of their economies, their heightened exposure to climate-related shocks, and their limited adaptive capacities.

in another side, many economies around the world remain heavily reliant on sectors intrinsically tied to climatic conditions, such as agriculture, fisheries, forestry, and other natural and tourism-based resources. Scientific research further indicates that even energy resources such as petroleum, long regarded as the backbone of modern economies—are increasingly at risk of depletion due to climate change and irrational consumption patterns. Consequently, the global economy finds itself confronted with a genuine challenge that necessitates collective action by all nations, at the very least to develop adaptive strategies. Directly overcoming this phenomenon has become

increasingly implausible from an environmental standpoint, as current climate data indicate that the effects of climate change are likely to persist across several successive centuries.

It should also be noted that environmental issues are inherently global in nature. Phenomena such as global warming and climate change transcend political and geographical boundaries, as pollutants recognize no borders. Climate change thus represents one of the most formidable environmental challenges facing the world at large , and the Arab region in particular. The gravity of the issue lies in the destructive impacts it generates, impacts that the world has already begun to experience in concrete and undeniable ways. It is evident that no Arab country will remain insulated from the repercussions of climate change; on the contrary, the region is projected to be among the most vulnerable to environmental degradation and the potential consequences of this phenomenon. This reality carries profound implications for economic, social, and environmental development and poses a significant obstacle to the trajectory of sustainable development efforts recently pursued in many Arab countries.

To cover all aspects of the topic, The chapters of the printed are organized as follows:

The first chapter addresses general conceptual foundations related to climate change and economics. It examines the basic principles of climate change, explores the phenomenon through the lens of environmental economics, and discusses the relationship between climate change, sustainable development, and economic systems.

The second chapter focuses on the impacts of climate change on the global economy. It encompasses an analysis of the global dimensions of climate-change effects, an economic interpretation of these impacts, and an overview of the international efforts undertaken to mitigate climate change, in addition to highlighting selected national experiences in confronting its repercussions.

Introduction:

The third chapter is devoted to examining the effects of climate change on the economies of Arab countries. It provides an overview of Arab economies, explores environmental challenges and climate-related transformations in the region, and analyzes their impacts. It also reviews the strategies adopted by Arab states to confront climate change, along with an evaluation of the efforts made and the challenges encountered in this regard.

CHAPTER ONE:

GENERAL CONCEPTS ON CLIMATE CHANGE AND ECONOMICS

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SECTION ONE: Fundamentals of Climate Change

SECTION TWO: Climate Change through the Lens of Environmental Economics

SECTION THREE: The Relationship Between Climate Change, Sustainable Development, and the Economy

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Introduction:

The climate changes the world is currently witnessing constitute one of the most pressing concerns for both developed and developing nations. This is largely due to the negative repercussions accompanying these changes, which have affected various human spheres. Moreover, the mismanagement of natural resources and the accelerating degradation of environmental systems have become evident challenges confronting global governance structures. Although the environmental crisis facing the world today is not new, a comprehensive understanding of its dimensions emerged rather late, only after the observable impact of environmental decline on weakening economic development and diminishing its potential became undeniable. Development cannot be sustained on a foundation of depleted natural resources, just as environmental protection cannot be achieved when economic growth overlooks the environmental costs it incurs. Development and environmental preservation are, in essence, two inseparable sides of the same coin.

In this chapter, we address the following points:

1. **Fundamentals of climate change**
2. **Climate change through the lens of environmental economics**
3. **The relationship between climate change, sustainable development, and the economy.**

CHAPTER ONE:
GENERAL CONCEPTS ON CLIMATE CHANGE AND ECONOMICS

Section One: Fundamentals of Climate Change

The topic of climate change is a relatively recent yet increasingly significant field of inquiry that has drawn the attention of numerous researchers and scientists over the last decades of the previous century and throughout the present one. Scholars have made considerable efforts to define the nature of climate change and identify its underlying causes.

Subsection One: The Concept of Climate Change

Numerous concepts and terms intersect with or relate to the notion of climate change. It is therefore essential to clarify their meanings and examine how they connect and overlap with one another. Among these are: climate, weather, the climate system, and climate change. Each of these concepts will be addressed in detail as follows:

Sub-subsection One: Climate

Climate is commonly defined as the average state of weather and its variations over a specified period and within a particular geographical region. It fluctuates from one season to another, from year to year, from decade to decade, or even over longer spans such as glacial eras. Statistically, climate refers to the significant variations that occur over decades or longer, commonly referred to as climate change. (Kharfan, 2009,p.3)

Climate is also traditionally defined as the typical weather conditions prevailing in a given place over a period ranging from several months to thousands or even millions of years. The conventional reference period adopted for climate measurement is thirty years. (Hosani, 2017,p.109)

Sub-subsection Two: Weather

Weather refers to the state of atmospheric fluctuations and the associated phenomena, such as air currents, rainfall, and cyclones, that occur within the lower layers of the atmosphere closest to the Earth's surface. This includes the troposphere, whose height ranges between 8 and 15 kilometers above the ground. (Saleh, 2002, p. 234)

Sub-subsection Three: The Climate System

The climate system is a complex and interactive framework composed of the atmosphere, the Earth's surface, ice and snow cover, oceans and other bodies of water, and living organisms. (UNFCCC U. N., 1992) The term *climate system* thus refers to the totality of processes within the atmosphere, hydrosphere, biosphere, and lithosphere, along with the interactions that link them.

Sub-subsection Four: Definition of Climate Change

The United Nations Framework Convention on Climate Change (UNFCCC) defines climate change as: « *a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere*.» (UNFCCC, 1992)

The Intergovernmental Panel on Climate Change (IPCC) further characterizes climate change as: «*a statistically significant variation in either the mean state of the climate or its variability, persisting for an extended period (typically decades or longer)*.» (Al-Saloum, 2013, p.17)

Despite the multiplicity of definitions, they all converge on the notion that climate change arises from both natural and anthropogenic causes, as well as from internal interactions within the climate system. Accordingly, it is possible to distinguish between internal and external indicators of climate variation.

Subsection Two: Causes of Climate Change

The primary factor governing climate is solar radiation. Variations in the amount of solar energy reaching any given region lead to differences in its climatic conditions. Thus, climate may shift for numerous reasons, as the factors influencing solar radiation, and consequently climate, are many. Any one of these factors may trigger climate change, while the interaction of multiple factors may amplify such changes. Furthermore, anthropogenic activities, especially those contributing to the intensification of the greenhouse effect, accelerate climate change by increasing the concentration of heat-trapping gases in the atmosphere. The principal drivers of climate change include:

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Sub-subsection One: Natural Causes of Climate Change

Several natural factors contribute to climate change, the most significant of which include continental drift, volcanic activity, ocean currents, and variations in the Earth's axial tilt. These factors are outlined as follows:

1. Changes in Solar Activity

Solar variability is believed to drive changes in the Earth's climate. Positive feedback processes may occur, involving the influence of solar winds on cosmic rays, which in turn affect cloud formation or the thermohaline circulation of the oceans. These processes alter sea-surface temperatures and wind patterns (Al-Mazrouei, 2013)

Sunspots, also known as solar blemishes, are dark patches appearing on the Sun's surface with temperatures 2,000 to 3,000 degrees Celsius lower than the Sun's average surface temperature (approximately 6,000°C). The number of sunspots varies over an 11- to 22-year cycle, and their abundance affects the amount of solar radiation reaching Earth.

2. Volcanic Activity

When a volcano erupts, it ejects large quantities of sulfur dioxide, water vapor, dust, and ash into the atmosphere. Although volcanic activity may last only a few days, the immense amounts of gases and ash released can influence climate patterns for years. These particles partially block incoming solar radiation, causing global cooling. Millions of tons of sulfur dioxide may reach the upper layers of the atmosphere (the stratosphere) during a major eruption. There, sulfur dioxide combines with water to form minute droplets of sulfuric acid that can remain aloft for years, acting as reflectors that reduce the solar energy reaching Earth. Stratospheric winds rapidly disperse aerosols eastward or westward across the globe, although their movement toward the poles is much slower)El-Sayed2015 ،. p. 6-7(

3. El Niño and La Niña Phenomena

Interactions between ocean currents and global weather patterns manifest in the periodic phenomena known as El Niño and La Niña. During El Niño events, the westward-flowing ocean current off the coast of Peru weakens or halts, allowing heat to accumulate in the waters of the

southern Pacific Ocean. This stored heat affects global weather patterns and raises average global temperatures. Conversely, when the westward current intensifies, excess heat dissipates across the Pacific, leading to cooler-than-average sea-surface temperatures and subsequently to lower global temperatures. an event known as La Niña (Al-Hussein, 2010, p. 125)

Sub-subsection Two: Human Causes of Climate Change

First: Irrational Energy Consumption

Among the most critical factors adversely affecting the Earth's climate is humanity's excessive use of fossil fuels over an extended historical period. It is well established that the combustion of coal and petroleum results in the emission of sulfur and carbon compounds, which pollute the air and negatively impact human health and that of other living organisms, in addition to causing undesirable climate change. Calculations indicate that, at current levels, the amount of carbon dioxide in the atmosphere will double by the year 2050, which is expected to lead to a rise in temperatures near the Earth's surface. This potential increase in temperature will alter the global distribution of rainfall in an undesirable manner, with studies confirming that rainfall will occur more over seas rather than over land and rivers, thereby triggering drought waves. (Abdel-Zaher, 2015)

The increased use of fossil energy sources (oil and gas) leads to heightened atmospheric pollution, elevated levels of dust and smoke, and consequent effects on the absorption or scattering of solar radiation. This, in turn, causes fluctuations in the Earth's temperature. (Anderson, 1996. p.32)

Second: Pesticides

The use of pesticides such as DDT and chemical fertilizers, which Rachel Carson highlighted in her 1962 book *Silent Spring*, when birds perished and their melodious spring songs disappeared, represents another major factor. This is further compounded by smoke arising from the combustion of conventional fuels in power plants, as well as emissions from vehicles and factories. Pollution also results from various types of fires, some of which are deliberately set each year to expand agricultural land, such as the burning of rice and sugarcane residues in Egypt,

Mexico, and elsewhere, producing bluish-gray clouds. Additional pollution stems from reckless fires ignited to clear land for investment purposes, as occurred in Greece during the summer of 2007, releasing carbon, nitrogen, sulfur oxides, methane, and other gases. (Aboudiya, The End of the World on the Altar of Climate Change, 2018)

Third: Global Warming

The term *global warming* was coined by Swedish chemist Svante Arrhenius in 1896, when he published a theory stating that fossil fuel combustion would increase atmospheric carbon dioxide concentrations, leading to a rise in global temperatures. He concluded that if the concentration of this gas were to double, the Earth's temperature would rise by an estimated 5.4°C (Aqila, 2009, p. 47.)

Global warming is also known as the greenhouse effect or planetary heating. It refers to a cosmic phenomenon in which the Earth's average temperature gradually increases. God endowed the Earth with a natural protective atmospheric system that maintains its average temperature at approximately 15.5–16°C, keeping it suitable for life. However, increased emissions of what are termed greenhouse gases, carbon dioxide, methane, nitrous oxide, and water vapor, trap heat around the Earth, thus contributing to the warming of its surface (Al-Sheikh, 2007. p.47).

1. Carbon Dioxide

Statistics indicate a continuous rise in global carbon dioxide emissions. The Intergovernmental Panel on Climate Change (IPCC) reported in its Fourth Assessment Report that atmospheric CO_2 concentrations have increased significantly. The manufacturing sector produces 50% of global CO_2 emissions, while the remaining 50% stems from changes in land use, deforestation, and biomass burning (see Table 01) (Abdel-Zaher, 2015).

Table (1): A list of selected countries around the world and the quantities of carbon dioxide emissions they produce, according to the estimates of the Fourth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC).

Country	Annual Emissions	% of Global Emissions
Total Global Emissions	27.2 million tons	100%
United States	6 million tons	22%
China	5 million tons	18%
European Union	3.1 million tons	11%
Russia	1.5 million tons	6%
India	1.3 million tons	5%
Japan	1.3 million tons	5%

source : (Abdel-Zaher, 2015)

Carbon dioxide emissions from fossil fuel combustion and industrial processes accounted for approximately 78% of the total increase in greenhouse gas emissions between 1970 and 2010, with a similar percentage recorded between 2000 and 2010. In 2010, fossil-fuel-related CO_2 emissions reached 32 gigatons annually, increasing by an additional 3% between 2010 and 2011, and by a further 1–2% between 2011 and 2012. Among total greenhouse gas emissions, which reached 49 gigatons CO_2 equivalent in 2010, carbon dioxide remained the most significant anthropogenic greenhouse gas, constituting 76% of the total (El-Sayed, 2015. p. 6-7)

CO_2 is primarily produced through the combustion of conventional fuels and land-use changes that expose decomposed organic matter, releasing CO_2 and other greenhouse gases. Cement production and other industrial activities also contribute significantly, with the cement industry alone responsible for roughly 5% of global warming. This underscores the urgent need for the development of environmentally friendly alternatives to cement. (Aboudiya, The End of the World on the Altar of Climate Change, 2018, p. 16.)

2. Methane, Nitrous Oxide, and Ozone

Three additional gases contribute to the greenhouse effect, each accounting for approximately 2%: methane, nitrous oxide, and ozone.

Methane absorbs infrared radiation 20 to 50 times more effectively than carbon dioxide, and human activity has accelerated its concentration increase at a pace faster than CO_2, having more than doubled since the beginning of the industrial era. Fortunately, methane remains in the atmosphere for a relatively short period, about a decade. This is not the case for nitrous oxide, which persists for around 120 years and absorbs radiation 253 times more efficiently than CO_2.

As for ozone, its chemically complex atmospheric layer undergoes constant decomposition and regeneration, making it difficult to assess the extent of human impact on its concentration. It is certain, however, that ozone levels are increasing in the lower atmosphere while decreasing in the stratosphere (above 12 km), forming the well-known ozone hole, an issue distinct from, though related to, global warming (Siama, 2015, p. 34)

Focusing on this matter, the World Meteorological Organization monitored gas emissions and their effects on the ozone layer between 1974 and 1982. This layer, with a thickness of 15–20 km, blocks harmful ultraviolet radiation from reaching the Earth. The organization reported that global temperature has risen by approximately 0.75°C since the pre-industrial era, and it estimates that temperatures will rise by an additional 2°C by 2050 compared to early industrial levels (Al-Saadoun-et-al, 2017)

Carbon dioxide and other greenhouse gases possess the ability to absorb invisible thermal infrared radiation. They function similarly to a greenhouse, allowing visible solar energy to reach the Earth's surface while trapping long-wave thermal radiation emitted by the Earth, thereby increasing the planet's temperature (Rabbo, 2009, p. 6.)

The Third Subsection: Manifestations of Climate Change

Climate change is now an established reality. Global warming has become an indisputable fact, evidenced by the rise in the global average temperature of both air and oceans, the widespread melting of snow and ice, and the increase in the global mean sea level.

Sub-subsection one : Precipitation

The geographical distribution of rainfall across the Earth has been shifting under the influence of greenhouse effects. For thousands of years, the desert has dominated most of North Africa; however, in the near or foreseeable future, aridity, both drought and heat, is expected to extend northward toward Mediterranean countries, the Middle East, and parts of Western Europe, especially southern France. This is the direct consequence of the anticipated global warming caused by greenhouse gases.

At very high altitudes, carbon dioxide emitted from the combustion of coal, gas, and oil reduces the escape of heat into outer space. As a result, surface temperatures rise, which in turn increases the evaporation of ocean water. The growing volume of water vapor is transported by high-altitude winds toward regions that already receive abundant precipitation, making them prone to more intense and destructive floods than those previously recorded.

Thus, some regions will experience acute water scarcity, while others will suffer from devastating floods that destroy crops and dwellings. The danger is amplified by the continuous growth of the global population, expected to reach eight billion within twenty years, and by the increasing concentration of people in large urban centers, making it ever more difficult to meet the water needs of drought-stricken regions and to protect them from flooding. (Lacoste, 2015, p. 7.)

Sub-subsection two: Sea-Level Rise

Rising global temperatures lead to the thermal expansion of ocean waters and to the melting of glacial masses, particularly in the Arctic and Antarctic regions, thereby raising the global mean

sea level. Scientists estimate that sea level rose by approximately 15–20 cm (6–8 inches) during the past century. If this trend continues, several coastal cities and low-lying regions around the world may face serious inundation. (Al-Sheikh h. , 2007, p.60)

Over the past decade, the rate of sea-level rise has accelerated beyond that of the previous thirty years. At the same time, a significant global reduction has been observed in mountain glaciers and seasonal snow cover. (Chan, 2008)

Sub-subsection three: Temperature Rise

Several studies indicate that temperatures in the Northern Hemisphere have increased in the lower atmosphere by about 0.6 ± 0.2°C during the twentieth century, with most of the warming occurring after 1976. Some estimates suggest that the average global temperature could rise by 1.4–5.8°C by the year 2100 compared to 1990 levels. Such rapid warming is expected to trigger regional and global climatic shifts with tangible impacts on natural and human systems, including decreases in precipitation quantities and frequency, increasing tendencies toward drought, and a rise in the number and severity of wildfires. (Rajab, 2014, p. 7)

Scientists have also noted that the rise in minimum nighttime temperatures is largely caused by dense cloud cover, which traps heat emitted from the Earth’s surface and prevents it from escaping to higher altitudes and into space. This phenomenon, known as the greenhouse effect, creates a warming barrier similar to that of glass-covered greenhouses. During cloudy days, soils also retain more moisture, and despite the heavy cloud cover, temperatures may not rise significantly because solar energy is consumed in evaporating and drying the wet soil. (Hariz & Abouwi, 2008, p. 102)

Subsection four : Quantitative Assessment of Climate-Change Scenarios

The estimated magnitude of climate change varies according to the scenarios adopted by specialized climate-modeling institutions. This subsection reviews the principal scenarios used to assess future climatic conditions.

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Sub-subsection one : Scenario Frameworks

A fundamental step in scenario construction is identifying climate-related variables over time and space. These variables must be supported by available data, whether gathered through direct observation, continuous monitoring, or derived from climate models. National meteorological institutions provide local climate data, while global climate datasets can be obtained from the Data Distribution Centre of the Intergovernmental Panel on Climate Change (IPCC). Scenarios are essential tools for understanding regional climate change and the response of ecological systems to these changes.

Climate-change scenarios must meet the following criteria : (Bousbaine, 2015,)

Consistency with established scientific knowledge regarding human influence on the climate system.

Internal coherence, meaning that projected climatic changes must be physically interpretable and scientifically plausible.

The most reliable method for validating scenarios is expert review by regional climatologists, ensuring their alignment with observed and measured climate trends.

Sub-subsection: Climate-Change Scenarios

The Intergovernmental Panel on Climate Change has assessed the current scientific understanding of climate change, its impacts, and strategies for mitigation, using global climate data from its Data Distribution Centre. The expected scenarios are summarized in the following table 2 (Suleiman, 2015, p. 5):

Climatic Variable	Projected Change	Degree of Confidence
Sea-level rise	Accelerated global mean rise of 0.1–0.9 meters by 2100	**Virtually certain**
Temperature rise	Increase of 1.4–5.8°C by 2100, with greater warming at high latitudes and inland regions	**Likely**
Precipitation change	General uncertainty; potential increase at high latitudes and near the equator; the Mediterranean may experience reductions	**Low confidence**
Precipitation intensity	Likely to increase on average, though not all events will be more intense	**Very likely**
Drought	Likely increase across many continental interiors during summer	**Likely**
Flood intensity	Increase expected in some regions	**Likely**
Tropical cyclones	Increased intensity expected in some areas	**Likely**

Source: (Suleiman, 2015, p. 5)

Section Two: Climate Changes in the Light of Environmental Economics

Climate change constitutes a long-term global challenge arising from the intricate interactions between environmental factors and economic conditions. Among the principal catalysts that have strained the relationship between climate and the economy is the pattern of energy use , particularly the reliance on fossil fuels, namely carbon. Many voices have asserted

the inevitability of humanity's need to cease using carbon-based fuels for energy generation, given that carbon emissions represent the primary and most significant driver of ozone layer depletion, a phenomenon intimately linked to global warming.

First Subsection: The Relationship Between Economics and the Environment

Resources form the central axis around which the definitions of both economics and the environment revolve. They also constitute the fundamental basis upon which each concept rests: economics concerns itself with the optimal allocation and utilization of available resources, while the environment refers to the stock of resources accessible at a given moment in time.

Sub-subsection One: The Nature of Economics

Economics is concerned with examining the economic behavior of individuals and societies in activities such as production, consumption, saving, and the exchange of goods and services. It therefore touches upon all aspects of life and is characterized by its breadth and comprehensiveness.

1. Definition of Economics

Wicksteed defined economics as the science that studies the general principles governing resource management, whether for an individual, a household, a firm, or a state, focusing on the methods for minimizing managerial waste (Harbi & Ariqat, 2004, p. 27).

Canon, in his 1928 publication of The Revolution, defined economics as the science concerned with the material dimension of human well-being or the science that studies material welfare (Al-Wadi-et-al, 2007, p. 21).

Adam Smith defined it as the science that examines the causes and mechanisms behind the expansion of a nation's wealth (Yousri, 2007, p. 7).

Drawing on these definitions, economics may be viewed as a body of theories and conceptual models aimed at explaining how wealth is created and distributed within societies, as well as how individuals manage resources, particularly given their inherent scarcity.

2. Economic Resources

From the earliest stages of human existence, individuals recognized that their control over life and livelihood depended on the extent of the material and human resources at their disposal. They understood that their needs were ever-growing, while the planet's resources remained relatively limited. This realization compelled humanity to pursue various paths to expand and develop its resource base, through migration to new territories, warfare, plunder, coercion, enslavement, trade, and commodity exchange.

Humans also established geographical boundaries and enacted laws that affirmed their ownership of resources and excluded others from accessing them. Accordingly, an economic resource may be defined as a stock possessing economic value whose exploitation generates a stream of benefits or satisfaction. This definition indicates that a resource is a quantifiable entity measured at a specific point in time) Salmi2006 ،, p. 11(

3. The Economic Problem

The economic problem is fundamentally rooted in the relative scarcity of available economic resources, regardless of their type or magnitude—when compared with the multiple and ever-renewing human needs they are meant to satisfy. Consequently, the problem persists due to the intrinsic limitation of the resources at hand (Maloukhia, 2009, p. 8)

Sub-subsection Two: The Nature of the Environment

Global concern for the environment has grown markedly, accompanied by increasing calls to devise solutions to environmental problems, given that the continuity and well-being of life are contingent upon the integrity of the environment. Owing to the reciprocal interactions between the environment and living organisms, the need has emerged to study environmental components and the challenges they face.

1. Definition of the Environment

According to Algerian legislation (Law No. 03-10 of 2010), the environment comprises natural, non-living, and living resources, such as air, atmosphere, water, land, animals, and plants,

along with genetic heritage and the forms of interaction among these resources and among natural areas and sites (Hammadi, 2016, p. 9)

The International Organization for Standardization (ISO) defines the environment as «*the surroundings in which an organization operates, including water, air, soil, natural resources, flora, fauna, human beings, and their interrelationships. These surroundings extend from within the organization to the global system*.» (Allab, 2017, p. 4)

From the foregoing, the environment may be defined as the totality of elements that surround us and influence the existence of living organisms on Earth, including water, air, soil, minerals, climate, and the organisms themselves.

2. The Ecosystem

The ecosystem refers to the system governing natural communities composed of all plants and animals that inhabit a particular environment and depend upon it (Al-Faraj, 2007, p. 32)

3. Components of the Environment

- ✓ **The Natural Environment:**

Also known as the physical environment, it consists of four interrelated systems: the atmosphere, the hydrosphere, the lithosphere, and the biosphere. These systems encompass water, air, soil, minerals, energy sources, plants, and animals, all of which are accessible to humans and provide the essential means for survival, such as food, shelter, and clothing.

- ✓ **The Biological Environment:**

An integral part of the natural environment, composed of three fundamental elements: humans, animals, and plants.

- ✓ **The Social Environment:**

This refers to the web of relationships regulating individuals' lives and their interactions with others. It may also be defined as the relational framework that underpins the organization of any human group and governs interactions among its members (Mishan, 2013, p. 26)

4. Environmental Problems

- ✓ Limited resources amid rapid population growth.
- ✓ Depletion of mineral wealth and the resulting pollution during extraction and processing.
- ✓ The production of massive quantities of waste that are difficult to dispose of, leading to contamination of surface and groundwater.
- ✓ Poor planning in project implementation and the absence of environmental impact assessments (Abed & Sfarini, 2003, pp. 22–23)

Sub-subsection Three: Environmental Economics

Environmental economics refers to the discipline that evaluates the theoretical, analytical, and accounting aspects of economic life through environmental measures. Its purpose is to preserve ecological balance within a framework of sustainable growth. Environmental economics brings us closer to sustainable development by enabling more effective integration of environmental and social considerations into economic decision-making processes. (Oweinat, 2008, p. 17) Environmental economics is a branch of human knowledge, specifically of the economic sciences, that examines the efficient allocation of natural resources across generations, both present and future, while addressing all issues related to the environment (Al-Rifi, 2015, p.76-81)

Peace and Turner note that environmental economics is broader and more comprehensive than traditional economics, as it encompasses extensive fields and adopts a holistic vision of economic activities. Some scholars view environmental economics as an alternative to conventional economics, seeing it as being in conflict with its foundational principles. Others, however, regard it as an application and extension of core economic principles, broadening economic thought to include the interrelations between the environment and the concepts of economic science (Al-Nish, 1999, p. 3)

Environmental economics may be divided into two levels: environmental economics at the level of the firm (micro level) and environmental economics at the level of the national economy (macro level) (Youssef, nd; p.17-20)

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First: Environmental Economics at the Micro Level

Micro-level environmental economics constitutes part of the firm's economic system, examining and analyzing the relationship between the firm and the natural environment, the qualitative evolution of the surrounding environment, and the effects of environmental policies on the firm. At this level, environmental economics encompasses the following tasks:

1. Studying and analyzing environmental protection procedures within the firm, their objectives, and their impact on profit maximization.
2. Providing advice and guidance to the firm in ways that align with environmental protection requirements.
3. Contributing to the orientation of production in accordance with environmental directives, regulations, and guidelines.
4. Examining environmental investments aimed at reducing environmental risks.
5. Supplying information on the costs of environmental protection, investment expenditures, the impact of environmental protection on profit-and-loss accounts, and the environmental feasibility of projects.
6. Offering advice, analyzing problems, and studying future prospects for selected sectors of the national economy in light of environmental developments, such as services, transport, industry, environmental protection, trade, and insurance.

Second: Environmental Economics at the Macro Level

Macro-level environmental economics addresses environmental problems at the scale of the national economy. One of its principal objectives is achieving higher levels of sustainable social welfare while maintaining environmental quality at elevated standards.

Its tasks include:

1. Valuing environmental damage in both material and monetary terms, and evaluating environmental improvements resulting from environmental policy within governmental or sectoral activities.

2. Identifying and studying the interrelationships between the environment and macroeconomic objectives, as well as examining linkages between economic and environmental policies.

The functions of macro-level environmental economics include:

Positioning environmental economics as part of the broader field of macroeconomics, concerned not merely with cost allocation at the firm level but with societal and economy-wide costs.

Providing information and expert assessments on which decisions may be based, particularly through:

1. Evaluating environmental damage, environmental protection measures, and their outcomes.
2. Assessing the development of environmental policy instruments—both local and global, and determining the extent to which existing problems have been addressed.
3. Analyzing the impact of environmental protection on macroeconomic objectives, particularly employment and economic growth.
4. Assessing the relationships between environmental and economic policies, given that environmental policy influences other policies such as regional policy, transport policy, energy policy, and resource policy.

Subsection Two: The Relationship Between Economics and Environmental Management

The post–Cold War era has witnessed heightened global attention to environmental issues. Environmental protection and preservation have become defining features of the new international order, and compliance with environmental standards has emerged as a key requirement for exporting to many world markets. As a result, environmental concerns and their management have risen to prominence as political, economic, and social priorities.

Sub-subsection One: The Concept of Environmental Management

With the growing concern for the environment and the emergence of sustainable development, institutions have been compelled to assume responsibility for the environmental

impacts of their activities, whether internal or external. This development, reinforced by expanding environmental legislation and pressure groups, has led to the creation of a dedicated function focused on managing and protecting environmental resources, known as environmental management.

1. Definition of Environmental Management

The concept of environmental management has received multiple definitions. It has been described as a set of administrative activities that determine environmental policy, objectives, and responsibilities, implemented through tools such as environmental goal-setting, performance measurement, and impact control (Haddad, 2016, p. 13)

Abdel-Aziz Mokhimer Abdel-Hadi defines environmental management as «*that branch of public administration concerned with activating and administering the sound foundations of environmental governance, and preventing its distortion or destruction as a result of technological progress*.» This definition emphasizes the preventive dimension of environmental management, particularly through ensuring that production inputs generate outputs with the least possible level of pollution. (Sharaf, 2017, p. 41).

ISO defines environmental management as «*a component of the overall management system that includes the organizational structure, planning activities, responsibilities, practices, procedures, processes, and resources required for developing, implementing, reviewing, and maintaining environmental policy*» (Kafi & Talem, 2017)

From the above, it can be concluded that the concept of environmental management encompasses environmental planning, protection, monitoring, reporting, research, education, conservation, and the rational substitution of resources.

2. Objectives of Environmental Management

The objectives of environmental management may be summarized as follows: (Al-Fiqi, 2008, p.50)

- Assisting institutions in managing and evaluating the environmental effectiveness of their activities, products, and services.
- Enhancing environmental performance in manufacturing and rationalizing the use of economic resources in industrial projects.
- Achieving cleaner production in accordance with both local and international environmental standards.
- Integrating environmental considerations into all production, marketing, financial, and developmental decision-making.
- Ensuring coordination between environmental management functions and other operational activities.
- Applying standardized criteria for environmental quality.

Sub-subsection Two: Environmental Management in Service of the Economy Through Environmental Planning

Environmental planning may be defined as the mechanism through which various strategies aimed at achieving specific environmental objectives are formulated, compiled, and compared. The scope of environmental planning can range from a set of limited activities to the planning of entire regions; regardless of the level of detail, it is generally recommended that the planning approach remain simple. (Al-Fiqi, 2008, p.50)

Environmental planning has gained its importance from the intrinsic significance of environmental protection itself, as it represents one of the most essential tools for safeguarding the environment. Although some had previously argued that environmental protection is a luxury or an impediment to economic growth, real-world experience has proven such assumptions incorrect. Japan, for instance, found that investing in environmental protection led to major advances: access to clean water, adequate sanitation, improved waste disposal, enhanced air quality, and a reduction in fine chemical pollutants, all accompanied by an **80% increase in economic growth** compared to the preceding period.

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By addressing environmental problems, evaluating projects, and ensuring that they do not produce harmful environmental impacts, environmental planning creates a safe and healthy environment that enhances individuals' productive capacity, ultimately contributing to economic growth. Moreover, it supports the achievement of economic savings capable of curbing the depletion of natural resources and rationalizing their use, including energy resources. Environmental planning also encompasses projects that generate economic returns, a notable example being waste recovery and recycling initiatives (Al-Quraishi, 2017, p. 21)

Subsection Three: Global Climatic and Environmental Challenges

Climate change constitutes one of the most pressing environmental and developmental security challenges facing the world today. Effective implementation of policies and programs at multiple levels can help prevent climate change and other environmental pressures that have become drivers of conflict.

Sub-subsection One: The Environment of the Global Economy

Although most nations have achieved high levels of GDP growth, considered economic growth under traditional economic thinking, this has not translated into improved long-term real well-being for populations.

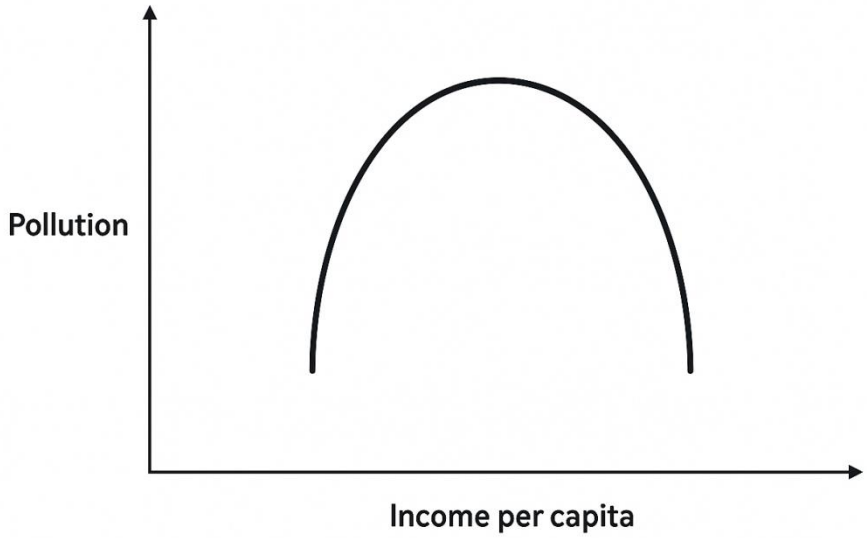
There is no doubt that accumulated material waste negatively affects growth; such accumulation deteriorates environmental quality and influences demographic expansion, particularly under the assumption of a **zero cost** for environmental use, that is, when natural environmental resources are treated as free goods with no value in economic calculations. (Ahmed, 2008)

The economist **Simon Kuznets (1901–1985)** contributed significantly to the study of the relationship between inequality and economic growth. According to **Grossman and Krueger (1994)**, the same analytical framework may be applied to the environmental domain. As economic growth accelerates, environmental pollution initially increases due to the expansion of industrial activity, the primary source of environmental degradation. Eventually, pollution reaches a

maximum threshold. With further development, societies acquire greater awareness and the financial capacity to confront pollution, leading to a gradual reduction in environmental damage.

This relationship is illustrated by the **Environmental Kuznets Curve (EKC)**, which takes the form of an inverted U-shaped curve. (Sara, 2016, p. 19.)

Figure (01): The Environmental Kuznets Curve



Source:(asma, 2008, p. 15)

Sub-subsection Two: Climatic Challenges

Climate change constitutes a global threat that spares no one, placing the responsibility squarely upon all humankind. This occurs within a world distinguished by its financial resources, technical capabilities, and accountability for the greenhouse gases already present in the atmosphere, in addition to the pollution and expanding concrete encroachment afflicting forest and marine wealth, harmful phenomena that impact all life on the planet. These repercussions manifest in the form of climate change capable of determining the future of life on Earth (Zayed, 2016, p.46)

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The sinking of coastlines, destruction of industrial and agricultural infrastructure, population displacement, and the spread of wars, epidemics, and famines (Aboudiya, The End of the World on the Altar of Climate Change, 2018, p. 16.)

The economic sector, across its various domains (tourism, agriculture, water resources, etc.), is the most sensitive to the potential impacts of climate change, whether directly or indirectly. Consequently, any economic process that fails to account for climatic factors becomes non-objective and ultimately futile (Bousbae'en, n.d). Climate constitutes one of the principal factors shaping the prevailing conditions within any region, such as patterns of energy use, vegetation growth, transportation, water supply, and development (Al-Shuaeili & Al-Rubaein, 2010, p.270)

Sub-subsection Three: Environmental Challenges

Migration-related challenges within the context of environmental change require a new strategic approach to policy formulation. Policymakers will need to make decisions that reduce the impact of environmental change on communities. At the same time, migration must be planned for, as achieving substantial improvements in the lives of millions of people becomes more likely when migration is viewed as offering both opportunities and challenges (Foresight, 2011)

Current reality demonstrates that environmental concern is no longer an internal matter confined to any single state; rather, it has assumed a global dimension, as the environment recognizes no political boundaries. The international community is thus compelled to address this issue beyond the limits of states and traditional political frameworks. The critical point here is that large production companies, if they are to truly consider the environmental damage they cause, must comprehensively reassess their production systems. However, this entails enormous costs that major corporations and capital in general are reluctant to bear (Al-Khouli, 2002, p. 22)

The policy of removing subsidies on fossil fuels at the international level carries significant social costs, particularly in developing countries that are striving to combat poverty. As such, this policy does not align with the United Nations' Millennium Development Goals, which call for supplying communities with energy, eradicating poverty, and upholding the principle of common

but differentiated responsibilities. Given that industrialized nations possess the economic capacity and are obligated to take the lead in reducing emissions, it is more appropriate for them to restructure their tax systems and eliminate subsidies on coal in ways compatible with the objectives of the Framework Convention on Climate Change, before calling for the removal of fossil-fuel subsidies globally. Such measures would otherwise shift the burden onto developing nations (Al-Laith, December 2014)

Section Three: The Relationship Linking Climate Change with the Economy and Sustainable Development

The progress and development witnessed by humanity throughout history have brought about an essential and undeniable interconnection between environmental systems and human lifestyles on Earth. This interconnection has in turn cast significant shadows over social and economic dimensions. Climate change, being a multidimensional environmental issue, stems primarily from human activities, especially economic ones. This places the dilemma of sustainable development at the forefront as an integrated solution capable of strengthening societies' roles in realizing social progress and sustainable economic growth.

Subsection One: The Relationship Between Climate Change and the Economy

Numerous studies have explored the nature of the relationship linking climate change and the economy. This relationship has long been obscured by ambiguity, as many economists have underestimated the possibility that economic activities could impact the environment in ways that would exacerbate climate change and produce economic repercussions.

Sub-subsection One: Climate Change from an Economic Perspective

Climate change will undoubtedly affect global financial and economic equilibrium. One of the most difficult lessons drawn from climate change is the impossibility of continuing with the prevailing economic model that promotes growth and excessive consumption in wealthy nations.

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Few challenges rival our entrenched assumptions about progress as profoundly as the intersection of economic activities and consumption with environmental realities (Mersli, n,d, p.258)

The economics of climate change constitutes a branch of economic science concerned with identifying tools capable of enhancing human social welfare while accounting for the impact of climatic challenges on the economy. It is impossible to avoid employing economic tools in developing climate-related policies aimed at mitigating and adapting to these challenges.

The economics of climate change has introduced numerous theoretical and practical challenges that underscore the need for economics to become more open to other sciences. The absence of a genuine market for managing goods in ways that account for the true environmental costs of products and services has led to a lack of economic efficiency. Many researchers attribute this deficiency to the global nature of climate change and the fact that its impacts are more future-oriented than immediate. This raises the issue of the rights of future generations to enjoy social and economic welfare (Tassadit, n,d)

Sub-subsection Two: Climate Change in the Economy

Escalating Economic Losses

Numerous experts have long warned that delays in addressing climate change and its impacts will only exacerbate the problem and significantly increase the cost of remedying it. The 2006 British economic report by **Nicholas Stern** stated that taking action now to curb climate change would cost the global economy *1% of the world's Gross National Product*. However, the risks, problems, and losses resulting from inaction would later cost the world *10% of global GNP* (Achachi, n,d. p,248-249)

Adopting a quota system for greenhouse gas emissions is considered the most significant manifestation of climate change within the economic sphere, whereby economic activity becomes subject to climatic constraints. This system grants a fixed amount of allowable emissions annually, which may not be exceeded, and any unused portion can be sold in the market in the following year (Tassadit, n,d)

Subsection Two: The Relationship Between Climate Change and Sustainable Development

The multidimensional nature of sustainable development—encompassing social, environmental, and economic domains—has given rise to a framework connecting climate change with sustainable development. Since climate change is a comprehensive phenomenon whose impacts do not harm some groups while sparing others, a fundamental question emerges: *To what extent can sustainable development encompass the consequences of climate change across its various dimensions?* Understanding the essence of this relationship becomes essential.

Sub-subsection One: The Nature of Sustainable Development

First: Definition of Development

Development may be defined as a series of transformations and changes affecting various sectors, aimed at revitalizing the national economy and shifting it from stagnation to dynamic activity, thereby increasing productive capacity, improving its performance and mechanisms, and enhancing employment levels. This is achieved through reliance on modern production systems rather than traditional ones, ultimately fostering positive and progressive change.

Second: The Evolution of the Concept of Development

The term *development* has undergone an evolution spanning four principal stages, summarized as follows:

1. Development and Economic Growth

This concept emerged between the end of World War II and the mid-1960s, during which development was equated with economic growth, with strong emphasis on economic aspects. Social considerations received comparatively limited attention, and environmental concerns were largely postponed. At this stage, the human being was regarded primarily as the ultimate objective of development.

2. Development and Distribution

This stage extended from the mid-1960s to the mid-1970s, during which the concept of development broadened to include social dimensions such as combating poverty, unemployment, and inequality, in addition to economic aspects. Here, the human being emerged not only as a goal but also as an instrument of development.

3. Comprehensive Development

This concept appeared from the mid-1960s to the mid-1980s, during which attention to development became distributed across economic, social, and environmental dimensions. The human being was now viewed as the *maker* of development rather than merely a goal or a means **(Ben Zayed, 2016, pp. 47–48)**

Sub-subsection Two: Definition of Sustainable Development from the Economic Side

Sustainable development focuses on the optimal management of resources to achieve the maximum benefits of economic development, provided that resource quality is preserved and that resource use does not diminish real future income. For developed countries, sustainable development implies reducing the level of energy and resource consumption; for developing countries, it entails utilizing resources to raise citizens' living standards, alleviate poverty, and, more broadly, ensure that future per-capita income is not lower than that of the present generation (Ismail, 2015, p. 44)

First: Definitions of Sustainable Development

1. **World Commission on Sustainable Development (1987)**

"Meeting the needs of the present without compromising the ability of future generations to meet their own needs."

2. **United Nations Conference on Environment and Development – Rio de Janeiro (1992)**

"Managing economic resources in ways that preserve or enhance resources and the environment, enabling future generations to lead better and more dignified lives."

From the foregoing, it is evident that there is no universally agreed-upon definition of sustainable development. These various definitions may be summarized as follows:

The prudent management of available natural resources in a manner that ensures economic and social prosperity while meeting the developmental and environmental needs of present and future generations (WSSD, 2002, pp. 59–60)

Second: Characteristics of Sustainable Development

Sustainable development is distinguished by several defining characteristics, which may be presented as follows:

1. **A long-term orientation**, in which the temporal dimension constitutes its essential foundation, complemented by both quantitative and qualitative considerations.

2. **Respect for the rights of future generations** to natural resources.

Prioritizing the fulfillment of basic human needs as a primary objective.

3. **Commitment to preserving the biosphere** and the natural environment in all its components.

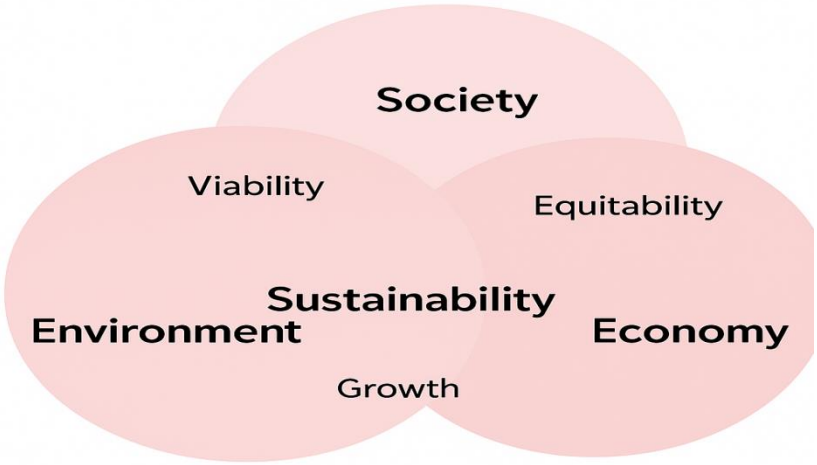
4. **A profoundly human-centered focus**, where human development, particularly the empowerment of the poor, stands as a central aim.

5. **Safeguarding the diversity of societies**, and honoring their cultural, religious, and civilizational specificities.

6. **Dependence on international coordination and integration** in resource utilization and in regulating relations between wealthy and poorer nations (WSSD, 2002, p. 61)

Third: Dimensions of Sustainable Development

Sustainable development encompasses three principal dimensions that are deeply interrelated and mutually reinforcing: figure 2



Source: Researcher's Illustration and Analysis

1. **Environmental Dimension:**

This dimension refers to the capacity of natural and environmental resources to meet present needs without degradation, depletion, or pollution beyond levels that would endanger the ability of future generations to meet their own needs.

2. **Social Dimension:**

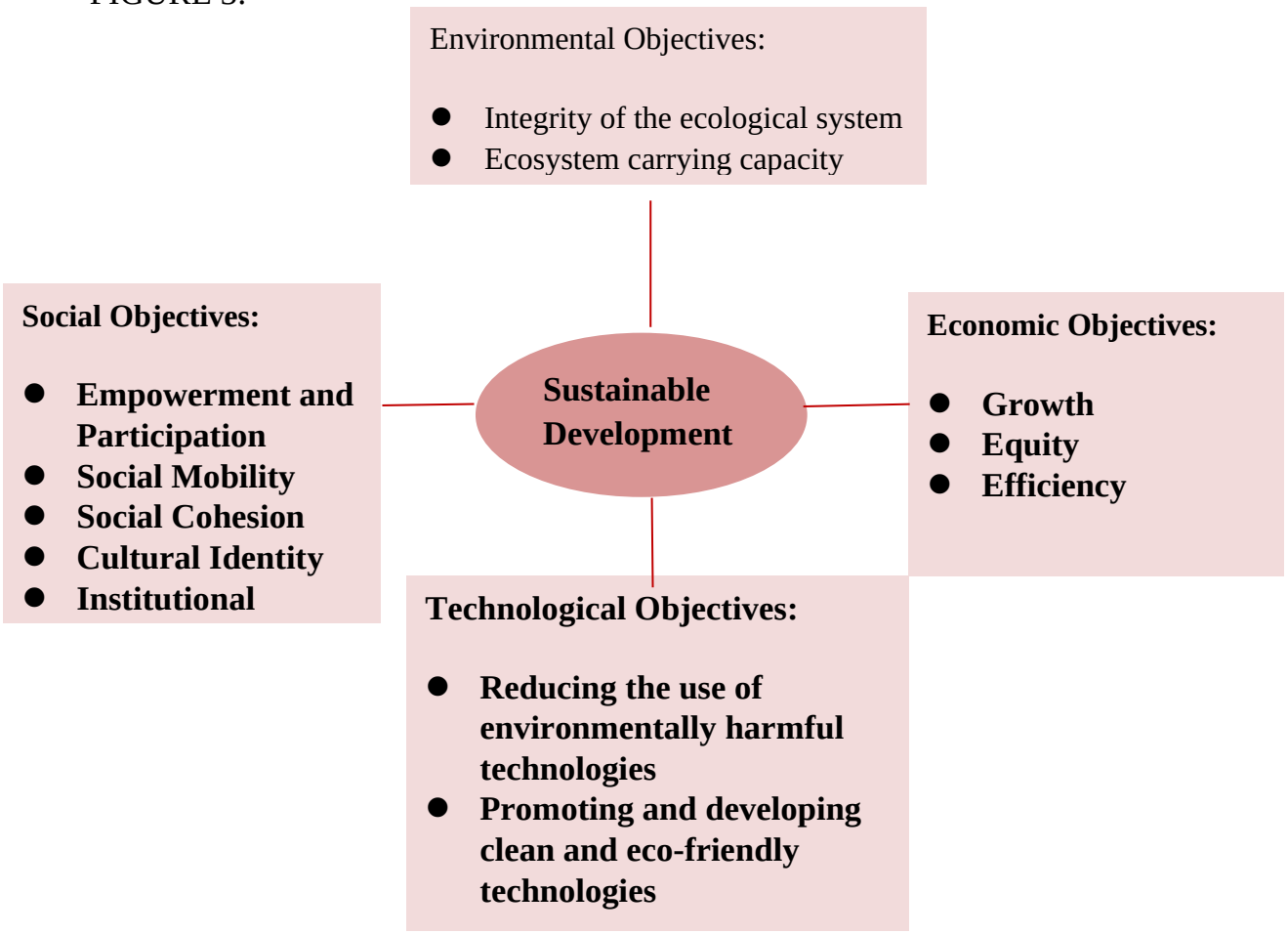
This dimension concerns societal needs, particularly the prioritization of the essential needs of poor and marginalized communities. Achieving this requires the active participation of these communities in the development process.

3. **Economic Dimension:**

The cost of developing contemporary societies must be economically viable in a way that does not shift or accumulate these burdens onto future generations (Ali, 1431–1432 AH, pp. 41–47)

Fourth: The Overall Objectives of Sustainable Development

FIGURE 3:



Source:(ilham, , 2013–2014,, p. 70).

Sub-subsection Two: The Nature of the Relationship between Climate Change and Sustainable Development

Climate change constitutes a serious threat to sustainable development. If greenhouse gas emissions continue without reduction, the world risks losing between **5% and 20% of global GDP** by the beginning of the next century.

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Unless climate change is addressed, it will **reverse the trajectory of developmental progress** and jeopardize the well-being of present and future generations.

Climate protection contributes significantly to strengthening sustainable development. In many cases, climate-related policies, particularly those linked to energy efficiency and renewable energy, are economically viable, enhance energy security, and reduce emissions of local pollutants. Likewise, reducing deforestation can yield substantial benefits for biodiversity conservation, water preservation, and soil protection (Al-Salloum, 2013; p.11)

The two issues are profoundly interconnected: climate change affects development prospects, while development pathways determine the future of the climate (Shili, 2014, p. 54.)

The debate surrounding the relationship between the environment and development has persisted for decades. The issue is complex, involving social, historical, and political dimensions. It was long believed that environmental interests were incompatible with developmental objectives, especially given the challenges that emerged throughout various development phases, the most severe of which is climate change. Environmental protection, particularly from climate-related threats, was often viewed as a constraint on development due to the costs of reducing greenhouse gas emissions.

However, this debate has evolved significantly. International concern over climate issues has become far more evident.

Article 3, paragraph 4 of the United Nations Framework Convention on Climate Change affirms that all Parties have the right to sustainable development and must adopt policies and measures that safeguard the climate system from anthropogenic changes, in a manner appropriate to each Party's specific circumstances. These policies should be integrated into national development programs, recognizing that economic development constitutes a fundamental pillar in adopting climate-mitigation measures (Bousbaa, 2016)

Sub-subsection Three: Sustainable Development Efforts under Climate Change

Achieving sustainable development requires **continuous technological transformation** in industrialized countries to reduce emissions of climate-altering gases. Technological improvement is essential for reconciling developmental goals with environmental constraints; climate change cannot be addressed in isolation from sustainable development principles (Munasingh & Swart, 2004, p. xi)

Development policy-making in any country prioritizes poverty reduction and the promotion of economic growth. Consequently, mitigation or adaptation strategies for climate change offer countries a critical opportunity to reassess their development strategies from a broader perspective. The challenge lies in ensuring that efforts directed toward addressing environmental problems, including climate change, also contribute to **sustained economic growth at the local, regional, and national levels**.

The key is to adopt policies that integrate climate-change management with environmental stewardship in ways that generate tangible benefits for society, benefits reflected in cleaner air, access to safe drinking water, and other essential environmental services. (Beg, Morlote, Davidson, & al, 2002)

Subsection Three: The Relationship between the Economy and Sustainable Development

Sustainable development, in its economic dimension, seeks to achieve economic growth and development that preserve the quality of human life while taking environmental constraints into account. This approach positions economic activity within a framework characterized by social equity, and it emphasizes the valorization of natural resources as the foundation of both production and consumption processes within society.

First Sub-subsection: Economic Growth and Sustainable Development

Economic activity reflects an interactive process among various economic resources. The availability, quality, and modes of utilization of human and natural resources constitute the principal determinants of economic growth potential. However, the mere availability of these

resources is insufficient to achieve comprehensive economic development, which requires significant structural transformations capable of supporting programs and strategies across all fields encompassed by the dimensions of sustainable development (Bousbaïne & Aroub, 5–6 October 2011)

The economy is one of the most important instruments for managing societal life, not only for managing development processes. This reality necessitates the continuous refinement of economic theories to enable societies to derive optimal outcomes from available wealth and opportunities.

Economics contributes to enhancing productive capacity, increasing production levels, and creating new employment opportunities that raise individual and collective income. It also improves overall quality of life. By addressing economic, cultural, and social challenges such as unemployment and the unequal distribution of wealth and income, societies acquire new insights that support the evolution of economic theories, the development of related tools and policies, and the identification of the most effective means of achieving sustainable community development (Rabie, 2015)

1. Sustainable Development and Economic Culture

The prevailing economic culture within a society directly and indirectly shapes the severity of economic, environmental, and social challenges, and consequently influences sustainable development. This culture is reflected in a set of values and convictions that guide behavior and shape particular lifestyles. Among these values are:

- The belief that natural resources exist in limitless abundance, which has encouraged the wasteful use of these resources.
- The assumption that there are no limits to economic growth.
- The belief that «more is better», whereby high rates of economic growth or profit are interpreted as indicators of favorable conditions, an assumption disproven by the accumulation and escalation of environmental problems.

- The perception of industrial activity as a linear process with unacknowledged impacts on the environment and society.

- The belief that the economic system is autonomous, self-contained, and insulated from environmental inputs and externalities, thus neglecting the economic returns generated through the exploitation of natural resources as well as the costs arising from environmental degradation.

Such values have shaped the dominant economic culture. It is evident that some industrialized countries remain unfamiliar with the concept of sustainability, while others lack a genuine understanding of development itself (Gouidri, n,d)

Climate change represents one of the most alarming phenomena confronting the world today as a result of industrial advancement, urban expansion, and the continuous decline of forested areas across nations. It has become an established scientific reality that threatens human life on all fronts, with profound repercussions for both the quality and stability of economic and social systems. This chapter leads to the following conclusions:

- Although climate change stems from multiple causes, its principal driver is the growing concentration of greenhouse gases produced by human activities. This phenomenon manifests in rising global temperatures and increasing sea and ocean levels due to the melting of polar and icebergs.

- Environmental management constitutes a crucial entry point for studying and addressing environmental problems. It enables the identification of causes and remedies in a manner that safeguards the environment and mitigates associated risks.

- The relationship linking climate change, sustainable development, and the economy is highly intertwined. This interdependence becomes evident as soon as each of these concepts is analytically examined. It is impossible to discuss economic activity without addressing the environmental issues generated by economic growth, issues that are, by their very nature, closely tied to the phenomenon of climate change.

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SECTION ONE: Climate Change and Its Global Effects

SECTION TWO: Economic Analysis of the Impacts of Climate Change

SECTION THREE: International Efforts to Address Climate Change

SECTION FOUR: Experiences of Some Countries in Addressing the Impacts of Climate Change

CHAPTER TWO:
THE IMPACTS OF CLIMATE CHANGE ON THE GLOBAL ECONOMY

Introduction

Until a not-so-distant past, the issue of climate change did not receive significant attention within scientific circles, nor among environmental civil society movements, let alone the wider public. This stood in contrast to other environmental phenomena, such as pollution, waste, or the degradation of ecosystems, despite the fact that one of the earliest manifestations of climate change, namely «acid rain», was the spark that first triggered global concern for environmental issues.

A set of decisive factors accelerated society's recognition of the magnitude of the phenomenon and its interwoven dimensions, particularly the increasing frequency of incidents and reports on the impacts of climate change and the severe and expanding damages it produces across all ecological and social systems, threatening the very possibility of sustaining life on Earth within the foreseeable future.

In this context, the convergence of international efforts has become indispensable for governing climate change and strengthening the means to confront it in ways that best serve human life. Accordingly, several agreements were established, all emphasizing the need for all countries, especially developing ones, to adopt policies capable of mobilizing the resources necessary to achieve sustainable economic development. To outline the key themes of this chapter, the following topics are addressed:

1. **Climate change and the global dimensions of its impacts**
2. **Economic analysis of the effects of climate change**
3. **International efforts to confront the impacts of climate change**
4. **Experiences of selected countries in addressing climate change**

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Section One: Climate Change and the Global Dimensions of Its Impacts

The world has no more than ten years to keep global warming within 1.5°C in order to avoid the catastrophic consequences of climate change, according to the most recent warning issued in the latest report of the Intergovernmental

Panel on Climate Change (IPCC). The major impacts of climate change may be summarized as follows:

Demand One: Social and Environmental Impacts Resulting from Climate Change

Numerous studies have examined the geophysical changes associated with global warming, whereas research dedicated to exploring the effects of climate change on health, food security, economic growth, migration, and social transformation has remained relatively limited, until the tangible consequences of this global issue became evident across these social, environmental, and economic variables.

Subsection One: Environmental Impacts of Climate Change

The environmental dimension is the most vulnerable to climate change, given that climate is an integral component of the ecological system. Among the major manifestations of these changes are the following:

First: Changes in the Living Components of the Ecosystem

Climate change harms ecological systems and their biological diversity through several mechanisms:

1. Biodiversity: Climate change profoundly affects all living organisms, as climate regulates the biological cycles of plants and animals, determining the ranges within which they expand and distribute (Juweili, 1999, p. 7)

2. Climate change alters ecological systems, and many species are expected to become extinct as global warming continues. This includes unique and endangered ecosystems such as coral reefs, which are particularly vulnerable to thermal stress and possess limited adaptive capacity. To date, 50% of coral reefs worldwide have suffered shrinkage due to rising sea temperatures (IPCC, 2008, p. 19)

3. The Great Barrier Reef in Australia is projected to lose up to 95% of its living coral cover by 2050 as a result of ocean warming and the chemical changes associated with it (Al-Ayeb, 2005/2006, p. 14)

Ice-based ecosystems have endured devastating impacts from climate change, especially in the Arctic. The decline in biological diversity there

has led to the depletion of forested regions, 20% of which may disappear entirely. (UNDP, 2007/2008, p. 8)

There is clear evidence that climate change is already affecting biodiversity, and will continue to do so. Its consequences for species include:

- Shifts in species distribution
- Rising extinction rates
- Changes in reproductive timing
- Alterations in the length of growing seasons) (CBD, 2007, p. 10)

Agricultural Production

Agriculture both influences climate change and is deeply affected by it. No sector is more climate-sensitive. Agricultural and food production in developing countries will suffer adverse impacts, particularly in regions already exposed to climatic variability, low incomes, and high levels of hunger and poverty.

Although adaptation in the agricultural sector will be costly, it is essential for ensuring food security, reducing poverty, and maintaining ecosystem services. Reducing greenhouse gas emissions from agriculture and enhancing carbon sinks, given that agriculture and forestry naturally absorb carbon, are equally necessary. These sectors currently contribute to climate mitigation and could contribute even further in the future through carbon-sink functions (High-Level-Expert-Forum & World2020, 12–13 October 2009, p. 1)

It is worth noting that the most severe impacts on agriculture will emerge not only from changes in global average climatic conditions but also from the shift of climatic zones themselves (Ouradi, 2011, p. 310)

Second: Changes in the Abiotic Components of the Ecosystem

The various impacts of climate change on these non-living components can be summarized as follow:

1. Rising Temperature

The projected global increase in temperature is attributed to excessive greenhouse gas emissions, primarily carbon dioxide. CO_2 possesses an exceptionally long atmospheric lifetime, often exceeding fifty years. This means that today's temperature rise stems largely from emissions released more than five decades ago, and that temperatures will continue to climb even if emissions were entirely halted today. (Al-Ra'i, September 2016)

According to the Intergovernmental Panel on Climate Change (IPCC), global temperatures are expected to rise by **1.1°C to 6.4°C** by the year 2100 (with **3°C** being the most plausible scenario), compared with levels recorded during the 1990s. Although such figures may appear modest, they acquire significance when viewed historically: during the last Ice Age around 18,000 years ago, global temperatures were only about **5°C lower** than today, yet massive ice sheets extended as far as present-day Belgium, and vast stretches of Europe resembled cold

steppes reaching the Mediterranean, crossed by herds of reindeer. Thus, the IPCC's projections for the next century represent a genuine climatic shift. (Siama, 2015, p. 34)

2. Rising Sea Levels

As global temperatures increase by approximately **2–4°C**, substantial melting of ice in the Arctic and Antarctic is expected. This phenomenon causes sea levels to rise, leading to the inundation of coastal cities, the loss of large tracts of land, and contamination of freshwater and groundwater reserves. During the 1997 Kyoto Climate Change Conference, scientists confirmed that warming of the Earth's surface would produce extreme climatic fluctuations and accelerated polar ice melt, resulting in a **15–95 cm** rise in sea level—an increase that could submerge entire islands and coastlines, trigger floods and destructive thunderstorms in some regions, and cause severe droughts in others.
(Al-Idami, n d. p.14)

3. Intensification of natural disasters

Climate change increases the likelihood of extreme weather events such as droughts, storms, and floods. Disaster records show a rise from **29 major events between 1980–1985** to **357 events between 2005–2009**. Floods constitute **66%** of these incidents, followed by hurricanes and strong winds at **23%**. Although linking any single disaster directly to climate change is challenging due to the randomness of contributing factors, numerous scientific sources associate the growing frequency of natural disasters with global warming. Tropical cyclones accompanied by intense rainfall, for instance, are expected to increase by **20% by 2100**.
(Bousbaa, 2016)

Section Two: The Social Impacts of Climate Change

The consequences of climate change and poverty are unevenly distributed among societies. Individual and social factors shape varying degrees of vulnerability and adaptive capacity.

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1. Impact on Population Growth

Both observed and anticipated effects of climate change pose direct and indirect risks to human life, particularly for children and women. Increased hunger, malnutrition, and related disorders hinder child development and adversely affect pregnant women. (Bousbaine, 2015,)

2. Impact on Security

Global warming exacerbates existing tensions and creates new ones, functioning as a « threat multiplier » and potentially becoming a catalyst for violent conflict and a source of global security instability. Its effects extend beyond community-level human security to national and regional security. Severe climatic events intensify disputes over access to water resources, as seen in heightened conflict between herders and farmers, and the escalation of tensions between Senegal and Mauritania following the disappearance of sections of the Senegal River beneath heavy silt. (Bousbaa, 2016)

3. Increase in Environmental Refugees

Negative impacts such as severe droughts, hurricanes, floods, and the degradation of vital ecosystems force populations to migrate in search of better living conditions. While some migration historically stems from human causes, climate-induced migration, particularly that driven by environmental changes, has been rising sharply. The UNHCR estimates that climate-related displacement will become one of the major humanitarian challenges of the 21st century. (Achachi, n,d. p,248-249)

4. Impact on Health

Climate change affects human health through three primary pathways:

Direct effects, including heatwaves and widespread air pollution, often accompanied by respiratory issues, allergic reactions, and climate-related natural disasters.

Indirect effects linked to ecological and environmental changes.

Socioeconomic effects associated with poverty, displacement, resource conflict (especially over water), and the mental health burdens caused by disasters.

Since the mid-1970s, researchers have observed a resurgence of various infectious diseases, such as malaria, transmitted by vectors like mosquitoes whose reproduction patterns depend on climatic conditions (temperature, humidity, and precipitation). Consequently, a shifting climate has adversely affected fundamental public health requirements (WHO, 2004, pp. 16–19)

Section Three: Economic Impacts Resulting from Climate Change

Climate change can produce both positive and negative economic effects; however, most studies indicate that its current and future impacts on societies and individuals are predominantly negative. The major economic consequences appear across key sectors as follows:

1. Impacts on the Energy Sector

Carbon emissions from fossil fuel consumption account for more than **75%** of total anthropogenic emissions. Given the critical role of energy, particularly fossil fuels, in driving economic development and improving living standards, reducing or abandoning global fossil fuel consumption is currently impractical. Most industrial machinery relies on fossil fuels, and the world's largest corporations operate within this sector, generating substantial profits, especially during periods of soaring oil prices. These corporations possess powerful lobbying influence and will resist transitions that threaten their interests by shifting to clean energy, which remains costly to produce (with the exception of nuclear energy).

At present, renewable energy sources constitute only **7%** of the global energy budget, largely due to government subsidies. Nonetheless, their long-term potential is promising, thanks to gradual technological advances driven by both public and private investment.

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THE IMPACTS OF CLIMATE CHANGE ON THE GLOBAL ECONOMY

According to the International Energy Agency, if countries are to meet commitments to halve carbon emissions by 2030, they must invest approximately **10.5 trillion** (currency value depending on the referenced report) during the period **2007–2030**. (Matlas, 2011–2012, pp. 226–227)

Second: The Impacts of Climate Change on the Agricultural Sector

Climate change leaves a profound mark on food security; without achieving food security, neither social nor economic development can be realized. Climate change also threatens the stability of food prices, as fluctuating rainfall patterns, shifting temperatures, and extreme weather events may, at the beginning of the next century, result in a significant decline in the yields of major staple crops, namely maize, wheat, rice, and soybeans. The repercussions of such a decline on food prices and food security are expected to be far-reaching. (FAO, 2018, p. 8)

Third: The Impacts of Climate Change on the Financial Sector

The financial sector has borne millions of dollars in losses over the past fifteen years as a result of natural disasters induced by climate change, losses that are expected to continue into the future. According to recent studies, these losses may reach approximately 150 billion USD annually over the next decade. The United Nations Environment Programme, in partnership with numerous banks, insurance companies, and investment institutions, stresses that the continued frequency and intensity of natural disasters over the coming years will lead to substantial losses in global financial markets.

Since the severity of extreme climate-related events is associated with significant social costs, investors and reinsurers are increasingly apprehensive. This heightened risk raises demand for climate-risk insurance, which in turn drives interest rates upward, reduces opportunities for capital accumulation, and consequently lowers GDP growth. (Al-Sheikh M. S., 2004)

Fourth: The Impacts of Climate Change on the Tourism Sector

Tourism is generally sensitive to environmental degradation, yet the effects of climate change have introduced further complexities for this sector, particularly in countries that are major tourism destinations. The situation is even more severe in nations where tourism forms the backbone of the economy and constitutes the primary source of foreign currency, most of which are developing countries.

Among the tourism activities that are highly vulnerable to climate change are marine-based tourism, such as coral reef exploration, and tourism in small island states with pristine natural environments. These areas face environmental threats stemming from global warming, the loss of biological diversity, and rising sea levels. (Achachi, n,d. p,248-249)

Subsection Three: The Future Impacts of Climate Change on Countries Worldwide

The future effects of climate change are distributed unevenly across regions of the world. Developing and impoverished nations are the most exposed to the

forthcoming climate-related risks. The following outlines these impacts by geographic region:

Sub-subsection one : Variation Across Geographic Regions

Africa is expected to be the most vulnerable region globally, due to factors such as poverty, illiteracy, and political instability in many of its countries. Asia, likewise, faces significant risks related to climate change. Rising sea levels in this region threaten the livelihoods and lives of millions, while severe shortages of freshwater are anticipated, leading to drastic reductions in food production.

In Latin America and the Caribbean, climate change is projected to worsen soil salinity and expand desertification in humid areas, resulting in reduced agricultural productivity and increasing the frequency of floods. The Arctic region will experience considerable reductions in the extent and thickness of its ice cover.

Meanwhile, the Middle East is expected to witness a sharp decline in river flows, which will reduce arable land and severely diminish agricultural output. These pressures may, in turn, trigger conflicts among states over shared water resources. (Bousbaine, 2015,)

Sub-subsection two : Major Anticipated Impacts on Developing Countries

Projections regarding the effects of climate change in Africa indicate that between **15 and 250 million people** will face water scarcity by **2020**, and that the continent's arid lands will expand by **5 to 8 percent** by **2080**. Climate-change scenarios further predict an increase in drought across many parts of Africa. (FAO, 2018, p. 8)

1. **Intensification of desertification** in Arab countries, commonly known as the problem of desert encroachment. (Mishdan, 2017; p.828)

2. **Spread of numerous diseases** linked to insufficient food quantity and quality.

3. **Former Soviet Union countries** have been exposed to waves of freezing temperatures, heavy snowfall, and occasionally drought, causing wheat production to drop by one quarter. (Al-Rifi, 2015, p.76-81)

4. **Rising sea levels** due to ocean expansion and melting ice. Sea levels could rise by **one meter** this century, threatening **60 million people** and causing more than **USD 200 billion** in asset losses in developing countries alone. Coastal areas around the world are likely to be severely affected. Indonesia, for example, may lose around **2,000 small islands** by 2030.
In the Arab world, sea-level rise threatens coastal communities from **Rabat to Dubai**, as well as fertile agricultural lands in the **Nile Delta** and the coastal regions of the **Levant**.

5. **Population displacement**, particularly in island states such as **Bahrain** and the **Comoros**, as well as in urban areas of **North Africa**. Estimates suggest that **6–25 million people** could be exposed to coastal flooding if temperatures rise by **1–3°C**.

6. **Impacts on public health**: According to the World Health Organization, climate change has contributed to approximately **24% of malaria cases** in developing, particularly African, countries. (Al-Saadoun-et-al, 2017)

Sub-subsection three : Major Anticipated Impacts on Developed Countries

1. Countries located in **high-latitude regions** are expected to benefit initially from increased agricultural output, reduced cold-related mortality, and expanded tourism activity with a temperature rise of **2–3°C**. However, further warming beyond this threshold will adversely affect agricultural productivity and biodiversity.

2. Developed countries situated in **lower latitudes**, such as those in **Southern Europe**, are expected to experience a **20% decline in water resources**, alongside reductions in agricultural productivity. In **California (USA)**, the volume of water generated from snowmelt is projected to fall by **25–40%.**

3. The **United States** is expected to face a **15% annual increase in hurricane wind speeds**, resulting in average economic losses estimated at **0.13% of GDP** by the end of the century.

4. In the **United Kingdom**, with temperatures rising by **3–4°C**, losses resulting from flooding are expected to rise from **0.1% to 0.2–0.4% annually**.

5. **Heat-wave mortality** in Europe is expected to increase significantly, similar to the catastrophic heatwave of **2003**, which caused **35,000 deaths**. (Noufal, 2007. p.16)

Section Two: The Economic Analysis of Climate-Change Impacts

Climate change represents an exceptional challenge to economic systems, as it constitutes the most extensive market failure ever observed. For this reason, the economic analysis of climate-change impacts must adopt a **global perspective** and operate within **long-term horizons**.

Subsection one : The Economic Assessment of Climate-Change Impacts

The urgent need for environmental impact assessment has emerged in recent decades due to environmental degradation and the rise of numerous ecological problems, including climate change, which have increasingly obstructed development efforts in the absence of environmental considerations and safe regulatory frameworks for development planning.

Sub-subsection One: Measuring and Estimating the Impacts of Climate Change

The assessment of the impact of greenhouse-gas emissions on the climate, and the direct environmental consequences of climate change, typically relies on sources external to the statistical system. These include meteorological data, hydrological information, and research-based scientific observations. Although environmental-impact analysis does not usually fall within the domain of official statistics and is considered part of modelling work, official statistics can nonetheless provide significant contributions to this field. (Council, n d)It is worth

noting that economic estimates of climate-change impacts rely on **damage functions** that link the loss of gross domestic product to rising temperatures. A wide array of climate-related effects, expressed in GDP terms,are integrated into these cost estimates through such functions. These effects are generally grouped into two categories: (Al-Hayti)

Market impacts: These include effects on climate-sensitive sectors such as agriculture, forestry, resorts, and tourism; damages to tourist destinations due to sea-level rise; changes in energy expenditures (for heating and cooling); and variations in water resources.

Non-market impacts: These cover effects on health, such as the spread of infectious diseases, worsening water scarcity, pollution, recreational activities (sports, leisure, outdoor activities), and ecological systems, including biodiversity loss and human settlements.

Sub-subsection Two: Assessing Aggregate Damage

In integrated models, climate-related damage is represented through a function dependent on economic variables and a climate-change indicator. This indicator may reflect atmospheric concentrations of carbon dioxide or express the estimated degree of damage in terms of global average monetary units.

These functions are typically calibrated at a few key points. Most studies employ a scenario based on carbon-dioxide concentrations relative to pre-industrial levels. They assume full adaptation to new climatic conditions, thereby isolating damages associated with the level of climate change alone, except for transitional impacts.
Sector-specific damages are not calibrated using comprehensive datasets, but rather based on expert judgment or specialized methods. A reference point is often assigned to current climate conditions (with minimal or zero damage), while an additional reference point may be assigned to a more divergent

climate scenario to provide a third calibration anchor for the function. (Dumas, 2006, p. 43)

These estimates align with several studies evaluating the economic damages of climate change. Lord Stern, former Chief Economist at the World Bank, estimated a **permanent loss in global economic output** of **0–3%** for a temperature increase of **2–3°C**, and **5–10%** for a rise of **5–6°C** under a "business-as-usual" scenario. Furthermore, global consumption is projected to decline by **up to 25%** over the next 200 years.

According to Nordhaus, the share of economic damage from climate change will reach **3% of global output by 2100**, and around **8% by 2200**, assuming current emissions trajectories persist. Average annual damages over the period **2000–2200** are expected to amount to **USD 26 trillion**. (ILO, 2013, pp. 12–13)

Subsection two: The Economic Cost of Climate Change

Environmental damage resulting from economic activity often generates costs that are, in most cases, extremely high and are borne by society. These costs diminish the benefits derived from productive activity and are manifested in the depletion of natural resources and the rate of degradation of the natural environment, namely the problem of climate change, which renders the environment less suitable and more harmful to human health.

Sub-subsection one: Estimating the Economic Cost of Climate Change

Estimating the economic costs of climate change constitutes a necessary entry point for justifying mitigation and adaptation measures and for designing response policies to this phenomenon. It provides a rational basis for decision-makers to evaluate options and select appropriate strategies. Economic studies of climate change contribute to the development of a systematic understanding of potential risks and the degree of vulnerability to them. The literature indicates that the costs of effective measures to confront climate change and reduce its impacts are significantly lower than the harmful economic costs that can be avoided, as well as the potential gains in growth and development that

such measures are likely to achieve.. (ESC, n d)

The costs of these changes may be estimated in the first manner by examining the resource costs of policy measures, including the introduction of low-carbon technologies and changes in land use, when compared with the costs of the alternative scenario of continuing business as usual. This approach provides an upper bound of costs, as it does not take into account response opportunities that involve reductions in demand for high-carbon goods and services.

Secondly, macroeconomic models may be used to explore the transitional impacts across the system toward a low-carbon energy economy. These models can be useful in tracing the dynamic interactions of different factors over time, including the responses of economic systems to changes in prices. However, they can be complex, and their results are influenced by a full set of underlying assumptions.

Based on these two approaches, there is a median estimate indicating that stabilizing greenhouse-gas concentrations at **500–550 parts per million** would, on average, cost approximately **1% of global gross national product per year by 2050**. Although this is a tangible cost, it is broadly consistent with the continuation of development and economic growth, in contrast to an unmitigated path of climate change, which would ultimately impose severe risks that threaten long-term growth.

Sub-subsection Two: Determining the Economic Cost

Before defining an economic cost function that can be used across multiple levels of climate-change analysis, researchers begin from the premise that such a function must pass through critical points identified in global damage assessments. One of the main obstacles lies in the aggregation property of functions built for a specific sector. Consequently, economic cost functions do not follow a single, unified formulation. This is evidenced by the fact that Smith and Hitz (2002) employ a different specification from that used by Tol (1999), especially in the way both construct aggregated functional forms, forms

that, in many cases, take on shapes significantly different from standard cost functions. (UNFCCC, 2006.)

Pending the establishment of mathematically accepted criteria for determining a robust functional form, it may be possible to adopt a function exhibiting key properties that qualify it as a damage function, such as:

- A function that increases, at least beyond a certain threshold, along with climate change.
- Minor (or even negative) losses at low levels of temperature rise.
- Substantial losses resulting from climate change, with the possibility of strongly nonlinear effects.
- Given the disagreements surrounding this function, it is appropriate to embed it within a framework that explicitly accounts for uncertainty.

Subsection Three: Environmental Accounting for Climate Change

Environmental accounting is one of the instrumental tools, both quantitative and monetary, designed to provide current and forward-looking information to decision-makers and environmental policymakers. It supports the identification of environmental and social costs associated with all operations and activities aimed at protecting both human and natural environments from direct and indirect ecological harm.
The primary objective of this research is to present and analyze the methods of environmental accounting relevant to the phenomenon of climate change.

Sub-subsection One: Environmental Accounting

Environmental accounting is intrinsically linked to the environment. Preserving the environment requires capital resources, which manifest as costs whose measurement and classification fall within the scope of environmental accounting. It refers to national accounting

systems expanded to incorporate information on environmental conditions and on the interactions between the economy and the environment.

1. Definition of Environmental Accountin

Some scholars define it as: « T*he identification and measurement of the costs of environmental activities, and the use of such information in environmental*

managerial decision-making, with the aim of reducing or eliminating the environmental impacts of activities and systems, in accordance with the 'polluter pays' principle.» (Karim, n.d; p.134)

2. Rationale for Expanding Interest in Environmental Accounting

The inclination toward disclosing environmental performance and integrating environmental accounting into the broader accounting system has increased significantly. This trend reflects the growing concern of governmental bodies, civil society organizations, international institutions, professional associations, and academic communities with environmental protection and sustainable development, for the following reasons: (Abdel-Wahab, 2012, p. 78) (Dadan, 2012, p. 78.)

- The critical importance of the environment and the need to protect and enhance it through the adoption of sustainable-development approaches.
- Intensifying pressure from various international organizations and institutions.
- The expanded attention of theoretical and empirical studies to environmental issues and the accounting mechanisms that address them.

Sub-subsection Two: Environmental Costs

A United Nations expert group specializing in environmental costs defines these costs as: « *All cost elements associated with reducing losses of services, energy, and available economic resources, in addition to the costs of recycling solid, liquid, and gaseous waste, and the costs of producing environmentally friendly goods. Environmental costs are thus viewed as yielding a positive return, as they identify and measure the costs linked to the available and utilized economic resources.*» (Ali A. H., n.d ; p.53) Another definition describes them as: «*Expenditures borne by the enterprise to comply with environmental regulatory standards, together with costs incurred to reduce or eliminate the emission of harmful substances, as wel*

as additional costs associated with mitigating adverse environmental impacts on employees and on the institution as a whole.» (Hamad, 2014, p. 45)

First: Accounting Measurement of Environmental Costs

1. Definition of Accounting Measurement

According to the International Accounting Standards Committee (IASC), accounting measurement is generally defined as: «*The process of determining the monetary values at which the elements of the financial statements are to be recognized, both in the statement of financial position and in the income statement. This process includes selecting a specific basis for measurement*.» Environmental accounting measurement, however, refers to: «*Determining the values of all cost elements arising from an institution's commitment to particular social and environmental responsibilities, whether such commitments are voluntarily undertaken or mandated by law.*» (Mustafa, December 2017, p. 11)

2. Accounting Disclosure of Environmental Performance

Scholars and researchers have offered various definitions of environmental performance disclosure, some of which focus mainly on its communication channels. One definition describes it as: «*The publication of information that reflects a company's environmental performance through different means, including printed financial and administrative reports, the company's website, conferences, and newspapers.*» (Samad, 2015, p. 68)

Ensuring effective environmental disclosure requires the availability of adequate financial and quantitative data, the identification of all environmentally related costs, and their separation from operational costs. This, in turn, necessitates that accountants possess a sound understanding of the standards governing such cost classifications, and that traditional cost-accounting systems be adapted to clearly incorporate all environment-related costs. (Al-Rifa'i-et-al, 2008; p.288)

Sub-subsection Two: Environmental Accounting for Climate Change.

Given the complex nature of climate change, the substantial costs associated with its mitigation and adaptation, and the ongoing debates surrounding the issue, political decision-making in this domain must rely on sound data. Environmental accounting can play a pivotal role in assisting governments in formulating informed policies related to climate change. Indeed, the global statistical community has recognized that asset and flow accounting provides a valuable framework for monitoring, measuring, and analyzing climate-change dynamics.

Since climate change has been linked to economic development, governments must be able to integrate economic and environmental datasets in order to design policies that support economic growth while ensuring sustainability. Official statistics do not always provide the necessary analytical depth; however, when governments attain a clearer understanding of the drivers, pressures, and impacts of climate change, they can formulate more appropriate policies. Environmental accounting can thus play a central role in the development and implementation of public policy tools and regulatory systems. (USGO, n d; p. 33)

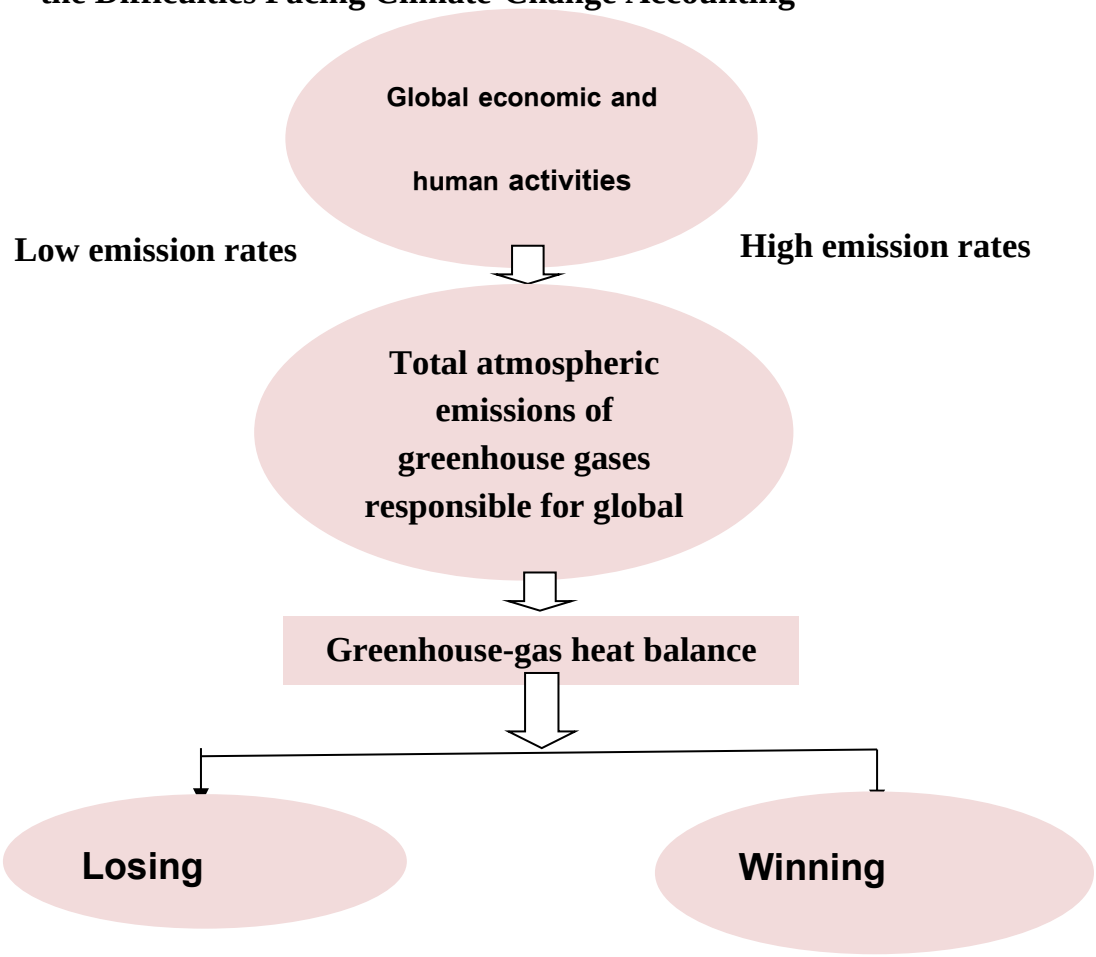
The general framework for environmental accounting for climate change includes two main approaches: (Hassan, n.d., p. 2)

First: Environmental Accounting for Mitigating the Environmental Impacts of Climate Change

The process of climate-change mitigation encompasses all activities and measures undertaken to reduce the magnitude of climate change in the long term. One of the principal mitigation strategies is the reduction of greenhouse-gas emissions, for example, through afforestation and the expansion of forest cover.

The following figure illustrates the relationship between the nature of climate change and the challenges associated with accounting for it:

Figure (4): The Relationship Between the Nature of Climate Change and the Difficulties Facing Climate-Change Accounting



Source:(Ahmed F. , n d)

The figure illustrates that the national output of countries benefiting from climate change tends to rise, whereas it declines in countries adversely affected by such changes.

Accounting for the mitigation of climate-change impacts gives rise to three categories of environmental costs: (Hassan, n.d., p. 5)

1. International Environmental Costs of Climate Change

These costs are estimated on the basis of each country's share under international climate-change agreements. The allocation is determined by the

extent to which each country contributes to the increase in the aggregate global stock of climate-related changes.

2. Regional Environmental Costs of Climate Change

This category reflects the share borne by each country within a specific regional grouping, comprising several states, of the total cost required to reduce emissions affecting climate change or the overall stock of greenhouse gases.

3. Sectoral Environmental Costs of Climate Change

These are the environmental costs incurred by each economic sector, such as the industrial sector, the petroleum sector, or the electricity sector within a given country, to reduce atmospheric emissions that influence the magnitude of climate change.

Second: Accounting for Adaptation to Climate Change

The cost of adapting to the impacts of climate change is shaped by several factors, including the availability of the resources required for adaptation and the level of technological advancement. The more readily available these factors are, the more effective and efficient adaptation policies become. Broadly, the costs arising from the implementation of such policies include the following: (Bousbaine, 2015,)

1. **Ecological Costs:**

These include increases in the cost of natural-asset outputs, such as enhanced productivity in agricultural zones.

2. **Social Costs:**

Costs borne by society as a result of rising global temperatures and the need to adapt to climate-change effects.

3. **Economic Costs:**

Production costs that are necessary and indispensable for manufacturing goods designed to facilitate adaptation to climate change.

Section Three: International Efforts to Protect the Environment and Address Climate Change

This chapter examines the role played by international organizations in confronting climate change, and reviews the key achievements and consensus outcomes produced by global climate negotiations aimed at curbing global warming, advancing mitigation and adaptation policies, and developing mechanisms to confront and manage climate-change challenges.

Subsection One: The Role of International Organizations in Addressing Climate Change

The United Nations and specialized international environmental organizations have shown growing concern for environmental protection, preservation, and the dissemination of environmental awareness among nations. Despite the diversity of these organizations and the differences in their mandates, the common denominator across all their activities is the protection of the environment and the prevention of pollution.

Sub-subsection One: The Role of the United Nations

First: The Role of the United Nations in Environmental Protection

The institutional framework of the United Nations active in the field of environment constitutes one of the most influential pillars of global environmental governance. At its core stands the United Nations Environment Programme (UNEP), the most prominent and effective entity in coordinating international efforts to protect the environment. UNEP has played a decisive role in negotiating environmental agreements, overseeing their implementation, and fostering cooperation among states. In addition, numerous other UN bodies contribute significantly, particularly in research, risk assessment, and the formation of epistemic communities concerned with environmental issues.

The United Nations has also sponsored a series of major global environmental conferences, which helped shape new institutional structures dedicated to addressing environmental challenges. Prominent among these are the World

Commission on Environment and Development and the Commission on Sustainable Development. (Said & Zayani, June 2013, p. 215)

The Charter of the United Nations was signed on 26 June 1945 in San Francisco, comprising 19 chapters that define the organization's structure and mandate. The UN emerged at a moment when the world was reeling from the devastation of the Second World War; unsurprisingly, one of its principal objectives was the maintenance of international peace and security, alongside the adoption of measures to deter threats to global stability. The Charter also affirms the promotion of international relations, cooperation in addressing economic, social, cultural, and humanitarian issues, the advancement of human rights, and the rejection of racial discrimination. (Slimani, 2016)

To confront escalating environmental threats, the United Nations convened numerous international conferences aimed at addressing environmental degradation and forging global solutions capable of mitigating environmental challenges. These efforts culminated in the 1972 Stockholm Conference, which marked the first major global platform for structured debate on environmental issues and was subsequently followed by a series of international environmental summits. (Deir, 2014, p. 86)

Second: The United Nations Environment Programme (UNEP)

UNEP is the first UN institution exclusively dedicated to environmental affairs. Established following the 1972 Stockholm Conference, it was mandated to monitor global environmental conditions and enhance the quality of life for current and future generations. Its membership includes all UN member states. Among UNEP's primary priorities are (Al-Azhar, 2016, p. 81)

1. **Environmental monitoring, assessment, and early warning systems.**
2. **Promoting environmental action worldwide and enhancing public awareness of environmental issues.**
3. **Facilitating the exchange of information related to peaceful technologies and ensuring their availability to the international community**

4. **Providing technical, legal, and institutional advice to governments and regional organizations.**

Sub-subsection Two: The Role of Specialized International Organizations

Environmental protection represents a collective responsibility shared by all nations. As such, states are encouraged to cooperate through a unified international organization or through multiple specialized bodies capable of assessing environmental impacts and facilitating access to the technologies required for environmental protection, entities that can also influence state behavior. Among the most prominent of these organizations are: the Food and Agriculture Organization (FAO), the International Atomic Energy Agency (IAEA), the International Maritime Organization (IMO), and the World Health Organization (WHO).

First: The Food and Agriculture Organization (FAO)

Founded in 1945, FAO's objectives revolve around improving global living standards and nutrition, increasing agricultural production, and preserving natural resources. The organization has established standards and guidelines to protect water, soil, and food from contamination, whether through pesticides or food additives used for preservation. (Al-Awadhi, 1985, p. 65)

In 1972, the FAO Council declared that the Organization's activities aimed at preserving the productive capacity of agricultural resources, forests, and fisheries were inherently connected to the protection of the human environment. Subsequently, FAO signed a Memorandum of Understanding with UNEP to advance international cooperation across multiple areas, including the development of international environmental law at both the institutional and national levels.

Moreover, FAO actively contributed to the preparation of the 1992 United Nations Conference on Environment and Development (UNCED) in Rio de Janeiro and participated in various working groups addressing biological pollution, marine pollution, forests, and agriculture. (Al-Eishawi, 2010, p. 131)

Second: The International Atomic Energy Agency (IAEA)

The IAEA is tasked with protecting the environment from contamination resulting from the use of nuclear energy. It sets international safety standards for radiation protection, and Article 3 of its Statute lists among its functions the adoption of safety measures designed to protect human health and reduce risks to individuals and property.

Examples include the Fundamental Safety Principles for radiation protection. Member states are required to promptly report major incidents so that the Agency may provide the necessary emergency assistance to protect humans and the environment from nuclear radiation. Through these measures, the IAEA plays a crucial role in safeguarding environmental and human well-being. (Hadi, 1986, p. 226)

Third: The International Maritime Organization (IMO)

Established in 1948 and operational as of 17 December 1958, the IMO is responsible for technical maritime matters, improving navigation safety, preventing marine pollution from ships, and drafting relevant international conventions. It also organizes international conferences on maritime affairs.

To enhance its mandate and ensure the implementation of adopted agreements, the Marine Environment Protection Committee (MEPC) was created in 1973. The IMO has endorsed several significant environmental agreements, including:

- The 1954 International Convention for the Prevention of Pollution of the Sea by Oil
- The 1973 International Convention for the Prevention of Pollution from Ships (MARPOL)
- The 1970 Convention establishing an international fund for compensation for oil pollution damage

All of these conventions have since entered into force.) Al-Hassawi23 ‹–24 April 2018, p. 19(

Fourth: The World Health Organization (WHO)

Established in 1945 as a specialized UN agency, the WHO's mission is to ensure that all peoples attain the highest possible standard of physical, mental, and social health, not merely the absence of disease or infirmity.

The Organization provides guidance to states in health matters, issues periodic reports on global environmental conditions, and sets international health standards. It also cooperates with governments to coordinate national health programs and supports developing countries in acquiring the necessary technologies to prevent and control diseases. Furthermore, the WHO runs a special program for the protection of human health in cooperation with the International Programme on Chemical Safety (IPCS), developing initiatives related to pesticide use and emergency responses to infectious disease outbreaks. (Afkarin, 2006, pp. 418–419).

The WHO also analyzes the impacts of waste, climate change, and environmental disruptions on human health, one of its core responsibilities. (World Health Organization [WHO], n.d)

Fifth: The World Meteorological Organization (WMO)

Established in 1947, the WMO succeeded the International Meteorological Organization (founded in 1873) and became a specialized UN agency in 1950. It is the primary body responsible for assessing ozone-layer depletion and its consequences. The Organization conducts global-scale monitoring and played a key role in establishing the Global Environmental Monitoring System (GEMS).

The WMO is also a founding partner, alongside UNEP, of the Intergovernmental Panel on Climate Change (IPCC), contributing significantly to global efforts to understand and address climate change. (Walid, 2017, pp. 63–64)

Subsection Two: International Agreements and Conferences Related to Climate Change and Environmental Protection

In its pursuit of fostering international cooperation for environmental protection, the United Nations has introduced numerous international

agreements and convened a series of international conferences aimed at securing stronger commitments from States worldwide to safeguard the global environmental system, without undermining the aspirations of peoples toward achieving sustainable development.

Sub-subsection One: The First Earth Summit (Stockholm), 1972

The United Nations Conference on the Human Environment, held in Stockholm in 1972, marked the beginning of global governmental concern for environmental issues. The conference resulted in two fundamental documents: the *Stockholm Declaration*, which set forth the basic environmental principles intended to guide public policy, and a comprehensive *Action Plan*. It also led to the establishment of the **United Nations Environment Programme (UNEP)** as the first international environmental agency (Calvert & Calvert, 2022: 424).

Although the Conference acknowledged, in Principle 21, the sovereign right of States to exploit their natural resources in accordance with their own environmental policies, it simultaneously required States, when exercising such rights, to ensure the non-depletion of non-renewable resources and the protection of natural resources through careful planning for the benefit of both present and future generations, as stated in Principles Two and Five. To this end, States were encouraged to «*adopt an integrated and coordinated approach to development planning in order to ensure that development is compatible with the need to protect and improve the environment*» (see Principle 13).

Accordingly, the Stockholm Declaration represented the first attempt to impose limitations on the unrestricted exploitation of natural resources by States, particularly

those of a non-renewable nature, in a manner that would not hinder environmental sustainability. (A) Al-Ghamdi2017 ،, pp. 24–25(

Sub-subsection Two: United Nations Conference on Desertification, 1977

The United Nations Conference on Desertification was held in Nairobi, Kenya, from 19 August to 9 September 1977. The conference brought together approximately 500 delegates from 94 countries to address the issue of

desertification. The United Nations General Assembly entrusted UNEP with addressing desertification as a major environmental challenge, given that approximately 30 million square kilometers, representing 19% of the Earth's land surface, were found to be threatened by desertification. These areas are distributed across nearly two-thirds of the world's countries (about 150 States) and endanger the livelihoods of between 50 and 78 million people out of a total population of approximately 628 million, accounting for 14% of the global population. (Muharib, 2011, p. 58.)

Sub-subsection Three: The Montreal Protocol, 1987

One of the most serious environmental problems is the depletion of the ozone layer, which is located in the stratosphere at an altitude of approximately 10–15 kilometers above the Earth's surface. This layer functions as a natural filter for harmful electromagnetic radiation emanating from the sun, particularly ultraviolet radiation.

According to numerous scientific studies, a 1% reduction in the thickness of the ozone layer results in a 32% increase in ultraviolet radiation reaching the Earth's surface, with profound consequences for all components of the environment. This scientific evidence led to the adoption of the **Montreal Protocol** under United Nations auspices in 1987. The Protocol contains twenty provisions aimed at the gradual elimination of substances that have harmful effects on the ozone layer. Its recommendations included granting an additional 17-year transitional period beyond the specified deadlines to phase out the production and consumption of certain compounds, such as chlorofluorocarbons (CFCs) used in refrigeration systems and halons used in fire extinguishers.

Sub-subsection Four: United Nations Framework Convention on Climate Change, 1992

The United Nations General Assembly was among the first to respond to calls for addressing climate change, initiating formal negotiations through Resolution No. 45/112 of December 1990 for the adoption of a framework

convention on climate change. These negotiations were conducted by the Intergovernmental Negotiating Committee (INC), chaired by the French diplomat Jean Ripert. In February 1991, the Committee held its first meeting to examine the issue, identifying several obstacles to concluding the agreement, including:

- The potential economic consequences of adopting such a convention, particularly the financial burden on States resulting from required industrial sector transformations to reduce emissions;
- Scientific uncertainty regarding the precise impact of greenhouse gases on global climate systems;
- Demands by many developing countries, which were otherwise prepared to approve the convention, for the provision of financial resources and technology transfer mechanisms to enable them to meet implementation obligations;
- Insufficient public awareness and engagement with the issue (Al-Naqeeb, 2013)

The Convention was adopted in 1992 following the Earth Summit, with the objective of stabilizing greenhouse gas concentrations in the atmosphere at levels that would prevent dangerous anthropogenic interference with the climate system, without threatening food production or economic development. It established the principle of *common but differentiated responsibilities*, under which industrialized countries assume a leading role based on their capabilities. The Convention consists of a preamble and 26 articles, and it articulated five guiding principles for international climate action. Article Four specifically addresses commitments grounded in equity, the protection of the climate system for present and future generations, the right to promote sustainable development, the adoption of precautionary measures to reduce greenhouse gas emissions, and adherence to climate adaptation mechanisms. (Dair, 2014, pp. 95–96)

Sub-subsection Five: The Earth Summit on Environment and Development, Rio de Janeiro, 1992

In the first half of June 1992, the Conference on Environment and Development , widely known as the Earth Summit, was convened in Rio de Janeiro, Brazil. It represented the largest global gathering in history, bringing together representatives from 178 countries, including more than 100 Heads of State and Government. The Conference aimed to protect the planet, its resources, and its climate, to establish a global policy for economic growth, and to eradicate poverty while preserving the environment. (Atiya, 2009, pp. 496–497)

The Conference concluded with the signing of three major agreements, endorsed by more than 150 States:

1. **The Convention on Biological Diversity**, aimed at protecting endangered plant and animal species.
2. **The Climate Convention**, addressing climate change and combating rising global temperatures through the reduction of greenhouse gas emissions.
3. **The Forest Principles and Green Areas Treaty**.(Michane**, 2013, p. 24)**

In addition, **Agenda 21** was adopted as a comprehensive action plan endorsed by 182 countries, outlining a detailed roadmap for achieving a sustainable future for the planet throughout the twenty-first century.

Agenda 21 encompasses a wide range of issues organized into forty chapters and 115 areas of action, each representing a critical dimension of a comprehensive strategy required to protect the environment and achieve integrated human development. Thus, Agenda 21 consistently emphasizes sustainable development across all its thematic areas. (Hassouna, 2013, p. 33.)

Sub-subsection Six: The Kyoto Protocol, 1998

Decision-makers in the United States and other countries have sought to establish agreements on measures necessary to reduce greenhouse gas emissions resulting from human activities and to mitigate their potential impact

on the climate. In 1997, the Kyoto Protocol on climate change was adopted and signed by numerous States (though not all ratified it). The Protocol aimed to impose binding obligations on major industrialized countries to reduce emissions of carbon dioxide and other greenhouse gases.

A major point of contention, however, was that large developing countries such as India and China were not subject to the Protocol's binding constraints, despite projections indicating that their energy consumption would surpass that of the United States in the coming years. The Kyoto Protocol proposed mechanisms to encourage developed countries to transfer expertise in energy use and pollution control to developing countries. (Fatha, 2006, p. 127)

Sub-subsection Seven: The Johannesburg Earth Summit, 2002

The Johannesburg World Summit on Sustainable Development, held in September 2002, was one of the largest conferences in history. It was attended by more than 100 Kings, Presidents, and Heads of Government, as well as representatives from 147 countries. The number of registered participants reached approximately 65,000, including 10,000 government officials and 6,000 journalists. Parallel non-governmental forums were also held, attended by around 15,000 participants representing a wide spectrum of interests, ranging from oil companies to bird protection associations. (Doubaihi, 2009, p. 19)

The Summit produced an extensive Plan of Action, the most prominent elements of which included: (Ben-Zayed, 2016, pp. 48–49)

- Acknowledgment of the limited progress achieved since the Rio Conference of 1992;
- Reaffirmation of previous commitments regarding development financing and poverty reduction, which had largely resulted in non-binding recommendations;
- A pledge to halve the proportion of people lacking access to safe drinking water and sanitation by 2015

- Commitments to increase energy efficiency and promote the use of clean energy, supported by an energy access plan targeting more than two-thirds of Africa's population within five years;
- Agreement that by 2020, chemicals should be produced and used in ways that do not harm human health or the environment;
- A commitment by the United States to invest USD 90 million in the following year in sustainable agriculture programs, alongside 17 partnership proposals supported by new funding amounting to USD 2 million;
- A global pledge to reduce biodiversity loss by 2004, including the announcement of a USD 53 million forest initiative by the United States (2002–2005) and the receipt of 32 initiatives amounting to USD 100 million in new funding.

Sub-subsection Eight: The Bali Conference, 2007

In 2007, the United Nations convened the Bali Climate Change Conference in Indonesia in an effort to agree on a roadmap for future negotiations toward a new treaty to succeed the Kyoto Protocol of 1997 and its first commitment period, which ended in 2012. The roadmap called upon ratifying States to reduce their greenhouse gas emissions by at least 5% below 1990 levels. (Hammoudi, n,d)

Sub-subsection Nine: The United Nations Copenhagen Conference, 2009

The Copenhagen Conference on Climate Change was held from 6 to 18 December 2009 under United Nations auspices, with the participation of more than one hundred international negotiators. It was marked by optimism and hope for reaching a comprehensive global agreement addressing climate change and global warming, including: (Khamissi, n,d. p. 18.)

- The immediate and effective implementation of adaptation measures related to climate change, development, and capacity-building in developing countries
- Ambitious commitments to eliminate or significantly reduce carbon emissions, accompanied by initial and long-term financial support for developing countries;
- Agreement on a shared long-term vision for future global reductions in carbon emissions.

Sub-subsection Ten: The Cancun Conference, 2010

The Cancun Conference was held in Cancun, Mexico, from 29 November to 10 December 2010, with the participation of approximately 193 countries and nearly 15,000 attendees, including government delegations, environmental experts, non-governmental organizations, business leaders, and media representatives. At the opening session, United Nations Secretary-General Ban Ki-moon urged States to agree on immediate steps to combat global warming rather than waiting for a comprehensive agreement.

The Conference aimed to: (Ali M. F., 2017, pp. 99-100)

- Reduce emissions responsible for climate change in order to prevent dangerous increases in global temperatures;
- Explore mechanisms for mobilizing financial resources to address anticipated climate-related disasters and to reach solutions acceptable to all parties.

Sub-subsection Eleven: The Durban Conference, 2011

More than 194 Heads of State and Government convened at the United Nations Climate Change Conference in Durban, South Africa, on 28 November 2011. The Conference addressed unresolved issues related to emission reductions and long-term climate commitments. After two weeks of intensive negotiations, delegates failed to reach a binding final agreement. This impasse resulted from developing countries' reluctance to accept binding commitments, given that the Kyoto Protocol imposed obligations only on industrialized nations, while developed countries sought to extend the Protocol into a second commitment period (2012–2015) with binding obligations for all States, commencing

implementation in 2020 with differentiated rates based on historical responsibility, emission levels, and industrial capacity. (Mishan, 2013, p. 26)

Sub-subsection Twelve: The United Nations Doha Climate Change Conference, 2012

Following the United Nations Climate Change Conference held in Doha, Qatar, in December 2012, it was decided to amend the Kyoto Protocol as the only existing legally binding instrument obligating States to reduce greenhouse gas emissions. The Protocol's second

commitment period was set to commence on 1 January 2013 and extend for eight years. Agreement was also reached on the timetable for a comprehensive global climate agreement to be adopted in 2015, along with a commitment to increase ambition prior to 2020. (Farhan, 2009, p. 15).

Sub-subsection Thirteen: The Paris Agreement, 2015

On 12 December 2015, French Foreign Minister Laurent Fabius, acting as President of the Conference, announced the preliminary agreement among the contracting parties on the final text of the new climate treaty. He described the agreement as fair, durable, dynamic, balanced, and legally binding on all parties. The Agreement aims to limit global warming to well below 2°C, with efforts to cap the increase at 1.5°C by the end of the century. It also reaffirmed the commitment of developed countries to mobilize USD 100 billion annually, starting in 2020, to support energy transition efforts in developing countries, alongside the obligation for States to review their national emission reduction plans every five years.

Notably, 175 countries signed the Paris Climate Agreement on 22 April 2016 at United Nations Headquarters in New York. On this occasion, the UN Secretary-General emphasized the urgency of accelerating ratification to ensure the Agreement's entry into force in 2020, following ratification by at least 55 countries accounting for 55% of global greenhouse gas emissions. (Al-Qardawi, July–June 2016, p. 48.)

Section Three: Adaptation and Mitigation Policies to Address Climate Change

Climate change constitutes one of the greatest challenges threatening the planet and its inhabitants. The reduction of greenhouse gas emissions is commonly referred to as **mitigation**, while the response to the impacts of climate change is known as **adaptation**. Although a certain degree of adaptation will be inevitable regardless of the measures taken, there remains a threshold beyond which adaptation may become impossible.

Sub-subsection One: The Concept of Adaptation and Mitigation Policies

First: Adaptation Policies

Adaptation is defined as the adjustment of natural or human systems in response to actual or expected climatic stimuli or their effects, in a manner that moderates harm or exploits beneficial opportunities, as defined by the Intergovernmental Panel on Climate Change (IPCC). (IFRC, n.d., p. 9)

The process of adapting to climate change is inherently dynamic, as is the management of adaptation itself. Political change, including transformations resulting from the Arab Spring, may offer opportunities to enhance civil society participation in managing adaptation processes and to move toward a more inclusive approach to addressing climate change issues and strengthening adaptive capacity. (Werner, (n.d.). (Report No. 64635))

Early action in adopting adaptation measures can significantly minimize future climate-related damage while yielding numerous immediate practical benefits. Conversely, delays in implementing adaptation strategies- particularly delays in financing and supporting adaptation efforts in developing countries- can exacerbate vulnerability. (Al-Nahyan, 2008, p. 40.)

Second: Mitigation Policies

Mitigation policies aim to reduce emissions responsible for global warming or to avoid impacts that are difficult to control. Mitigation refers to policies and measures designed to limit greenhouse gas emissions and may include reducing demand for emission-intensive goods and services, enhancing efficiency gains, and increasing the use of low-carbon technologies. Another mitigation approach involves promoting carbon sinks, namely natural reservoirs that absorb carbon dioxide, such as forests and wetlands. (Gad El-Sayed, 2015, p. 65.)

Mitigation policies may lead to a reduction in the value of fossil fuel assets and a decline in revenues for fossil fuel-exporting countries. However, variations across regions and fuel types persist (high confidence). Most mitigation scenarios are associated with decreased revenues from oil and coal trade for major exporters (high confidence). (Al-Leif, 2014, p. 4)

Sub-subsection Two: Measuring the Impacts of Climate Change and Its Importance for Adaptation and Mitigation

The recommendations issued by the Conference of European Statisticians propose priorities and practical steps across three main areas, notably improving official statistics to support greenhouse gas inventories. Such statistics can provide a substantial portion of the activity data required to calculate greenhouse gas inventories. It is essential to expand and enhance the availability and relevance of official statistics to support climate change impact analysis, as well as mitigation and adaptation efforts.

Achieving these objectives requires a comprehensive review of existing statistical infrastructures, including classifications, definitions, datasets, organizational structures, expertise, products, and services, to enable statistical offices to provide an appropriate context for all climate change-related statistics.

Statisticians are also encouraged to establish new partnerships and exchange knowledge with relevant data producers at both national and international levels. (UNESC, 2009, pp. 11)

Monitoring mitigation measures, utilizing convention funds and mechanisms, and implementing the Kyoto Protocol, particularly in relation to tracking technology transfer, generate increased demand for statistics, classifications, frameworks, and integration systems capable of assessing the impacts of such measures on society, the economy, and the environment. (UNESC, 2009, pp. 11)
(United Nations Economic and Social Council [UN ESC], 2009, p. 11)

Sub-subsection Three: Examples of Mitigation and Adaptation Projects in Response to Climate Change

First: Examples of Emission Reduction (Mitigation) Projects

- Power generation plants
- Energy-efficient buildings
- Electric vehicles

- Solar energy projects for power generation and heating
- Energy-efficient lighting systems that reduce emissions from power plants
- Buses operating on natural gas, fuel cells, or hydrogen

Second: Examples of Climate Change Adaptation Projects

- Dams for river protection
- Shading of streets and markets
- Sand nourishment
- Green roofs and vegetated building façades
- Floodwater drainage systems
- Protective and defensive wall

Section Four: The Cost of Adaptation and Mitigation of Climate Change Impacts

At present, the cost of investment in adaptation and mitigation measures to address the impacts of climate change is considerably lower than the cost that would be incurred in the future. In applied practice, however, significant difficulties arise in estimating these costs, largely due to uncertainties associated with future climatic changes. Such uncertainties complicate the assessment of both the material and non-material costs of climate change impacts. Moreover, the broad temporal horizon required for cost estimation necessitates the use of discounting coefficients that allow for the comparison of present costs with anticipated future benefits. (Mansanet-Batalle, April 2010)

According to all available estimates, approximate adaptation costs are relatively high. The Secretariat of the United Nations Framework Convention on Climate Change (UNFCCC) has estimated that by 2030, developing countries will require between USD 28 and 67 billion to cover the costs of adapting to climate change. This amount represents approximately 0.5 to 0.8 percent of global investment flows, or only 0.06 to 0.21 percent of projected global GDP in 2030. Additional adaptation costs related to anticipated climate change impacts in developing countries are expected to range between USD 10 and 40 billion annually (World Bank, 2006) . Furthermore,

according to the Stern Review on the economics of climate change, failure to take action to mitigate climate change would result in total damage costs equivalent to a loss of at least 5 percent of global GDP annually, with developing countries expected to incur even greater losses (Stern, 2007). Current global financing for adaptation represents only a fraction of the required amount. (Schipper-et-al, 2008, p. 7)

Subsection Four: Mechanisms for Addressing Climate Change

In light of the global awareness of the impacts of climate change, states have shown growing concern for this issue. This concern has manifested in a range

of measures and actions adopted by countries as part of their fundamental and sustained commitment to environmental protection and development. The most significant measures related to climate change are outlined below.

Sub-subsection One: Reducing Carbon Emissions

First: Carbon Markets

Carbon markets constitute a global market for carbon and greenhouse gases. These gases include six specific categories: carbon dioxide, methane, nitrous oxide, and three fluorinated compounds. Collectively, this system is commonly referred to as the «carbon market.»It operates by imposing caps on permissible carbon dioxide emissions. Companies that exceed the allowable limit may purchase unused emission allowances from companies that have successfully reduced their emissions. Conversely, firms that exceed the imposed caps and fail to acquire sufficient allowances are subject to fines for each ton of carbon dioxide emitted beyond the permitted threshold. (Abdel-Jalil, 2011, p. 92)

Second: Carbon Tax

A carbon tax is levied on fossil fuels according to their carbon content. Coal is taxed at a higher rate than oil and natural gas per unit of energy, while non-fossil energy sources are exempt. Since the combustion of fuels containing specific amounts of carbon inevitably produces

corresponding levels of carbon dioxide emissions, the tax on fuel carbon content effectively functions as a tax on carbon dioxide emissions themselves.

(Smith, 2014, pp. 115–116)

Sub-subsection Two: Information and Communication Technologies

Climate change science, which emerged primarily during the past century, has benefited significantly from parallel advances in information and communication technologies (ICTs), including radio technologies, communication standards, and supporting publications. These developments

have enhanced weather forecasting, climate monitoring, disaster impact prediction, detection, and mitigation. The role of ICTs in weather and climate monitoring is particularly evident in the Global Observing System of the World Weather Watch (WWW) operated by the World Meteorological Organization (WMO). This system consists of three integrated components: the Global

Observing System (GOS), the Global Telecommunication System (GTS), and the Global Data Processing System (GDPS (Touria, 2006, pp. 16–17)

Media and communication play a crucial role in managing and addressing crises. In the context of climate change, several general principles govern the use of media and communication in addressing climate-related crises, including: (Mostafa, 2010, p. 28.)

- Accuracy and caution in disseminating information related to natural phenomena resulting from climate change and their destructive impacts.
- Precise formulation of official statements.
- Commitment by media institutions to publishing and broadcasting official statements.
- Objectivity and composure on the part of official spokespersons.
- Dissemination of verified facts once their accuracy has been confirmed.

Sub-subsection Three: Climate Change Governance

The term *climate governance* is used to denote the process of managing all issues related to projects and programs designed to combat the impacts of climate change. This encompasses decision-making processes concerned with the generation, management, utilization, and allocation of climate-related finance, as well as the development of new low-carbon and climate-resilient infrastructure, forest governance, and a wide range of other related domains.

The annual cost to be incurred in the field of climate change since 2020 is estimated at no less than USD 100 billion, while some projections indicate that total financial flows could reach up to USD 700 billion by 2020. The establishment of a new framework for climate governance would contribute significantly to reducing the risks of corruption and ensuring that funds

allocated to combating climate change are spent appropriately and for their intended purposes. (*Global Corruption Report: Climate Change*, 2011.)

Sub-subsection Four: Biodiversity

First: Definition of Biodiversity

The concept of biodiversity refers to the variability among living organisms from all sources, including terrestrial, marine, and other aquatic ecosystems, as well as the ecological complexes of which they are part. It encompasses the following dimensions: (Hamdani, 2009, p. 230)

- **Species diversity:** the variability among living species on Earth.
- **Genetic diversity:** the diversity or variation in genetic material and hereditary characteristics among living organisms.
- **Ecosystem diversity:** the variation among different ecosystems within a specific geographical area.

Second: The Importance of Biodiversity

- Biodiversity plays a vital role in securing livelihoods and is of particular importance for the subsistence of rural poor populations, as well as for the regulation of local environmental

conditions. Functioning ecosystems serve as effective buffers against extreme climatic events, including acting as carbon sinks.

- Agriculture worldwide, ranging from the use of genetic resources to the exploitation of ecosystem services, depends fundamentally on biodiversity. At the same time, agriculture represents the principal driver of genetic erosion, species loss, and the transformation of natural habitats.

- Human health is influenced by changes in biodiversity and ecosystem services. Environmental alterations have led to shifts in disease patterns and increased human exposure to their spread. Moreover, prevailing agricultural practices reliant on intensive global resource inputs (such as water and fertilizers), along with agricultural adaptation strategies, impose substantial pressures on ecosystems, thereby contributing to nutritional imbalances and limiting access to wild food sources. (UNEP, 2007, p.159)

Third: Biodiversity and Its Role in Reducing the Impacts of Climate Chang

The resilience of ecosystems can be enhanced, and the risk of damage to both human and natural systems can be reduced, through the adoption of adaptation and mitigation strategies grounded in biodiversity.

Mitigation is defined as human intervention aimed at reducing sources of greenhouse gas emissions or enhancing carbon sequestration, whereas adaptation to climate change refers to adjustments in natural or human systems in response to climatic stimuli or their effects, with the objective of moderating harm or exploiting beneficial opportunities.

Examples of activities that promote climate change mitigation and adaptation include:

- The conservation and restoration of local ecosystems.
- The protection and enhancement of ecosystem services.
- The management of habitats for threatened species.
- The establishment of refuges and protected areas.

- The designation of protected area networks on land, in freshwater systems, and in marine environments, while taking anticipated climate change impacts into account. (Djoghlaf, 2007, p. 10)

Sub-subsection Five: Toward Renewable Energy

Many climate experts emphasize the urgent need for a rapid and effective reduction of carbon-based gases, particularly carbon dioxide, which accounts for approximately 63% of these emissions. This can be achieved through the substitution of clean fuels for fossil fuels and by expanding the use of renewable energy sources, such as solar, wind, and hydropower, to produce clean energy alternatives to oil, coal, and natural gas. It is worth noting that the share of renewable energy currently does not exceed 3% of total global energy consumption.

Greenhouse gas emissions can be reduced through a combination of measures, some of which require financial investment, while others can be implemented without any direct cost. (Karzam, 2012, p. 5.)

Sub-subsection Six: The ISO 14000 Series of International Standards

First: Definition of the ISO 14000 Series

ISO 14000 refers to a series of international standards for environmental management systems issued by the International Organization for Standardization in 1996. These standards focus on how environmental issues are managed more effectively rather than on prescribing specific levels of environmental performance. They represent an important step toward improving environmental management systems within projects. The ISO 14000 system is characterized by flexible global standards that can be applied across different locations, sectors, and sizes of industrial enterprises. (Sharaf, n,d, pp. 70–71).

Second: Benefits of Obtaining ISO Certification

1. Rationalizing the consumption of energy and natural resources.

2. Reducing waste and limiting pollution.
3. Ensuring compliance with environmental laws and regulations.
4. Gaining international recognition, thereby facilitating access to export markets.
5. Enhancing environmental awareness among company employees.
6. Improving environmental conditions at both national and global levels.
7. Increasing the institution's competitiveness by enhancing its image in the eyes of consumers.

(Abdel Jalil, n,d, p. 109).

Third: The Reality of Implementing ISO 14000 Environmental Management Systems in Developed Countries

Environmental policies implemented in developed countries—such as environmental taxes, environmental legislation, pollution permit markets, and environmental standards, constitute the primary drivers behind the adoption of

ISO 14000 environmental management systems within their institutions. The application of such systems reduces waste and emissions, thereby enabling

institutions to avoid environmental taxes, legal accountability, and pressure from environmental non-governmental organizations. Moreover, the growing environmental awareness among consumers and the emergence of a new category of environmentally conscious consumers «green consumers». who take environmental considerations into account in their purchasing behavior and prefer environmentally friendly products, have encouraged institutions to integrate this dimension into their management practices through the adoption of ISO 14000 systems in order to target this market segment. (Shtouh, 2016, p. 107.)

Section Three: The Experiences of Certain Countries in Addressing the Impacts of Climate Change

Certain regions of the world are particularly vulnerable to the impacts of climate change, especially those prone to natural disasters due to geological or climatic factors, such as tropical Asia and Latin America. Populations in developing countries have become increasingly affected

by disasters as a result of population growth, environmental degradation, and rapid urbanization in disaster-prone areas. This situation necessitates the formulation of local and national policies to address this phenomenon, which will be examined through the presentation of selected national experiences.

Subsection One: The German Experience

Germany is located in Central Europe and is considered one of the world's major industrial countries, a status that has contributed to the emergence and complexity of environmental and climatic challenges. Germany's experience is taken as a model for the developed world, which bears significant responsibility for addressing the risks of climate change, given its role as a primary contributor to the phenomenon. Compared to other European countries, Germany represents a leading example in confronting climate change.

Subsection One: Germany's Commitment to International Agreements

Environmental and climate protection have long occupied a prominent position in Germany. The country is regarded as a global pioneer in climate protection

efforts and plays a highly active role at the international level in ensuring that climate protection remains a permanent item on the global agenda. The German federal government played a central and influential role in the 1992 Earth Summit in Rio de Janeiro, as well as in the adoption of the Kyoto Protocol in 1997. A major achievement was later realized with the conclusion of the Paris Climate Agreement.

In line with the provisions of the Paris Agreement, Germany strives to limit the increase in global temperature to well below two degrees Celsius, promotes cooperation in the fields of energy and environmentally friendly development, and works toward reducing greenhouse gas emissions. Furthermore, Germany strongly advocates effective international cooperation on climate issues and provides support to developing and emerging countries in matters related to climate protection. (*Facts about Germany*, 2018, pp. 78–84).

Sub-subsection Two: The Position of Environment-Based German Industry within the German Economy

Reports addressing climate change in Germany have long found a receptive audience. This has created a genuine opportunity for the economy, and it is no coincidence that Germany accords particular importance to engineering sciences while simultaneously demonstrating a strong commitment to nature and environmental protection. At the same time, Germany leads in patent registration and is among the most advanced countries in recycling practices, waste separation, and the reuse of various types of waste. Consequently, the environmental sector has evolved into a major pillar of the German economy and has become one of the principal drivers of employment.

The German economy is experiencing what may be described as a «green miracle.» Trade in solar, wind, and hydropower technologies generates substantial profits and achieves record export figures, positioning Germany as a global leader in this field. It is projected that sales within the green sector will

reach one billion euros by 2030. German companies hold global leadership positions across numerous areas, including the world's largest production

capacity for wind energy installations and the most advanced technologies in power generation plants, as well as occupying leading positions worldwide in the manufacture of high-efficiency equipment, among many other fields.

Moreover, a consultancy survey covering approximately 1,500 companies operating in environmental technologies analyzed a wide range of studies and concluded that these green technological efforts developed in Germany contribute significantly to the creation of new employment opportunities. By 2020, employment in this sector was expected to surpass that of both the machinery manufacturing and automotive industries. (Talbi & Sahel, 2008, p. 206). (Talbi & Sahel, 2008, p. 206.)

Sub-subsection Three: Germany's Policy in Addressing Climate Change

Germany was among the first countries to adopt a new energy policy beginning in 1996, accompanied by the enactment of environmental and economic legislation aimed at promoting sustainable development. By the end of 2002, Germany had succeeded in reducing carbon dioxide emissions by approximately 18%. Furthermore, the country decided to phase out nuclear reactors by 2025 and replace them with new and renewable energy sources.
(Ibrahimi, 2013, p. 98)

Over recent years, Germany has witnessed rapid growth in the use of renewable energy, positioning itself as a global leader in this field. It possesses the world's second-largest wind energy sector and the second-largest solar energy market. It is anticipated that renewable and alternative energy sources will supply up to 50% of primary energy requirements by 2050. Germany aims to confront climate change, reduce reliance on fossil fuels, and increase the contribution of renewable energy. It has also placed strong emphasis on scientific research in renewable and alternative energy fields. To this end, Germany has adopted policies, legislation, and concrete national plans, both

current and future, characterized by innovation, adaptability, continuity, and, notably, effective implementation in practice. (Abdel-Al-Hassan, April 2018, pp. 27/28.)

Subsection Two: The Chinese Experience

China is located in East Asia and is the most populous country in the world. It is considered one of the most prominent emerging powers facing a genuine dilemma, as environmental degradation and climate change have become core issues that will shape the trajectory of its development model and determine its future as a potential global power.

Sub-subsection One: The Impact of Climate Change and Means of Addressing It in China

Climate change in China has negatively affected its investment climate by undermining its attractiveness to investors. Foreign investment represents one of the key drivers of China's

economic growth, which renders the situation increasingly complex. This challenge is compounded by the severe environmental consequences of rapid economic growth, including the rising frequency of natural disasters, particularly floods, which adversely affect China's development efforts and result in significant material and human losses.

These events not only damage the environment but also threaten public health and human life, hinder sustainable development, and expose national security and social stability to serious risks. It is projected that by 2020, air pollution alone would impose losses equivalent to approximately 1.3% of China's gross domestic product. This is in addition to the continuous decline in vegetation cover and the steady expansion of desertification across wider areas of the country each year.

This alarming situation has prompted both official and non-official actors to urgently seek ways to rectify the major shortcomings in development practices, or at the very least, to redirect future development strategies.

(Mounir Moubarkia, July 2014, pp. 52/60.)

Sub-subsection Two: China's Efforts to Comply with International Agreements

Since 2005, China has adopted a number of decisive measures. Through its State Council, China announced that it had reduced, and would continue to reduce, the carbon dioxide emission intensity per unit of gross domestic

product by 40–42% by the year 2020 compared to 2005 levels. The Chinese State Council emphasized that this measure was a voluntary action undertaken by the Chinese government in accordance with its specific national circumstances. This position is regarded as a major contribution to global efforts to confront climate change and has been widely welcomed as evidence of China's good faith.. (Al-Naqeeb, International Protection against the Phenomenon of Global Warming, 2013, p. 115.)

Subsection Three: China's Intended Nationally Determined Contributions

China officially submitted its nationally determined contribution on 30 June 2015, declaring its intention to participate in reaching a new global climate agreement. It committed to the following targets by 2030, while continuing efforts to achieve peak emissions at an earlier stage:

- Reducing carbon dioxide emission intensity by 60–65% compared to 2005 levels.
- Increasing the share of non-fossil fuels in primary energy consumption to approximately 20%.
- Expanding forest stock volume by around 4.5 billion cubic meters compared to 2005 levels.

According to analyses conducted by leading international energy institutions, such as the U.S. Energy Information Administration (EIA), the International Energy Agency (IEA), and the Massachusetts Institute of Technology (MIT), China's nationally determined contributions represent a major undertaking that significantly supports collective global action on climate change. When China's emissions reach their peak by 2030, this is expected to reduce emissions by approximately 1.7 billion tons, equivalent to about 14% of its total annual emissions. This reduction alone would lead to a substantial

decrease in greenhouse gas concentrations in the atmosphere. (Ali M. F., 2017, pp. 99-100)

Subsection Three: The Experience of the United States of America

The United States is among the countries that have contributed most significantly to the intensification of global warming. Despite this, it has not

consistently taken the necessary measures to confront the phenomenon. It is therefore essential to examine the domestic actions it has undertaken, its stance toward international agreements, and the potential for changes in its climate policy in light of current scientific findings.

Sub-subsection One: The Effects of Climate Change on the United States and Means of Addressing Them

Climate change has caused considerable losses in the United States due to hurricanes and severe cold waves affecting many states. Temperatures are projected to rise significantly, accompanied by an increase in sea levels, which threatens to inundate vast areas of agricultural land. As a result, the agricultural sector, along with other key economic sectors such as energy and transportation, faces substantial financial burdens. In recent years, the forestry sector alone has incurred costs amounting to approximately 3.1 billion dollars to combat forest fires.

To address the impacts of climate change, the United States has adopted several policies aimed at both adaptation and mitigation. These measures were largely initiated following American scientific research that demonstrated the necessity for the state to alter its approach to dealing with climate change.
(Bousbaine, 2015,)

Subsection Two: The Intended Nationally Determined Contributions of the United States

After initially adhering to the objectives of the Framework Convention on Climate Change, the United States responded to calls to inform the Convention's Secretariat of its nationally determined contribution toward achieving the Convention's goals. The United States intends to reduce its

emissions by 26–28% below 2005 levels. It has already committed to implementing specific policies aimed at reducing emissions to meet its 2020 target of a 17% reduction compared to 2005 levels.

In addition, it has developed an additional plan for the period 2020–2025, targeting a further reduction of 9–11% on top of the 17% baseline reduction, as

well as a long-term objective of reducing emissions by 80% or more by 2050. However, all these measures are undertaken at the national level. It remains unclear whether the United States

will participate in climate financing as mandated by the Paris Climate Agreement, particularly in light of statements by former U.S. President Donald Trump indicating that the funds allocated for climate commitments would instead be directed toward improving domestic infrastructure. (Fahd Ali, *2017*, p. 99).

Subsection Three: The Extent of Compliance with International Agreements

The United States is the world's largest emitter of greenhouse gases, accounting for approximately 25% of total global emissions. The energy sector is the most polluting sector, largely due to the reliance on coal, which generates more than half of the country's electricity.

Despite this, the United States has opposed ratifying the Kyoto Protocol, arguing that it conflicts with its industrial interests. As the world's largest industrial, political, and military power, the United States exerts significant influence over global affairs and has played a substantial role in obstructing international efforts aimed at addressing climate change.

Furthermore, the United States has expressed opposition to proposals advanced by developing countries calling for recognition of their need for greater technical and financial assistance from developed nations. However, scientific reports increasingly indicate that the United States must alter its course; otherwise, correcting the deteriorating situation may become too late.

(Dhiba, 2010, p. 48.)

The challenges faced by developed countries as a result of their environmental commitments differ from those encountered by developing countries. Developed states have already succeeded in achieving high rates of economic growth, largely due to their extensive use of fossil energy sources of various types and their relatively low costs. In contrast, developing countries, including Arab states, must continue their struggle to achieve development objectives, while benefiting as much as possible from the experiences of developed countries in the field of economic development.

CHAPTER TWO:
THE IMPACTS OF CLIMATE CHANGE ON THE GLOBAL ECONOMY

According to the provisions of the Framework Convention on Climate Change, countries whose economies are adversely affected by the implementation of the Convention are entitled to claim compensation, pursuant to Articles 48 and 41 of the Convention, as well as Articles 23 and 31 of the Kyoto Protocol. This constitutes a legal basis upon which Arab countries may rely in the event of significant negative impacts resulting from the implementation of the Convention's provisions, particularly where such implementation leads to a reduction in demand for hydrocarbons or a decline in their prices, and consequently to a decrease in the financial revenues on which these countries heavily depend in their annual budgets and development plans.

This chapter has reached the following conclusions:

- Climate change will have profound effects on the environment, with severe and far-reaching damages anticipated in the future. The most critical manifestations of climate change lie in its negative repercussions on economic interests and the serious imbalance it creates in the distribution of resources both within and among states.

- There is an urgent need to conduct economic assessments of the various impacts of climate change, despite the methodological difficulties associated with such evaluations. The cost of delay or inaction inaddressing climate change and its consequences is extremely high and will contribute to the expansion of global tensions and crises.

- The emergence of a picture of the international community making substantial efforts to protect the environment through international institutions and mechanisms, foremost among them the United Nations and its specialized agencies. These bodies have played a significant role in convening international conferences and concluding international treaties aimed at limiting carbon dioxide emissions by proposing solutions and establishing standards and specifications, within the framework of unifying international efforts to protect the environment and confront the risks of climate change.

- The experiences of states in addressing climate change demonstrate that the efforts any country can undertake are primarily linked to the public policies adopted by the state in this field

CHAPTER THREE:

CLIMATE CHANGE AND ITS IMPACTS ON THE ECONOMIES OF ARAB COUNTRIES

Introduction

SECTION ONE**:** The Economies of Arab Countries and Environmental Challenges

SECTION TWO**:** Climate Change in Arab Countries and Its Impacts

SECTION THREE**:** The Strategy of Arab Countries in Confronting Climate Change

SECTION FOUR**:** Assessment of International Efforts to Address Climate Change in Arab Countries and the Associated Challenges

CHAPTER THREE:
CLIMATE CHANGE AND ITS IMPACTS ON THE ECONOMIES OF ARAB COUNTRIES:

Introduction

Environmental problems are characterized by their global nature, as environmental phenomena such as global warming, climate change, and pollution transcend political and regional boundaries. Climate change is considered one of the most serious and pressing environmental challenges facing the world in general, and the Arab region in particular. The gravity of this issue lies in the destructive impacts it generates, which science has already begun to confront in tangible reality. There is no doubt that all Arab countries will not be immune to the effects of climate change; rather, they are among the regions most vulnerable to environmental degradation and the potential repercussions of this phenomenon. This has resulted in significant negative implications for economic, social, and environmental development, and has hindered the path toward sustainable development that many Arab countries have recently sought to pursue.

Through this chapter, the impacts of climate change on the economies of Arab countries will be examined through the following sections:

1. **The economies of Arab countries and environmental challenges**
2. **Climate change in Arab countries and its impacts**
3. **The strategy of Arab countries in confronting climate change**
4. **Assessment of international efforts to address climate change in Arab countries and the associated challenges**

Section One: The Economies of Arab Countries and Environmental Challenges

The Arab economy occupies an important position within the global economy. Historically, the Arab region made a significant and effective contribution to world civilization during the Middle Ages. In the contemporary period, however, it has increasingly become a region affected by conflicts and wars, and a source of threats to global stability. This situation has added new

burdens to those already resulting from the slow growth of the global economy, as the region faces a wide range of challenges across various dimensions, particularly environmental challenges.

Subsection One: Economic Indicators of Arab Countries

The Arab economic structure is characterized by a set of distinctive social and economic features, which can be outlined as follows:

First: Demographic Growth in the Arab World

The total population of Arab countries reached approximately 413 million in 2017, with an average annual growth rate estimated at about 2.2% for the period 2007–2017. This rate, which did not witness a significant decline compared to the period 1990–2000, remains relatively high, exceeding that of all major world regions except Sub-Saharan Africa.

In 2017, the population growth rate reached approximately 2.0% in Kuwait. Higher growth rates exceeding 3.0% were recorded in Qatar, Oman, Bahrain, Libya, and Sudan. Meanwhile, some Arab countries—such as Jordan, Algeria, Djibouti, Iraq, Palestine, Comoros, Egypt, Mauritania, and Yemen—succeeded in achieving lower population growth rates due to their family planning policies, with rates ranging between approximately 2.4% and 2.9%. This indicator declined further to levels between about 1.0% and 1.8% in Tunisia, Syria, Somalia, and Morocco, reaching its lowest levels in the United Arab Emirates and Lebanon, at approximately 0.9% and 0.1% respectively. (AMF, Unified Arab Economic Report, 2018, , pp. 36-37)

Second: Health in the Arab World

The majority of Arab countries have achieved notable progress in expanding access to healthcare services, leading to an increase in life expectancy at birth.

1. Infant Mortality

The infant mortality rate is considered an indicator of the efficiency of healthcare services provided to infants during the early months of life, as well as a reflection of the overall

effectiveness of the health system in a given country. In 2016, the infant mortality rate across Arab countries collectively stood at approximately 20 deaths per 1,000 live births, a figure lower than that recorded in developing countries and at the global level in the same year. The lowest infant mortality rates among Arab countries were observed in the United Arab Emirates, Bahrain, and Saudi Arabia, where the rate did not exceed seven deaths per 1,000 live births in 2016.

The under-five mortality rate in Arab countries collectively reached approximately 24 deaths per 1,000 live births in 2016. This rate exceeded 55 deaths in Djibouti, Sudan, Comoros, Mauritania, and Yemen, and rose sharply to around 133 deaths per 1,000 live births in Somalia.

2. Life Expectancy at Birth

Life expectancy at birth is a composite indicator that reflects multiple factors related to the efficiency of the healthcare system and the standard of living of the population. In 2016, the average life expectancy at birth in Arab countries reached approximately 74 years, compared to 45 years in 1960. It is noteworthy that life expectancy approached or exceeded 70 years in all Arab countries except Yemen, where it stood at 65 years, and Sudan and Comoros, where it reached approximately 64 years. The figure declined further in Mauritania, Djibouti, and Somalia to approximately 63, 62, and 56 years respectively.
(Arab Monetary Fund [AMF], 2018, p. 39)

First: Economic Underdevelopment and Dependency

Economic underdevelopment and dependency are characteristics shared by all developing economies, with specific features emerging in each country according to its particular conditions and economic capabilities. Below are some of the key features that characterize the Arab economy and serve as clear indicators of its underdevelopment and dependency, including the following: (Bouzidi, p. 132)

1. **Poor utilization of economic resources**, reflected in the persistence of unused or underutilized resources. This is particularly evident in unemployment, which constitutes a major

obstacle to economic development, as well as in the weak exploitation of available resources. Examples include inefficient use of agricultural land, failure to adopt modern crop rotation systems, and the limited application of advanced irrigation techniques. These factors have led to declining agricultural yields and weakened the capacity of the Arab agricultural sector to meet domestic consumption needs, resulting in food and agricultural dependency on developed countries.

2. **Weakness of basic infrastructure institutions**, as the establishment and availability of fundamental infrastructure, both service-related and non-service-related, contribute to horizontal expansion in the production process and help reduce the underutilization of available economic resources within society. These institutions can therefore be considered a decisive factor in mitigating the inefficient use of resources suffered by the Arab world. Such basic infrastructure includes roads, buildings, bridges, hospitals, and similar facilities.

3. **Weak integration among Arab economies and their dependency on the capitalist economy**, as at the national level, the specialization imposed on Arab economies has been largely limited to the provision of raw materials. This has resulted in the emergence of two economic sectors: a relatively developed sector that receives support and financing to serve external markets, without adequate attention to domestic markets and their requirements; and an underdeveloped sector oriented toward meeting internal market needs. The first sector is subject to global monopolies and is therefore integrated into the international economy, leading to increased economic dependency on the capitalist system due to the structural imbalance between Arab countries on the one hand and developed countries on the other. At the regional level, the economic dependency of the Arab world is a logical outcome of the similarity of economic activities across Arab countries in general, combined with weak interconnections and imbalances among their economies.

4. **Limited adoption of scientific and technological methods**, where, from a material perspective, this limitation is reflected in the weak capacity of productive institutions to absorb modern technological tools. From an intellectual and scientific perspective, educational policies

in the Arab world remain far removed from achieving the objectives of economic development, as they place greater emphasis on theoretical aspects at the expense of technical and scientific training.

Second: Economic Developments in the Arab World

The gross domestic product (GDP) of Arab countries continued to rise during 2017, reaching approximately USD 2,425 billion (across 20 countries). However, this figure represents a significant decline compared to the estimates of Arab GDP issued for 2016. This decline is largely attributable to the sharp reduction in GDP estimates for Egypt and Sudan at current dollar prices in 2017, resulting from the devaluation of their local currencies against the US dollar. GDP declined by 44.5% in Egypt and by 21.8% in Sudan.

As a reflection of these changes, the Arab countries' share of global GDP decreased from 3.2% in 2015 to 3.1% in 2017. Similarly, their share of the GDP of emerging and developing countries declined from 8.3% to 7.9% over the same period.

The Fund projected an increase in Arab GDP to USD 2,703 billion in 2018, supported by the anticipated improvement in growth across several countries, particularly oil-producing economies, due to rising oil prices and improved revenues. This projection was made despite the continued depreciation of local currencies in key countries, notably Egypt by 17.5% and Sudan by 37.8%. The Fund also expected Arab GDP to continue rising to USD 2,888 billion in 2019. The following table illustrates these developments.

(Ibrahim, 2008, p. 10.)

Table No. (3): Nominal GDP of Arab countries in billion of dollars in alphabetical order

Country	Average 2000–2014	2015	2016	2017	Expectations	
					2018	2019
Jordan	19.7	37.6	38.7	40.1	41.9	
United Arab Emirates	241.8	358.1	357.0	382.6	432.6	455.8
Bahrain	20.5	31.1	32.2	35.3	39.3	41.6
Tunisia	36.5	43.2	41.8	40.0	41.7	42.3
Algeria	131.8	166.0	160.1	167.6	188.3	200.2
Djibouti	0.9	1.7	1.9	2.0	2.2	2.4
Saudi Arabia	436.4	654.3	644.9	686.7	769.9	795.6
Sudan	…	65.9	55.8	45.8	33.2	34.4
Somalia	6.5	6.7	6.8	7.1	7.4	7.8
Iraq	105.0	177.7	170.7	192.4	230.9	250.1
Sultanate of Oman	45.8	68.9	65.9	70.8	81.7	86.5
Palestine	7.1	12.7	13.4	14.5	15.0	15.4
Qatar	92.9	161.7	151.7	166.9	188.3	204.3
Kuwait	103.3	114.6	110.9	120.7	144.5	152.4
Lebanon	29.6	49.9	51.5	54.2	56.7	59.7
Libya	46.9	17.2	18.5	30.6	43.2	51.3
Egypt	168.6	332.1	332.5	236.5	249.5	298.2
Morocco	75.8	101.2	103.3	109.3	118.2	122.5
Mauritania	3.3	4.8	4.7	4.9	5.2	5.2
Yemen	32.2	45.6	36.4	31.3	28.5	34.3
Total Arab Countries	**1,632**	**2,438**	**2,385**	**2,425**	**2,703**	2.888

World	55,247	73,171	73,994	77,779	81,808	86.371
Arab Countries / World (%)	3.0	3.3	3.2	3.1	3.3	3.3
Developed Countries Group	38,229	44,388	45,344	47,029	48,724	50.613
Emerging and Developing Countries Group	17,018	28,783	28,650	30,750	33,084	35.757
Arab Countries / Emerging & Developing Countries (%)	6.9	8.5	8.3	7.9	8.2	8.1

Source: (International Monetary Fund (IMF-November 2018), 2018)

Based on the table, it can be observed that in 2017, gross domestic product remained highly concentrated in six countries, Saudi Arabia, the United Arab Emirates, Egypt, Iraq, Algeria, and Qatar, with a combined value of USD 1,833 billion, accounting for 75.6% of the total Arab GDP.

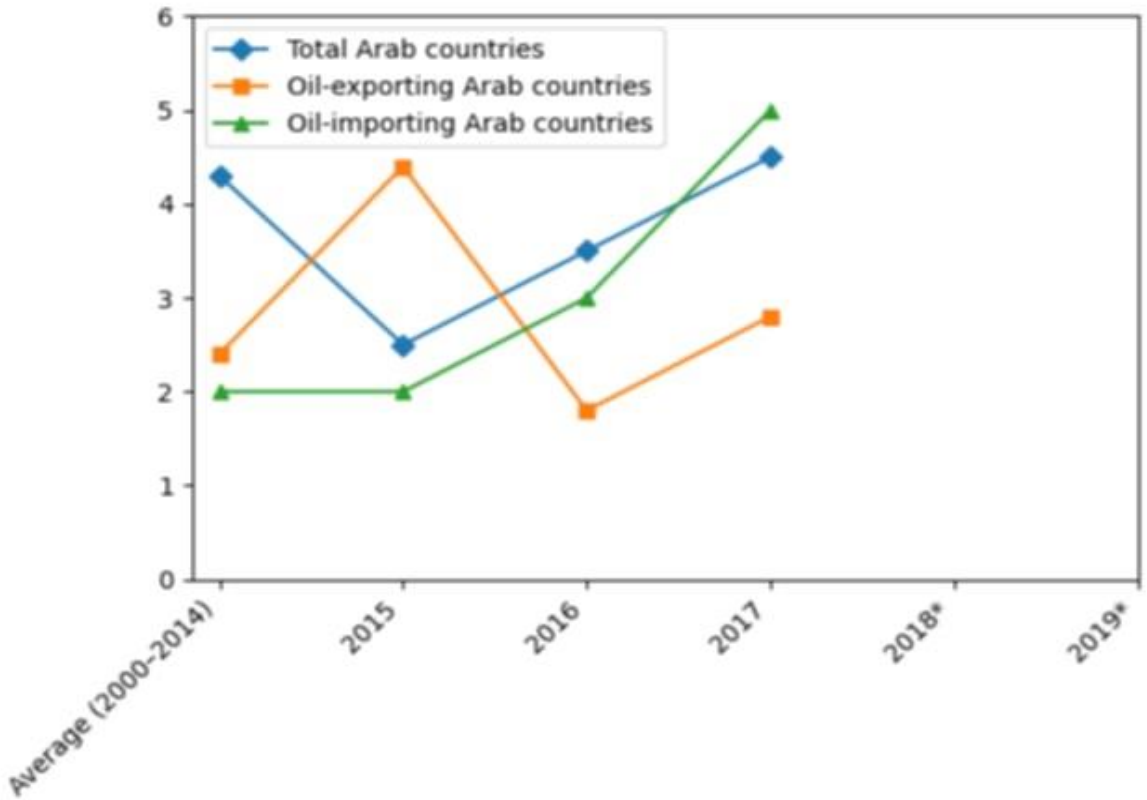
Overall GDP continued to grow in 2017; however, the growth rate declined (average of 20 countries) to 1.3%, compared with 3.3% in 2016. This performance also fell below the International Monetary Fund's projections of 2% for the same year.

This modest growth was the net result of strong positive growth in a number of countries, most notably Libya, which recorded a substantial surge of 64%, driven by the resumption of oil production at previously suspended fields. Djibouti followed with a growth rate of 6.7%, while Egypt and Morocco achieved growth rates of 4.2% and 4.1%, respectively. In contrast, eleven countries recorded moderate growth rates ranging between 1.4% and 3.8%. Meanwhile, five countries, predominantly oil-producing economies, namely Yemen, Kuwait, Iraq, the Sultanate of Oman, and Saudi Arabia, experienced negative growth rates ranging from –5.9% to –0.9% during the same year, reflecting contractions in their economic output.

Arab economic growth in 2017 remained below the global growth rate of 3.7% and lower than the growth rate recorded by emerging and developing economies, which stood at 4.7%. For the first time since 2000, the Arab growth rate fell below that of advanced economies, which reached 2.3%.

The Fund projected an acceleration in Arab GDP growth to 2.8% in 2018, with all Arab countries expected to record positive growth except Yemen and Sudan, followed by a further increase to 3.9% in 2019. This improvement reflects the continued recovery in global oil prices, as the average OPEC reference basket price rose from USD 40.8 per barrel in 2016 to USD 52.4 per barrel in 2017, and further to USD 71.2 per barrel in 2018. These trends are illustrated in Figure (5), which summarizes the foregoing developments.

Figure (5): Economic growth rate in Arab countries, percent



Source: (AMF, Unified Arab Economic Report, 2018,)

Section Three: Arab Economic Relations

First: Intra-Arab Trade

As a result of the continued decline in global oil prices, the total value of Arab merchandise exports decreased significantly in 2016, recording a decline of approximately 7.0%, to reach USD 796.4 billion, compared with about USD 856.6 billion in 2015. This decline reduced the share of Arab exports in total world exports to approximately 4.7% in 2016, compared with 5.2% in 2015.

Likewise, the total value of Arab merchandise imports fell by around 6.5%, amounting to USD 795.8 billion in 2016, compared with approximately USD 850.7 billion in 2015. This contraction is mainly attributed to weaker domestic demand, resulting from the reduction of public spending by a number of Arab countries, in addition to the measures adopted by some countries in response to pressures on local currency exchange rates amid declining foreign exchange revenues.table nO **(4):**

Item	**Value (USD billion)**					**Annual Growth Rate (%)**					**Annual Growth Rate (2012–2015) (%)**
	2012	2013	2014	2015	2016	2012	2013	2014	2015	2016	
Arab Exports	1,321.7	1,311.1	1,243.9	856.0	796.4	8.9	–0.8	–5.1	–31.1	–7.0	–13.5
Arab Imports	815.9	858.2	900.7	850.7	795.8	8.0	5.2	5.0	–5.6	–6.5	1.4
World Exports	18,400.0	18,784.0	18,935.0	16,482.0	16,843.3	0.6	2.1	0.8	–13.0	2.2	–3.6

World Imports	18,608.0	18,874.0	19,024.0	16,766.0	17,169.9	0.7	1.4	0.8	–11.9	2.4	–3.4
Share of Arab Exports in World Exports (%)	7.2	7.0	6.6	5.2	4.7	…	…	…	…	…	…
Share of Arab Imports in World Imports (%)	4.4	4.5	4.7	5.1	4.6	…	…	…	…	…	…

Source: Annex on Arab trade data: Arab Monetary Fund; global trade data: International Monetary Fund or World Trade Organization

Preliminary data

3. Position of Arab Trade in Global Foreign Trade (2015)

The share of total Arab exports in global exports declined to approximately 5.1% in 2015, compared with the previous year. This outcome reflects the rise in the value of global exports alongside a contraction in total Arab exports.

Conversely, the share of Arab imports increased to about 5.0% in 2015 compared with the preceding year. (Talbi W. , 2017, p. 33.)

Table No. (5) Contribution of Arab foreign trade to total world trade for the year 2015

Item	Total Exports		Total Imports	
	Value (USD billion)	% of World Total	Value (USD billion)	% of World Total
Arab Countries (Total)	832.5	5.1	830.9	5.0
World Total	16,482.0	100	16,766.0	100

Source: Author's calculations based on the Arab Monetary Fund, 2015, Chapter Eight, p. 03.

3. Commodity Structure of Intra-Arab Trade

Regarding the commodity composition of intra-Arab exports, the decline in the share of mineral fuels and other minerals, as well as agricultural commodities, continued in 2016. In contrast, the share of manufactured goods increased within total intra-Arab exports.

In line with persistently low global oil prices in 2016, the share of mineral fuels and other minerals in intra-Arab exports declined to approximately 15.9%, compared with 18.2% in the previous year. Similarly, the share of agricultural commodities fell from 20.3% in 2015 to around 19.8% in 2016.

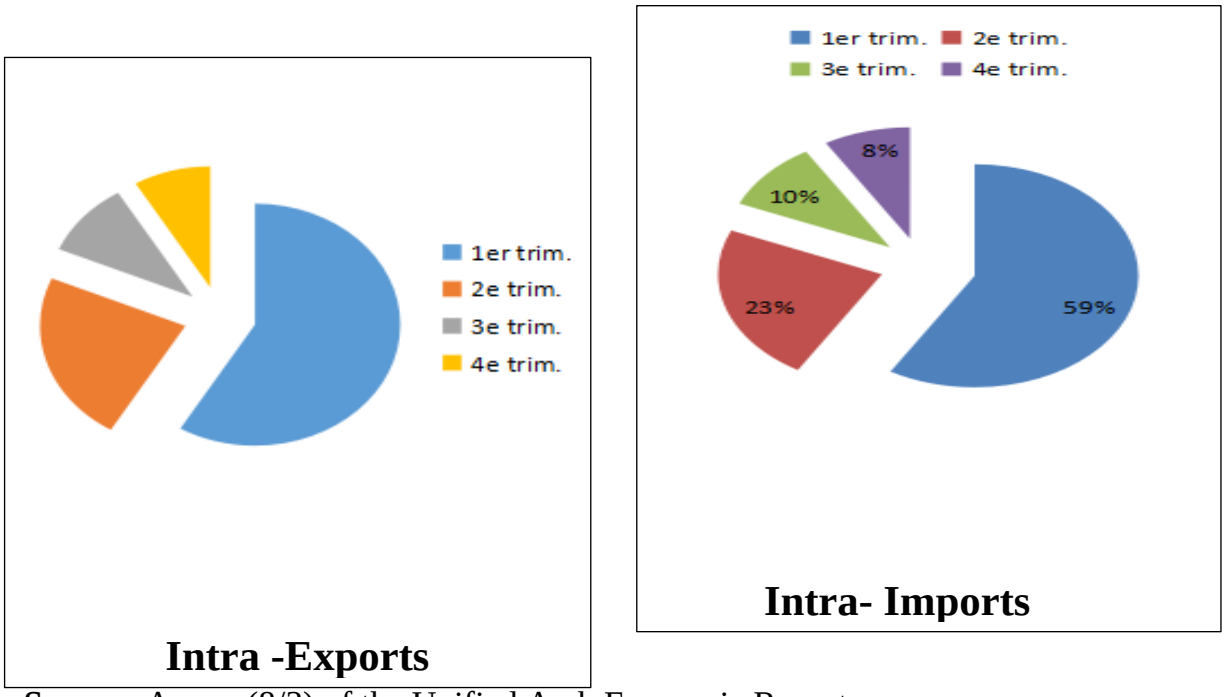
Manufactured goods recorded the highest contribution to intra-Arab exports, rising to 59.6% in 2016, compared with 55.0% in 2015 (Figure 6).

With regard to the sub-groups of manufactured goods, the shares of chemical products, machinery, metals, and transport equipment increased in intra-Arab exports during 2016. Meanwhile, the share of basic manufactured goods declined to approximately 17.9% in 2016, compared with 18.4% in 2015.

As for the structure of intra-Arab imports, it is well established that intra-Arab imports correspond to intra-Arab exports, plus freight and insurance costs. Therefore, in theory, the

commodity structure of intra-Arab imports should not differ from that of intra-Arab exports. However, in practice, statistical discrepancies arise due to differences in recording methods, classification systems, and valuation, resulting in divergences between export and import figures and, consequently, variations in the reported values of commodity groups. (AMF, 2017, pp. 151–152)

Figure (6): Commodity structure of intra-Arab trade (percentage) (2016)



Source: Annex (8/3) of the Unified Arab Economic Report.

Second: Balance of Payments, External Public Debt, and Exchange Rates

1. Balance of Payments

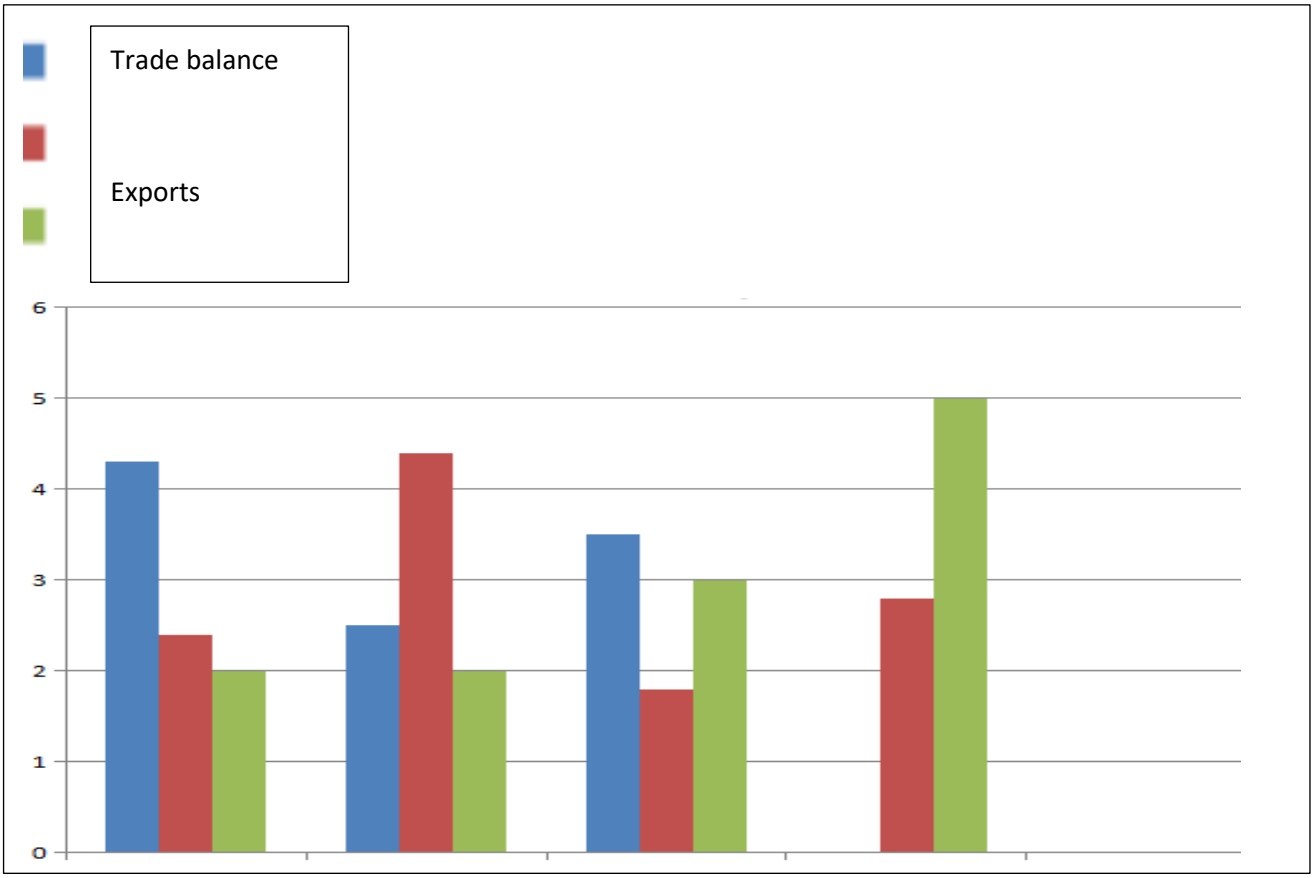
- Trade Balances:

The surplus in the Arab trade balance improved significantly during 2017, primarily as a result of the improvement in global prices of oil and raw materials. This came after 2016, when Arab countries recorded the lowest trade balance surplus achieved over the past two decades. The trade balance surplus of Arab countries as a group increased from approximately USD 70.5 billion in 2016 to about USD 174.1 billion in 2017, representing a growth rate of 146.9%.

This improvement was driven by a rise in total merchandise exports of Arab countries as a group during 2017 by 17.4%, reaching approximately USD 894.9 billion, compared to about USD 792.2 billion in the previous year, as a result of the recovery in global oil prices. Total merchandise imports of Arab countries also increased by around 4.2%, reaching USD 720.8 billion.

These developments led to an increase in the ratio of the trade balance surplus to gross domestic product (GDP) for Arab countries as a group in 2017, reaching approximately 7.1%, compared to about 3.0% in 2015. The following figure illustrates the evolution of the trade balance as a percentage of GDP in Arab countries (AMF, Unified Arab Economic Report, 2018,)

Figure (7): The development of the trade balance as a percentage of the gross domestic product of Arab countries during the period (2013-2017*)



*** Preliminary data.**
Source: (AMF, Unified Arab Economic Report, 2018,)

With regard to the evolution of trade balance positions of Arab countries by groups, the surplus recorded by the member states of the Gulf Cooperation Council (GCC) during 2017 increased by approximately 45.0%, reaching about USD 253.1 billion. This improvement was mainly attributable to a 13.3% increase in the value of merchandise exports of this group, which amounted to approximately USD 705.5 billion, driven by the improvement in global oil prices despite a decline in production levels. At the same time, total payments for merchandise imports of GCC countries rose slightly in 2017 by about 0.9%, reaching USD 452.4 billion.

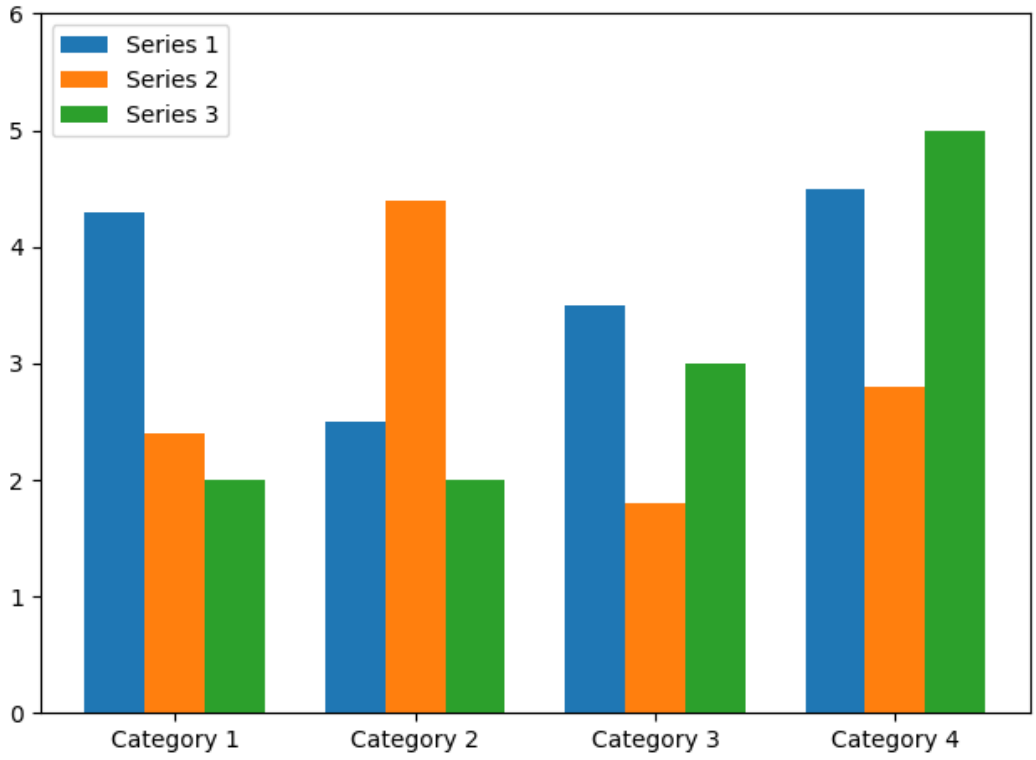
Services, Income, and Transfers Balances:

In 2017, the deficit in the balance of services and income for Arab countries as a group increased by approximately 1.8%, reaching around USD 68.7 billion, compared with a deficit of USD 67.5 billion recorded in 2016. This development resulted from the impact of higher global interest rates on investment income, in addition to the partial recovery observed in travel receipts in major Arab tourism countries.

Current External Accounts Balances:

Current account transactions of Arab countries as a group during 2017 led to a shift from a deficit of approximately USD 80.6 billion recorded in the previous year to a surplus of USD 30.3 billion, marking the first such surplus since 2014. This turnaround was mainly due to the more than doubling of the trade balance surplus of Arab countries as a group in 2017, which reached about USD 174.1 billion, primarily as a result of the improvement in global oil prices. The ratio of the current account balance of Arab countries as a group to GDP amounted to approximately 1.2% in 2017. Figure (8) illustrates these developments.

Figure (8): The ratio of the current account balance to the gross domestic product of Arab countries (2013-2017*)



*** Preliminary data.**

Source: (AMF, Unified Arab Economic Report, 2018,)

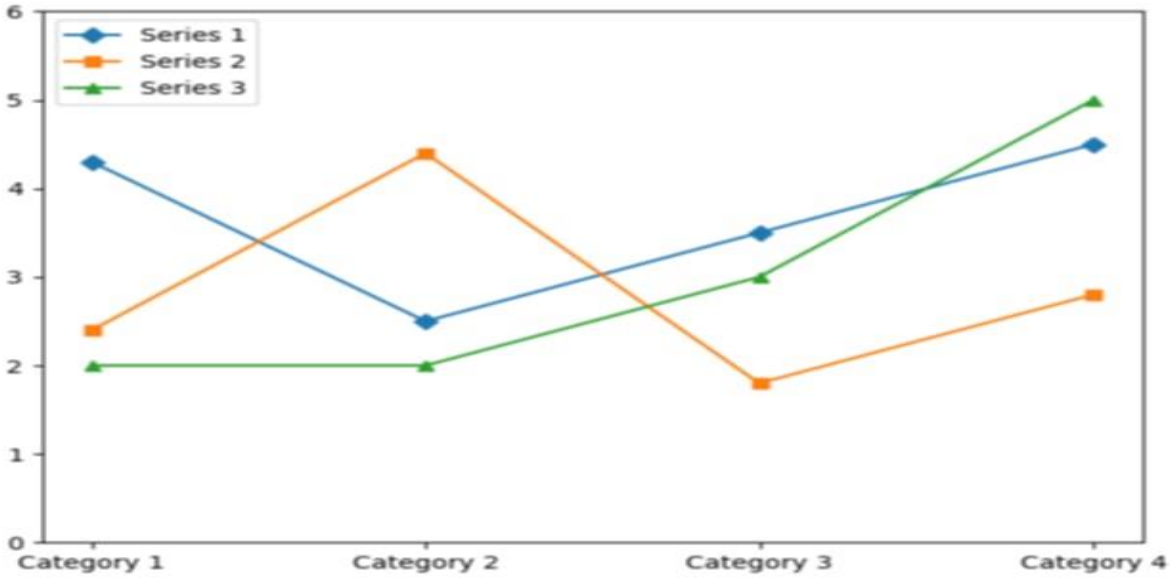
– Capital and Financial Accounts and Overall Balances:

The net inflow recorded in the capital and financial transactions balances during 2016, amounting to approximately USD 146.8 billion, shifted to a net outflow of about USD 21.9 billion in 2017. This shift reflects the improvement achieved in the current account balances of Arab countries. It resulted primarily from the transition of the net inflow recorded by the Gulf Cooperation Council (GCC) countries, from approximately USD 77.1 billion in 2016, to a net outflow of about USD 64.3 billion in 2017.

As a result of developments in both the current account and the capital and financial accounts, the overall deficit in the balance of payments of Arab countries as a group declined by

about 58.0%, reaching approximately USD 57.8 billion in 2017, compared with an overall deficit of about USD 137.5 billion recorded in the previous year. These developments are illustrated in Figure (9). (AMF, Unified Arab Economic Report, 2018,)

Figure (9): The development in the balance of payments of Arab countries as a group (2013-2017)



Source: Annex (9/1) of the Unified Arab Economic Report.

2. External Debt:

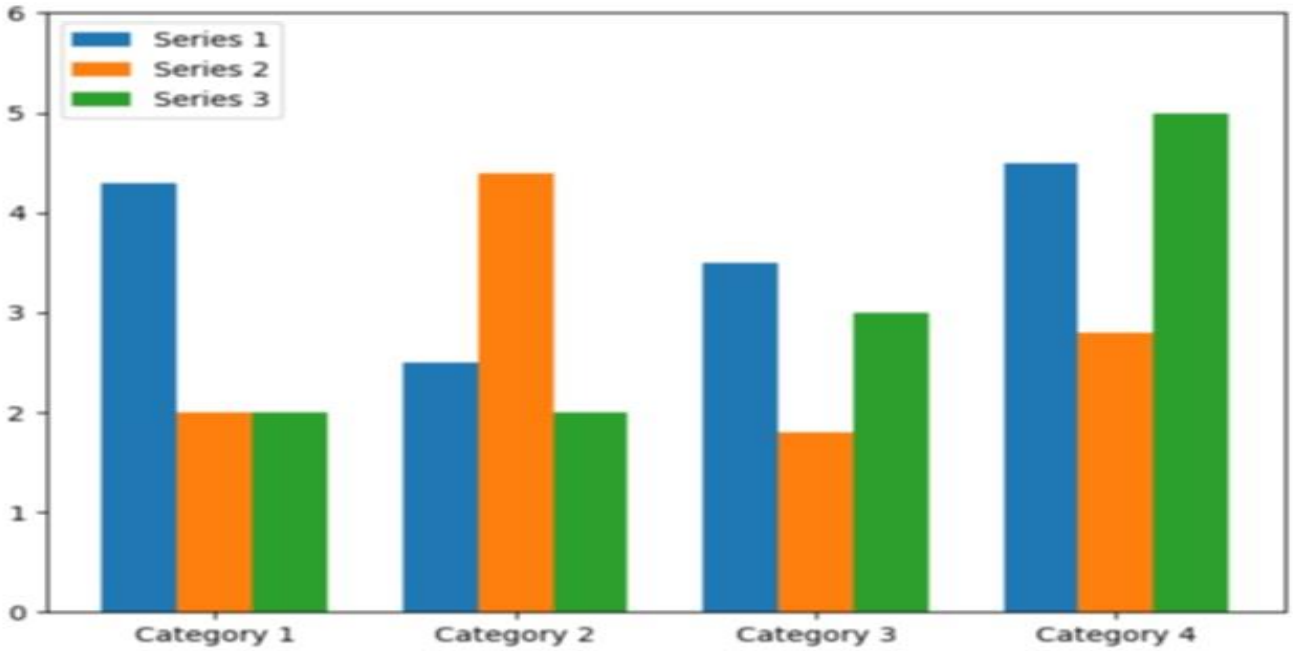
Indicators of external indebtedness of Arab countries generally exhibited stability during 2017, as the number of countries in which external debt accounted for less than 50% of GDP remained at eight countries, unchanged from the previous year. Likewise, the number of Arab countries where external debt was lower than the value of GDP remained stable at fourteen.

Despite this overall stability, country-level performance indicates that eight Arab countries recorded an improvement in the external debt indicator as a percentage of GDP during 2017, while ten Arab countries experienced an increase in this indicator.

In 2018, the number of countries where external debt represented less than 50% of GDP remained at eight, while the number of countries witnessing an improvement in this indicator rose

to eleven. It is expected that the number of countries showing improvement will increase to twelve in 2019, as illustrated in Figure (10). (Ibrahim, n.d , p14)

Figure (10): External public debt as a percentage of GDP (%) for 2017



Source: (AMF, Unified Arab Economic Report, 2018,)

3. Exchange Rates:

Arab currencies were affected by developments in the exchange rates of major global currencies during 2017, particularly in light of the appreciation of the euro against the US dollar. This occurred despite the US Federal Reserve's move to raise US dollar interest rates by approximately 75 basis points during the year, while the European Central Bank opted to maintain interest rates at near-zero levels. (AMF, Unified Arab Economic Report, 2018,)

Subsection two: Resources and Economic Sectors of the Arab Countries

At present, most, if not all, countries are increasingly concerned with the study of economic resources, given that the level of economic welfare in any society is determined by the volume of resources available to it. Moreover, the wealth or poverty of countries today is measured not only by the resources they possess, but also by their capacity to exploit those resources efficiently.

CHAPTER THREE:
CLIMATE CHANGE AND ITS IMPACTS ON THE ECONOMIES OF ARAB COUNTRIES:

Below, we present the most significant economic resources owned by the Arab countries and the manner in which they are utilized.

Sub-subsection one : Economic Resources

First: Water Resources

1. Precipitation Rates in the Arab Region:

The Arab world lies within the arid and semi-arid zones, traversed from west to east by vast deserts where rainfall is almost nonexistent. As for the coastal areas and the adjacent mountainous regions, they are exposed to maritime air currents and atmospheric depressions that cause rainfall during specific seasons. In the Arab countries bordering the Mediterranean Sea, rainfall typically occurs during the winter season, whereas countries overlooking the Arabian Sea, as well as certain areas of the Arabian Peninsula and southern Sudan, are influenced by summer monsoon winds carrying rainfall.

The upper annual precipitation rates across the Arab world range between 250 mm and 400 mm, and may exceed 1,000 mm in certain areas of the Lebanese mountains, the Syrian coast, some highlands of Yemen, southern Sudan, and parts of the Maghreb region in general. Total annual rainfall in the Arab world is estimated to range between 2,100 and 2,300 billion cubic meters.
(Khaddam, 2001, p. 22.)

2. Surface Water:

Surface water resources in the Arab world reflect the spatial distribution of rainfall carried by fifty rivers, including the tributaries of the Nile, Tigris, and Euphrates. Most surface water resources in the Arab world originate outside the region, accounting for approximately two-thirds of the total surface water resources, with an estimated average volume of 205 billion cubic meters in the year 2000.

The proportion of shared water in Arab rivers with non-Arab countries varies: it reaches 54% in the case of the Nile River, 40% for the Tigris and Euphrates, 6.5% for the Juba and Shabelle rivers, and about 7% in the case of the Senegal River, from which Mauritania benefits. These shared waters require agreements to ensure their equitable allocation with other countries sharing the river basins.

The utilization of surface water resources in Arab countries depends on the availability of water storage capacities such as dams and reservoirs. Consequently, the amount of surface water effectively utilized does not exceed 150 billion cubic meters, representing 73% of the Arab world's total share of surface water resources.

3. Groundwater:

Groundwater resources in the Arab world are divided into renewable groundwater, amounting to 42 billion cubic meters annually, and non-renewable groundwater estimated at 15,000 billion cubic meters. Recharge areas for groundwater in the Arab world are limited to permanent river basins and mountainous regions with high rainfall rates. Non-renewable groundwater, by contrast, is ancient water that accumulated largely during the rainy periods experienced by the Arab world in the Pleistocene epoch and is known as fossil water.

Groundwater in the Arab world is concentrated in twelve major aquifers, in addition to a number of smaller regional and local reservoirs.

Annual groundwater abstraction in the Arab world ranges between 35 and 39 billion cubic meters, distributed as follows: the Maghreb region accounts for 43%, the Nile Valley and Horn of Africa region for approximately one quarter, the Fertile Crescent region for about one fifth, and finally the Arabian Peninsula region for 13%. (Mohamed, 2004, pp. 454–456)

Second: Mineral and Energy Resources

Extractive industries, such as the extraction of oil, gas, and minerals, most notably iron, followed by copper, zinc, and aluminum, are among the largest activities based on the exploitation

of available natural resources in the Arab countries. In addition, other raw materials such as phosphates and potash constitute natural resources upon which mining industries are based in certain Arab countries.

An increase in phosphate and cement production in the Arab world is expected, as well as an increase in potash production in Jordan, the only producer of this resource in the region.

Arab countries possess 59.8% of global oil reserves and 31% of natural gas reserves, with natural gas production witnessing a notable increase.

In recent years, the Arab world has experienced new discoveries of oil and gas in massive quantities.

Accordingly, the region abounds in substantial natural resources, foremost among them crude oil and natural gas. Undoubtedly, these new oil and gas discoveries in the Arab world will drive global companies to compete for operating opportunities therein, given the new markets and revenues they represent. (Al-Assaf & Al-Wadi, 2010, pp. 93–96.)

Third: Natural Resources Related to Agriculture and Food

Agricultural activity represents a prominent resource within the economic structure of many Arab countries, contributing approximately 7.7% to the gross domestic product of Arab countries. Agriculture in most countries relies on rainfall, whereas countries endowed with river water and groundwater depend on irrigation to cultivate areas sufficient to meet the growing needs of the population.

Agricultural production has witnessed notable development due to the increasing use of modern technologies in irrigation, improved seeds, and fertilizers, reflecting positive developments in the agricultural policies adopted.

Arab countries also possess significant potential for increasing fishery resources, as fish stocks are estimated at approximately 10.2 million tons annually. Enhancing productivity requires

the rehabilitation and sustainable management of natural and aquaculture fisheries, support for large-scale sustainable fishing projects, encouragement of investment in these projects, enabling continuous production capacity, and the development of human resources capabilities in the fishing industry. (Al-Assaf & Al-Wadi, 2010, pp. 98–99).

Fourth: Financial Resources

The Arab world possesses successive economic capabilities in the form of financial resources derived from oil production and its refining. It is observed that Arab countries—particularly oil-producing ones—have obtained high financial revenues as a result. These revenues have tended to increase due to several factors, especially during the 1970s. Among the most prominent factors behind this increase are the following: (Khalaf, 2000, pp. 66–67.)

1. The increase in oil prices during the first half of the 1970s, which continued throughout that period.

2. The rise in oil production in these countries, encouraged on the one hand by relatively high prices, and on the other by pressure to pursue economic expansion, whether through the implementation of certain development projects or through the expansion of service provision in its various aspects.

3. The increase in revenues of several oil-producing countries as a result of oil nationalization, as was the case in Libya, Algeria, and Iraq, or through participation arrangements, as in some Gulf countries.

Sub-subsection two: Economic Sectors

Arab countries rely on several sectors to develop their economies. The most important of these sectors are outlined below.

CHAPTER THREE:
CLIMATE CHANGE AND ITS IMPACTS ON THE ECONOMIES OF ARAB COUNTRIES:

First: The Agricultural Sector

The nominal value of Arab agricultural output was estimated at approximately USD 142.1 billion in 2015, representing a decline of about 14% compared with the previous year, while the sector recorded an average annual growth rate of 1.7% during the period (2010–2016), as shown in Table (7).

Table (6): Development of GDP and agricultural output in Arab countries at current prices (2010-2016)

Item	**2010**	**2013**	**2014**	**2015**	**2016**	**Average Annual Growth Rate (2010–2016)**	**Annual Growth Rate (2015–2016)**
Gross Domestic Product	2083.5	2715.7	2741.1	2436.7	2347.1	2.0	-3.7
Agricultural Output	128.4	133.0	141.1	144.1	141.1	1.7	-1.4
Share of Agricultural Output in GDP (%)	6.2	6.4	5.2	5.9	6.1	…	…

Source: Annex (2/2) of the Unified Arab Economic Report.

The decline in agricultural output in 2016 is attributed to weak agricultural performance in several agriculturally oriented Arab countries due to drought and unfavorable climatic conditions,

notably Egypt with a decline of 16.7%, Tunisia by 11.8%, and Algeria by 3.6%. Algeria's agricultural output represented approximately 13% of total Arab agricultural output in 2016.

The ratio of agricultural output to GDP varied significantly among Arab countries. The Comoros ranked first among Arab countries in terms of agriculture's contribution to GDP, reaching approximately 32.9% in 2015, followed by Sudan at 31.6%, Mauritania at 24.9%, Yemen at 17.7%, Morocco at 12.1%, and Egypt and Algeria at 11.8% and 11.6%, respectively. This ratio ranged between 2.0% and 9.2% in Oman, Saudi Arabia, Libya, Djibouti, Lebanon, Jordan, Iraq, and Tunisia. It declined further in other Arab countries with limited agricultural resources, such as the Gulf Cooperation Council states, where it ranged between 0.2% in Qatar and 0.8% in the United Arab Emirates. *(*AMF, 2017, p. 52).

Second: The Industrial Sector

The industrial sector's gross domestic product in Arab countries amounted to approximately USD 701 billion in 2016, compared to about USD 802.5 billion in 2015, reflecting a decline of approximately 12.6%. This decrease is attributed to the continued downward trend and impact of lower oil prices in 2016 compared to the previous year, as the average oil price stood at approximately USD 40.7 per barrel in 2016, compared to an average of USD 49.5 per barrel in 2015.

Despite the decline in Arab industrial output from the high levels recorded in 2014 and 2015, its contribution to GDP remained significant, accounting for 29.9% of GDP in 2016. At the country level, this contribution ranged from approximately 46.3% in Kuwait to 2.3% in Djibouti.

The contribution of extractive and manufacturing industries to GDP was distributed at approximately 18.8% for extractive industries and 11.1% for manufacturing industries. *(*AMF, 2017, pp. 67–68*).*

Table (7): Value of Arab industrial output (at current prices) (2011-2016)

Year	**Extractive Industry**	**Manufacturing Industry**	***Total sector***

	Value Added	Growth %	Share of GDP %	Value Added	Growth %	Share of GDP %	Value Added	Growth %	Share of GDP %
2011	956.7	34.1	40.1	11.6	11.6	9.4	1181.3	29.3	49.5
2012	1082.0	13.1	40.8	10.7	10.7	9.4	1331.0	12.7	50.2
2013	1024.0	-5.4	37.7	2.0	2.0	9.3	1277.9	-4.0	47.1
2014	943.0	-8.0	34.4	5.1	5.1	9.7	1209.0	-5.4	44.1
2015	534.0	-43.3	21.9	0.6	0.6	11.0	802.5	-33.6	32.9
2016	441.0	-17.4	18.8	-3.2	-3.2	11.1	701.0	-12.6	29.9

Source: (AMF, Unified Arab Economic Report, 2016.)

Third: The Tourism Sector

This section seeks to analyze the contribution of Arab tourism to gross domestic product and employment opportunities in selected countries, demonstrating the significant role tourism plays in economic development and unemployment reduction across various Arab countries.

In Lebanon and Jordan, the tourism sector contributes approximately 19.4% of GDP, amounting to about USD 9.2 billion and USD 7.6 billion respectively, and provides more than 338,000 jobs in Lebanon and 287,000 jobs in Jordan. These countries rank highly in terms of tourism's total contribution to GDP and employment among 185 countries worldwide.

In Morocco, the tourism sector contributes 18.5% of GDP, enabling the creation of more than 1,902 jobs, accounting for approximately 16.6% of total employment. This performance can be attributed to the unique tourism assets these countries possess, including archaeological and historical sites, in addition to the high quality of tourism services available.

By contrast, despite Egypt's substantial tourism potential and strong attractions, its contribution to GDP reached a lower level of 7.2% (ranked 129th globally), with approximately 1,763,000 workers employed in the sector (ranked 130th globally) in 2016. This relatively limited performance coincided with a sharp decline in tourist arrivals during that year due to local and regional conditions affecting the region.

(Shouk & Yahyaoui, n,d; p. 103.)

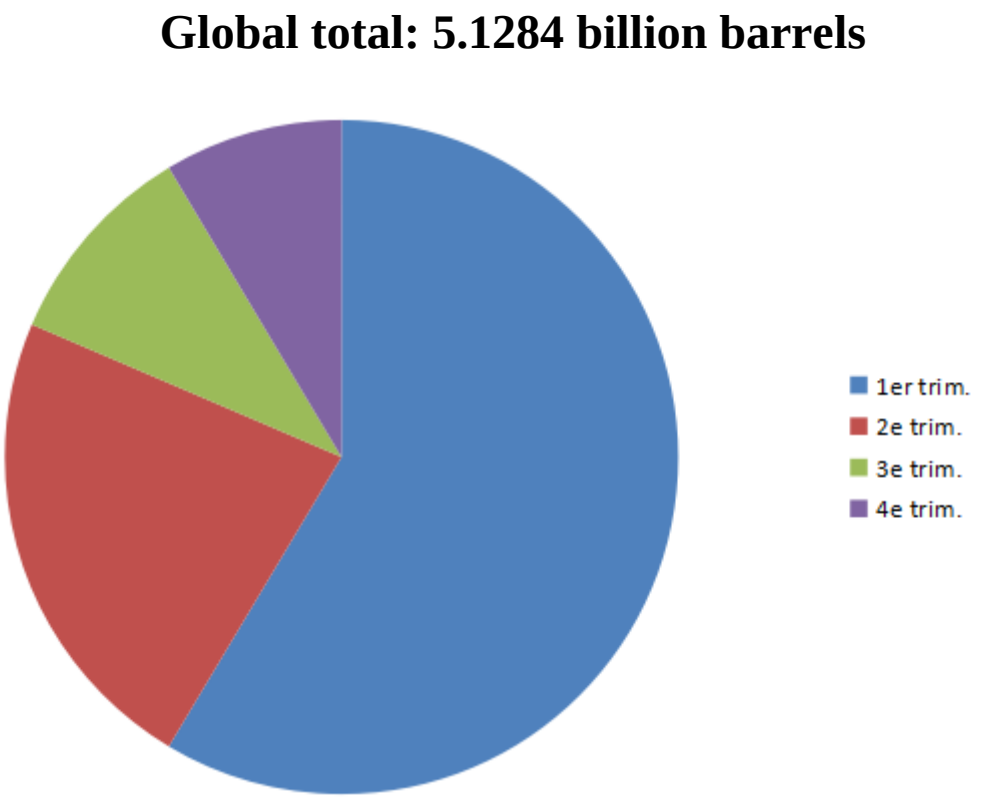
Fourth: The Energy Sector

1. Oil

Global estimates of proven oil reserves recorded a slight increase by the end of 2015, reaching 1,284.5 billion barrels, representing an increase of no more than 0.23% compared to the levels recorded in the previous year. As for Arab countries, estimates of proven crude oil reserves for 2015 remained approximately stable at the levels recorded in the preceding year.

It is worth noting that 92.3% of crude oil reserves in Arab countries, amounting to 711.0 billion barrels in 2015, are concentrated in five Arab states, namely: Saudi Arabia, which holds 37.4% of total Arab reserves; Iraq with 20.1%; Kuwait with 14.3%; the United Arab Emirates with 13.7%; and Libya with 6.8%. Arab countries' reserves accounted for 55.4% of global oil reserves, as illustrated in Figure (11). *(*AMF, 2016, p. 143*).*

Figure (11): Proven global crude oil reserves according to international groups in (2015)

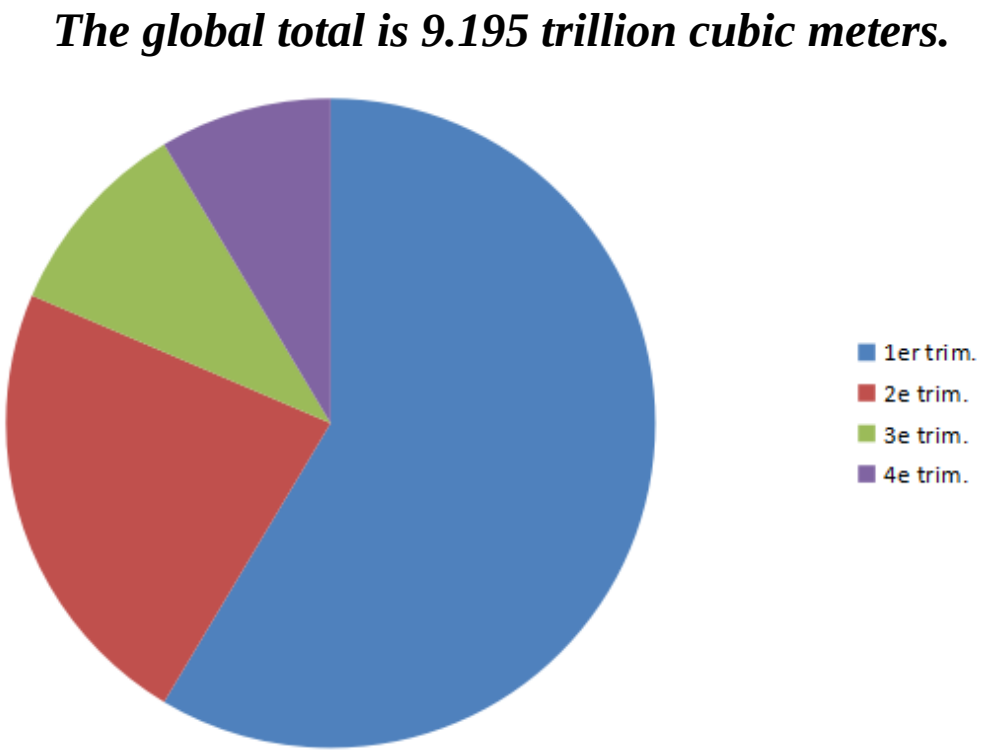


Source: Annex (5/1) of the Unified Arab Economic Report.

2. Natural Gas

Global natural gas reserves declined slightly by the end of 2016 by 0.5%, reaching 195.9 trillion cubic meters. With regard to natural gas reserves in Arab countries, they increased marginally by about 100 billion cubic meters compared to reserves in 2016. All Arab countries maintained their previous levels of natural gas reserves by the end of 2015, with the exception of Saudi Arabia, where new discoveries contributed to an increase in

reserves by 1.2% during 2015 compared to the previous year. Collectively, Arab countries accounted for a share of 27.7% of global natural gas reserves, as shown in **Figure (12).** *(*AMF, 2017, p. 85*).*



Source: Organization of Arab Petroleum Exporting Countries (OAPEC), «Annual Secretary-General's Report» 2016.

3. Coal

Estimates of total proven coal reserves declined in 2017 by 9.2%, reaching 1,035 billion tons. No significant developments were recorded in Arab countries in the field of coal production and extraction. It is noteworthy that coal is primarily consumed in electricity generation and industrial heating processes. Coal plays an important role in the global energy sector due to the wide availability of its sources in many countries worldwide, in addition to its ease of transport, import, and export. (AMF, Unified Arab Economic Report, 2018, , p. 89)

The Third Requirement: Estimating the Cost of Environmental Degradation in Arab Countries

The cost of environmental degradation is calculated as a percentage of gross domestic product, in order to provide a clear and economically recognized indicator. Moreover, the systematic annual repetition of this calculation can help clarify time trends in the environmental cost of economic policies and decisions. If the rate of environmental degradation exceeds the rate of economic growth, indicators suggest that resource losses and pollution impacts have become greater than economic growth in a given country, which hinders the achievement of sustainable development.

The economic cost of environmental degradation is estimated through several stages, as follows: (Al-Yuzbaki & Abdullah, 2012, p. 168)

1.Quantitative and numerical estimation of environmental degradation (air pollution, water pollution, decline in soil productivity, etc.).

2. Quantitative numerical estimation of the outcomes of degradation (negative health impacts due to air and water pollution, changes in agricultural production due to soil pollution and salinization, depletion of natural resources).

3. Financial valuation of the results of environmental degradation (costs of medical treatment, lost working years due to chronic illnesses, etc.).

The following table shows the total cost of environmental degradation for the sample countries during the period (2004–2006) and its percentage of GDP:

Table No. (8): Comparison of the cost of environmental degradation in the sample countries (World Bank 2004-2006).

Country	Total Cost of Environmental Degradation (USD million)	Environmental Degradation as % of GDP
Jordan	205	3.1%
Syria	624	3.5%

Egypt	4,280	4.8%
Morocco	1,230	3.7%
Country	**Total Cost of Environmental Degradation (USD million)**	**Environmental Degradation as % of GDP**

Source: (Al-Juwadi, , 2009)**.**

The Second Section: Climate Change in Arab Countries and Its Impacts

The Arab region is considered one of the most vulnerable regions to the potential impacts of climate change, despite its relatively small contribution to global greenhouse gas emissions. These impacts include threats to coastal areas, increased severity of drought, desertification, scarcity of water resources, rising salinity of groundwater, and the unprecedented spread of epidemics and diseases. The impact on these resources is expected to affect various economic and social sectors. This section addresses the various current and potential effects of climate change in Arab countries.

The First Requirement: Climate Change in Arab Countries

Studying the phenomenon of climate change in Arab countries requires examining geographical location and climate characteristics, the main influencing factors, rainfall patterns, the extent of Arab countries' contribution to the exacerbation of this phenomenon, and the volume of greenhouse gas emissions originating from them.

Sub-subsection one : The Location of the Arab World and Climatic Conditions

The area of the Arab world is approximately 14.06 million km², representing about 10.2% of the world's total area. The Arab world lies between longitude 60.17° east and latitudes ranging from 1.30° to 37.30°. This vast area extending across a wide range of latitudes naturally encompasses diverse environmental zones. Approximately 90% of the Arab world lies within very arid, arid, and semi-arid regions. These areas are characterized by significant variability in annual rainfall amounts, as well as marked variation in rainfall distribution throughout the year. Rainfall is naturally the most important climatic factor for ecosystems. It is observed that 66% of the Arab

world receives less than 100 mm of rainfall annually, 20% receives between 200 and 300 mm, and only 14% receives more than 300 mm. (Al-Yuzbaki & Abdullah, 2012, p. 168)

Sub-subsection two: Climatic Characteristics of the Arab Region

Arab countries encompass five climatic and environmental zones, including the moderate Mediterranean maritime climate, which covers the Mediterranean coasts of Arab countries and is characterized by mild weather and rainfall reaching up to about 600 mm. There is also the interior plains climate and the mountainous climate, which is characterized by rainfall and snowfall and covers high mountain ranges in Lebanon and the Atlas Mountains in Morocco, Algeria, and Tunisia. In addition, the tropical monsoon climate with heavy summer rainfall extends from southern Arabia to central southern Sudan and Somalia. The semi-arid climate, with annual rainfall ranging between 100 and 300 mm, is also present, as well as the arid climate, which covers approximately 80% of the total area of Arab countries, where rainfall is less than 100 mm annually. The Arab region is predominantly arid or semi-arid, as it lies within latitudes dominated by descending dry air masses and high temperatures. (Mishdan, 2017; p.828)

Third: The Contribution of Arab Countries to the Increase in the Phenomenon of Global Warming

Despite the relatively low contribution of the Arab region to greenhouse gas emissions, accounting for less than 5% of total global emissions, its vast geographical expanse, internal diversity, social and economic structures, in addition to the degradation of its natural resources, and the reliance of many of its countries on resources that are highly vulnerable to climate change, such as agriculture, water resources, and fisheries, render it among the regions most exposed to the potential impacts of climate change and its various interactions. These impacts include threats to coastal areas, increased severity of drought, desertification, scarcity of water resources, rising salinity of groundwater, and the unprecedented spread of epidemics, pests, and diseases, which in turn result in adverse repercussions on economic and social development. *(*AMF, 2016, p. 331*).*

The Second Requirement: Environmental Impacts of Climate Change on Arab Countries

Changes in climatic factors, namely rising temperatures and declining rainfall, cause both direct and indirect damage to the environment in Arab countries. This requirement addresses a number of risks to which the Arab environment has been exposed, and is expected to be exposed, as a result of climate change.

The First Sub-subsection: Rising Temperatures

The Arab region is considered one of the areas threatened by risks that may arise from climate change, with impacts varying from one area to another. Surface temperatures in the Arab region have increased in some locations by approximately 0.7°C since 1900. This increase has resulted primarily from rising nighttime temperatures and minimum temperatures around sunrise, while maximum temperatures have tended to decline slightly.

For example, in the Arab Republic of Egypt, minimum temperatures increased by 0.5°C, nighttime temperatures rose by 0.61°C, and surface temperatures throughout the day increased by 0.2°C, while maximum temperatures declined by 0.1°C. The thermal range also decreased by 0.4°C. In Tunisia, the average temperature is expected to rise by 1.1°C by the year 2030. In Morocco, temperatures are projected to increase by between 0.6 and 1.1°C by 2020. In the Kingdom of Saudi Arabia, a noticeable rise in temperatures is expected by 2060, ranging between 1.5 and 3.1°C depending on the season. In Sudan, summer temperatures are expected to increase by between 2.2 and 2.7°C in the northwestern regions, and between 0.2 and 0.4°C in the southern and southwestern parts of the country. These climatic changes in the Arab region will have negative impacts on various aspects of life. *(*IMF, 2016, p. 331*).*

The Second Sub-subsection: Biodiversity

Many plant and animal species in the Arab world are already facing threats to their survival, and their vulnerability is expected to intensify as a result of the anticipated impacts of climate change. According to the threat criteria of the International Union for Conservation of Nature (IUCN), Yemen has the largest number of threatened plant species, totaling 159 species, while Sudan and Somalia each have 17 species. Djibouti, Egypt, Jordan, Morocco, Saudi Arabia, Somalia, Sudan, and Yemen collectively have more than 80 threatened animal species. Egypt ranks at the top of the list, with 108 species. Climate change may alter the entire faunal structure

of ecosystems. Bird diversity represents a major natural asset of the Arab world, yet it is highly threatened as a result of climate change. (Tolba & Saab, 2009. p. 21.)

The Third Sub-subsection: Sea Level Rise

The majority of economic and agricultural activities and population centers are located in coastal areas. Rising sea levels would lead to their inundation, increased salinity of soil and freshwater resources, the extinction of approximately 40% of livestock wealth, and direct impacts on 3.21% of the population of Arab countries. According to the World Bank, the list of countries threatened by sea level rise includes Egypt in third place, followed by Tunisia in fourth place, Mauritania in sixth place, and Libya in twelfth and last place. *(Bousbaine Tessaadit, n.d, p. 123).*

Cities most vulnerable to these impacts in the Arab world include Alexandria, Port Said, Nouakchott, Djibouti, Kuwait City, Dubai, Doha, and Manama. Nevertheless, all countries and cities in the Arab world are exposed either to flooding, heat waves, or both.

Table No. (9): Comparison between the sensitivity of Arab coasts and different regions of the world to sea level rise according to specific indicators (%)

Indicator	World	Latin America	Middle East & North Africa	Sub-Saharan Africa	East Asia	South Asia
At a one- meter rise in sea leve						
Area	0.31	0.34	0.25	0.12	0.52	0.29
Population	1.28	0.57	3.2	0.45	1.97	0.45
GDP	1.3	0.54	1.49	0.23	2.09	0.55
Urban areas	1.02	0.61	1.94	0.39	1.71	0.33
Agricultural areas	0.39	0.33	1.15	0.04	0.83	0.11
Wetlands	1.86	1.35	3.32	1.11	2.67	0.59
At a three-meter rise in sea level						
Indicator	**World**	**Latin America**	**Middle East & North Africa**	**Sub-Saharan Africa**	**East Asia**	**South Asia**
Area	1.21	1.24	0.63	0.48	2.3	1.65

Population	5.57	2.96	7.49	2.38	8.63	3.02
GDP	6.05	2.38	3.91	1.42	10.2	2.85
Urban areas	4.68	3.03	4.94	2.24	8.99	2.72
Agricultural areas	22.7	1.76	3.23	0.38	4.19	1.16

Source: (Arab Forum for Environment and Development, 2009)

The Fourth Sub-subsection: Desertification

Arab countries suffer from the problem of desert encroachment. In 2013, the total area affected by desertification reached approximately **9.8 million square kilometers**, representing **73.7% of the total land area**. Most of these areas are concentrated in the **Arabian Peninsula**, where desertified lands account for approximately **90% of its total area**, compared to **78% in the Maghreb**, **45% in the Nile Basin and the Horn of Africa**, and **36% in the Mashreq**. Libya ranks first among the Maghreb countries, Egypt in the Nile Basin region, Jordan in the Mashreq, and Qatar, the United Arab Emirates, Bahrain, and Kuwait in the Arabian Peninsula. It can be stated that climate change, and the resulting decline in water availability, exacerbates land degradation and desertification. (Mishdan, 2017; p.828)

The following table identifies the areas of land threatened by desertification in the Arab region:

Table No. (10): Area of land threatened by desertification in the Arab region

Country	Total Area (thousand km²)	Desertified Area (thousand km²)	Percentage (%)	Area Threatened by Desertification	
				(thousand km²)	(%)
Mauritania	1031.00	636	62.00	343	33.3
Morocco	711.00	455	64.00	195	27.4
Algeria	2382.00	1970	82.70	230	9.7
Tunisia	164.00	—	—	105	64.0
Libya	1806.53	1589	87.96	380.635	21.1
Sudan	2506.00	725	28.90	650	25.9
Yemen	566.00	405	71.60	90	15.9
Kuwait	18.00	5	27.80	4	22.2
Qatar	11.00	11	100.00	—	—
Saudi Arabia	2150.00	1182	55.00	860	40.0
Total	**11345.53**	**6978**	**61.51**	**2857.635**	**25.2**

Source: (AMF, Unified Arab Economic Report, 2016., p. 335)

The Fifth Sub-subsection: Impact on Water Resources

Water scarcity is expected to reach critical levels by **2025**, particularly in the **Fertile Crescent**, which is likely to lose its agricultural fertility. With the continued rise in temperatures, the flow of the **Euphrates River** and the **Jordan River** is expected to decline before the end of the current century. According to the World Bank's 2013 list of the twelve countries most

threatened by drought, **Mauritania ranked seventh**, followed by **Sudan in ninth place**. (Bousbaine, 2015,, p. 112)

The Third Subsection: Social and Economic Impacts of Climate Change on Arab Countries

Climate change will have serious negative impacts on the economic and social development of Arab countries. Nevertheless, research on the social and economic dimensions of climate change in the Arab region remains at an early stage. Among the consequences of climate change in the Arab region are the following:

The First Sub-subsection: Social Impacts of Climate Change on Arab Countries

Climate change affects all populations in the Arab region; however, these impacts are not equal across regions or social groups. Among these effects are the following:

First: Migration

Urban populations are growing rapidly, as approximately **56% of the Arab population** currently lives in urban centers. By **2050**, this proportion is expected to increase to **75%**. Drought and aridity have contributed to increased migration from rural to urban areas in the region. Estimates indicate that the prolonged drought experienced in recent years in the **Syrian Arab Republic** led to the migration of approximately **one million people** to informal settlement areas surrounding major cities. Many cities are expected to face severe housing shortages as a result of this massive urban population growth.

Second: Health

Human health is expected to deteriorate as temperatures rise, with an increase in the spread of infectious diseases such as **malaria** and **bilharzia**, as well as a rise in cases of allergies and pulmonary diseases.
(The impact of climate change on Arab countries, 2010*).*
Heat waves are expected to become more intense, more frequent, and of longer duration as a result of climate change. Several regional studies have examined heat-related mortality rates and consistently found a significant relationship between temperature levels and mortality rates. The relationship between climate conditions and infectious diseases, responsible for the deaths of

between **14 and 17 million people globally each year,** has been widely studied. Malaria, for example, which affects approximately **three million people annually in the Arab region**, may become more widespread, as rising temperatures shorten the incubation period of the disease, expand the habitat of malaria-carrying mosquitoes, and increase their reproduction

(Kamal-Tolba & Saab, 2009, p.21)

The Second Sub-subsection: Economic Impacts of Climate Change on Arab Countries

All economies are likely to suffer increasing damage from climate change over time; however, some countries are more affected than others. Among the most prominent economic sectors impacted by climate change in Arab countries are the following:

First: Impact on the Energy Sector

The energy sector is expected to be one of the economic sectors most affected by climate change. Potential impacts include reduced electricity generation from hydropower plants due to possible droughts, and increased demand for energy required for water desalination. Rising air temperatures also increase electricity demand for cooling and air-conditioning systems. Furthermore, rising sea levels may cause flooding of energy production facilities, particularly offshore oil extraction platforms, coastal power plants, or transformer stations located in flood-prone areas, as well as damage to national electricity grids, interconnection networks, and natural gas transmission pipelines in affected regions.

Second: Impact on the Tourism Sector

Tourism is an important sector for a number of Arab economies; however, like most economic activities, it is vulnerable to the impacts of climate change. The attractiveness of tourist destinations depends largely on climate, although several other factors are also significant. Using a composite climate index, the **Tourism Comfort Index** measures climatic enjoyment at a given location. With climate change, these factors are expected to shift.

For example, arid zones in the Arab region are expected to expand northward in North Africa, and the Tourism Comfort Index in the Arab world is projected to decline over the coming decades. Most areas currently classified as «good», «very good», or «excellent» are expected to

fall below acceptable levels by **2080**. Rising temperatures pose a clear threat to tourism in a region that is already characterized by high heat levels. Analyses of tourism patterns indicate that destinations along the northern Mediterranean coast or within Europe will become more attractive in the long term compared to the Arab region. While expatriate tourists may be less deterred by high temperatures, significant losses in tourism revenues may come from Arab citizens themselves, who may seek cooler destinations.

For instance, ski tourism in **Lebanon** is at risk, as projections indicate that the snow season may decline from **100 days to 45 days** over the coming decades. Coastal erosion also poses a threat, and nature-based tourism, of particular importance to the region, is jeopardized, as coral reefs and wildlife that attract tourists are at risk in many locations. (Werner, (n.d.). (Report No. 64635), pp. 45-46)

Third: Impact on Industry

The industrial sector is considered one of the sectors most affected by the environment and most influential upon it, given its significant contribution to energy consumption and the emission of various greenhouse gases. Industries are negatively affected by phenomena resulting from climate variability and change due, on the one hand, to changes in the productivity of resources, and on the other hand, to shifts in demand for produced goods and services. The decline in agricultural production as a result of climate change is reflected negatively on the industrial sector, reducing the production and availability of food commodities.

In addition, drought waves contribute to reducing the quantities of water stored in dams and reservoirs, causing a shortage in the generation of hydroelectric power used across all sectors, including industrial activities. Climate change also has significant implications for planning investments in the infrastructure required for industrial development, as rising sea levels, increasing temperatures, and greater exposure to floods and storms affect the viability of investments in coastal areas due to heightened risks. Moreover, climate change is likely to lead to higher insurance costs, which may hinder development projects in high-risk areas. Financial institutions may also refrain from providing loans and credit guarantees for such projects, which

could ultimately affect the future distribution of industrial development projects across different regions. *(*IMF, 2016, p. 336*).*

Fourth: Impact on Food Security

Arab agricultural production is characterized by instability due to its sensitivity to climate change and limited water resources, particularly rainfall. Rain-fed agriculture dominates more than three-quarters of the agricultural land area, which represents approximately **63% of the total arable land**. Projections indicate that the rate of increase in agricultural production will slow over the coming decades as a result of climate change and may begin to decline after **2050**. The Mediterranean region, which supports **80% of agricultural production**, is expected to experience reduced rainfall under conditions of higher temperatures and increased climatic variability. This will lead to increased water use and reduced productivity of certain crops.

Other regions, such as the **Nile Delta**, will have to contend with saltwater intrusion from the sea. Farmers will face additional challenges caused by higher temperatures, as the chilling requirements necessary for certain fruit crops may not be met. Soil fertility is also likely to decline and deteriorate. (Mishdan, 2017; p.828)

Table 11: Undernourishment Indicators in Arab World

Country	Number of Undernourished (million)		Prevalence of Undernourishment (%)	
	1990–1992	2010–2013	1990–1992	2010–2013
Somalia	4.7	…	71.9	…
Djibouti	0.4	0.2	70.2	20.5
Yemen	3.7	7.4	29.2	28.8
Mauritania	0.3	0.3	12.9	7.8
Iraq	1.8	8.8	10.0	26.2
Morocco	1.7	1.6	6.7	>5
Jordan	0.2	…	6.1	>5
Algeria	1.4	…	5.5	>5
Syria	0.6	1.3	4.7	>5
Lebanon	0.1	…	3.5	>5
Saudi Arabia	0.5	…	3.1	>5
Egypt	1.3	…	2.3	>5
United Arab Emirates	0	…	1.1	>5
Libya	0	…	0.9	>5
Tunisia	0.1	…	0.9	>5
Kuwait	0.8	…	…	>5
Sudan	0	…	0	…
Bahrain	0	…	0	…
Oman	0	…	0	…
Qatar	0	…	0	…
Total	**16.7**	**46**	…	**10**

Source: («Adapting to a Changing Climate in Arab Countries», p. 39. , 2012).

Based on the data presented in this table, the risks of undernourishment are higher in **Somalia, Djibouti, Yemen, Mauritania, Iraq, and Syria**. However, recent information indicates that conditions of undernutrition and hunger in the Arab world are worse than those reflected in the above statistics, particularly in countries experiencing wars or difficult transitional periods. It is estimated that **10% of the Arab population**, or approximately **46 million people** (including **25% children**), suffer from undernourishment, and this number continues to increase at an alarming rate.

Section Three: Strategy of Arab Countries in Confronting the Impacts of Climate Change

The vulnerability to climate change across all sectors has prompted Arab countries to adopt a comprehensive strategy to confront its impacts. This strategy revolves around public policies to be pursued at the regional and international levels, as well as the establishment of institutional frameworks capable of monitoring the implementation of these policies. The strategy aims to stabilize greenhouse gas levels through adaptation and mitigation mechanisms addressing the impacts of climate change.

Subsection one: Policies of Arab Countries in Addressing Climate Change

Arab countries attach great importance to the issue of climate change and have signed numerous international and regional agreements related to environmental protection, many of which address climate change. This reflects political will to integrate the issue into economic, social, and environmental policy debates. The following section presents regional and international public policies addressing climate change.

The First Sub-subsection: Regional Public Policy

At the regional level, Arab countries have adopted increased attention to climate change issues. This concern has been reflected in the activities of the **Council of Arab Ministers Responsible for Environmental Affairs**, some of which are outlined below.

The Council, during its **19th session**, adopted the *«Arab Ministerial Declaration on Climate Change»*, which constitutes a foundation for future action, starting from the **Conference of the Parties in Bali, December 2007**. The declaration reflects the Arab perspective on addressing

climate change issues and emphasizes that the Arab region will be among the regions most exposed to the potential impacts of climate change, and that confronting these impacts requires maximum collective action by Arab states.

The **Arab Group on Climate Change Negotiations** was established in implementation of the decisions of the Council of Arab Ministers Responsible for Environmental Affairs in **December 2008**, as one of the most important mechanisms for Arab engagement in climate change negotiations. The group held an extraordinary meeting in **2011** to coordinate Arab positions.

(Unified Arab Economic Report 2016, International Monetary Fund, p. 346).

A **Joint Committee on Environment and Development in the Arab World** was formed, comprising Arab states, international, regional, and national institutions, as well as specialized organizations of the League of Arab States. The committee is tasked with coordinating environmental programs, projects, and activities in the Arab region. (Baker, January 2004, p. 12.)

The Second Sub-subsection: International Public Policy

At the global level, there are numerous international environmental protection agreements in which Arab countries participate as members, such as the **Montreal Protocol on the Protection of the Ozone Layer**, the **United Nations Convention on Biological Diversity**, the **Basel Convention**, the **United Nations Framework Convention on Climate Change (UNFCCC)**, and the **Kyoto Protocol** derived from it. These international agreements obligate Arab countries, like other nations, to cooperate with the international community in protecting local and global environments by adopting appropriate national policies and action plans to confront existing environmental challenges.

Based on these commitments, many Arab countries have recently undertaken efforts to adopt policies and legislation necessary for environmental protection, improve and develop productive structures, and rationalize consumption patterns in line with sustainable development objectives. In this context, national and regional organizations play a key role in activating these

trends through organizing seminars, workshops, scientific forums, and preparing relevant research and studies. (Al-Ghazali, January 2014, p. 12.)

Section Two: International Agreements Signed on the Environment and Climate Change

Arab countries participate in most international agreements and protocols related to the governance of transboundary pollution and trade in endangered species. With regard to the United Nations Framework Convention on Climate Change (UNFCCC) and its annexed Kyoto Protocol, Arab countries coordinated their positions in rejecting the proposals of industrialized countries concerning negotiations on the second commitment period beyond 2012, particularly with respect to emission reduction obligations in developing countries. (AMF, Unified Arab Economic Report, 2006.P.212)

Most Arab countries, especially oil-producing ones, chose not to sign the Kyoto Protocol, arguing that their emission quotas were already saturated and that they would not derive significant benefits from it. In contrast, non-oil-producing Arab countries found an opportunity to benefit from the Clean Development Mechanism and carbon trading. Accordingly, Egypt, Morocco, Tunisia, Jordan, Yemen, and finally the State of Qatar signed the agreement. (Hashem, n,d. p.9)

The following table illustrates the status of Arab countries with respect to the United Nations Framework Convention on Climate Change (UNFCCC).

(Fakhr-Al-Din, n.d, p.2)

Table No. (12): A table showing the Arab oil-exporting countries and the United Nations Climate Change Convention

(R = Ratification, AC = Accession)

Country	Signature	Ratification	Entry into Force
United Arab Emirates	–	29-12-1995 (AC)	28-03-1996
Bahrain	08-06-1992	28-12-1994 (R)	28-03-1995
Algeria	13-06-1992	09-06-1993 (R)	31-03-1994
Saudi Arabia	–	28-12-1994 (AC)	28-03-1995
Syria	–	04-01-1996 (AC)	03-04-1996
Qatar	–	18-04-1996 (AC)	17-07-1996
Kuwait	–	28-12-1994 (AC)	28-03-1995
Libya	29-06-1992	14-06-1996 (R)	12-09-1999
Egypt	–	05-12-1994 (R)	05-03-1995

Source: (Rula , nd, p. 3)

From the above statistics, it can be observed that most oil-exporting Arab countries have begun implementing the Convention.

The United Arab Emirates ratified accession to the United Nations Framework Convention on Climate Change pursuant to Federal Decree No. (61) of 1995, shortly after its entry into force in 1994. It subsequently ratified accession to the Kyoto Protocol immediately upon its entry into force, pursuant to Executive Decree No. (75) of 2004. (FEA, February 2008, p. 10)

The following table shows the dates of accession and ratification of the Kyoto Protocol by Arab countries:

Table No. (13): Arab Oil Exporting Countries and the Kyoto Protocol

Country	Signature	Date of Ratification / Accession to the Kyoto Protocol
United Arab Emirates	–	26-02-2005
People's Democratic Republic of Algeria	–	16-02-2005
Kingdom of Saudi Arabia	–	31-02-2005
State of Qatar	–	11-12-2005
Arab Republic of Egypt	15-03-1999	12-02-2005
State of Kuwait	–	11-03-2005
Syrian Arab Republic	–	27-01-2005
Kingdom of Bahrain	–	31-02-2006
Socialist People's Libyan Arab Jamahiriya	–	24-08-2006

Source: (Rula , nd, p. 3)

The table indicates that most Arab countries ratified accession to the Kyoto Protocol shortly after its entry into force.

Within this framework, Algeria signed several agreements and worked toward fulfilling their provisions. The following table summarizes the most important international agreements signed by Algeria and the national reports prepared accordingly. (**Ministry of Spatial Planning and the Environment, & National Observatory for the Environment and Sustainable Development.**

Table No. (14): The most important international agreements signed by Algeria and the commitments fulfilled

Agreement	Date of Ratification	Implemented Commitments
UN Framework Convention on Climate Change	1993	Reports for 2001 and 2010; currently preparing a new report
Kyoto Protocol	2005	Preparation of the National Climate Plan
UN Convention to Combat Desertification	1996	National reports for 1999, 2000, and 2004
UN Convention on Biological Diversity	1995	Reports for 1997 and 2005
Ramsar Convention	1984	Law No. 11-20 of 2011
Basel Convention	1998, 2006	Reports for 2000, 2001, 2004, 2005, and 2006
Convention on Wetlands	1982	Law No. 11-02 of 2011
Barcelona Convention on Industrial Pollution	2006	National plan prepared in cooperation with relevant sectoral partners

Source: (Observatoire National de l'Environnement et du Développement Durable, , March 2012.)

Section Three: Adaptation and Mitigation Strategies for Climate Change Impacts

The development of adaptation and mitigation strategies for climate change impacts is of paramount importance in identifying priority adaptation and mitigation activities that respond to urgent and immediate needs, as well as in defining guiding principles for efforts undertaken to address climate change. In this context, Arab countries have prepared strategies for adaptation and mitigation of climate change impacts, which are presented as follows:

CHAPTER THREE:
CLIMATE CHANGE AND ITS IMPACTS ON THE ECONOMIES OF ARAB COUNTRIES:

Section One: Adaptation Strategy to Climate Change Impacts

Adaptation measures have become a priority necessity for addressing climate change issues during the first half of the current century. This necessity stems from a set of objective factors, foremost among them the inevitability of climate change as a result of past emissions, the limited effectiveness of mitigation measures in the Arab region, and the prevailing natural, environmental, economic, and social conditions. In addition, adaptation measures play an effective role in saving lives and reducing risks associated with climate variability and climate change.

First: The Agricultural Sector

Although adapting agricultural cover to climate change is expected to be costly, it remains essential for achieving Arab food security. Among the adaptation options is a shift toward cultivating crops that are more resistant to drought and faster in maturation, such as maize, as well as diversifying the production of high-value crops, including fruits and vegetables that are more flexible and better adapted to climatic conditions. This also entails improving soil management and fertility by transitioning to new agricultural systems compatible with future climatic and economic conditions, in addition to research and development of genetically modified crops capable of withstanding drought, and the use of seawater desalination technologies.

There is also a need to focus on increasing irrigation efficiency and using supplements for rain-fed crops. Nevertheless, the Arab region is considered the original habitat of genetic resources for approximately 80 to 100 crops, fruit trees, and livestock breeds that possess the capacity to enhance water-use efficiency, resist diseases, and whose value is increasing due to their adaptive characteristics under the pressures resulting from climate change. Other adaptation options include the use of green belts as barriers to curb desertification, and the avoidance of deforestation.

Moreover, increasing practices that enhance carbon dioxide sequestration in forests, and converting animal waste into biogas as an alternative and renewable energy source,

constitute additional adaptive measures. (Mashdan, 2017, p.p833-834)

Second: The Water Sector

Adaptation strategies in the water sector are urgently required for Arab countries facing recurrent droughts. Among the most important measures is the construction and development of dams. Currently, the total storage capacity of dams in the Arab world is estimated at approximately 280 cubic kilometers. Although some countries have expanded their dam construction capacities (such as Egypt and Iraq), storage capacity is no longer sufficient in many cases, and dam waters suffer from increased evaporation losses under climate change conditions.

At present, approximately 30 cubic kilometers of non-conventional water are produced annually through seawater desalination, particularly in the Arabian Gulf, with groundwater aquifers being used as a strategic reserve for desalinated water. Arab countries should also work to reduce water losses, which may exceed 60% in poorly maintained distribution networks, and benefit from available opportunities to reuse treated wastewater. Furthermore, pricing water at its market value can help curb excessive consumption, despite the fact that bridging the water deficit in the region has become increasingly costly, as shown in the following table.

Additional measures include enhancing soil water retention through improved agricultural land management, integrating agriculture with forestry, improving nutrient-use efficiency, and rehabilitating degraded lands. (Mashdan, Climate Change and the Challenges of Arab Food Security, Studies in Economics, 2017, p.p. 835-836)

Third: The Tourism Sector

The future of Arab tourism depends on the manner in which this sector adapts to climate change. Future tourism development must take anticipated climate changes into account through integrated and comprehensive planning, including the establishment of

clearer guidelines regarding permissible distances between permanent facilities and the coastline.

It is also necessary to explore alternative and more sustainable tourism options that are less affected by climate variability, such as cultural and heritage tourism. Finally, greater emphasis should be placed on developing inland and desert tourism centers as alternatives to coastal areas that are at risk of loss.
(Kamal-Tolba & Saab, 2009, p.21)

Sub-subsection Two: Climate Change Mitigation Strategy

Various international agreements include provisions that obligate signatory states to reduce their emissions of greenhouse gases responsible for global warming. Accordingly, Arab countries, by signing most of these international agreements, are required to intensify their efforts within this framework. Since the majority of greenhouse gas emissions in the Arab region are associated with the energy sector, most climate change mitigation policies have focused on reducing emissions originating from the energy sector, in addition to certain other sectors such as industry and transport, among others.

First: The Energy Sector

The Arab energy sector, on both the production and consumption sides, represents the largest contributor to greenhouse gas emissions in the region, particularly carbon dioxide (CO_2). Energy production processes alone account for approximately 34% of greenhouse gas emissions. Therefore, it is necessary to give priority to climate change mitigation programs in this sector, not only to confront climate change, but also to improve the efficiency of energy production and consumption processes, diversify energy sources, preserve the natural resources available to countries in the region, achieve economic efficiency in production and consumption, and protect the environment and public health. (AMF, Unified Arab Economic Report, 2016.)

On the demand side, measures to improve energy efficiency in the most energy-consuming sectors, such as industry, transport, and commercial sectors, include efficient

lighting systems, improving cooling efficiency, enhancing combustion efficiency, and recovering waste heat, in addition to many other measures. These actions contribute to improving overall energy efficiency in the economy and diversifying energy sources and uses away from fossil fuels, while encouraging the use of renewable energy alternatives.

Concrete examples in the Arab world include the commercial use of wind energy in Egypt; the widespread use of solar energy for water heating in Palestine, Tunisia, and Morocco; the adoption of compressed natural gas as fuel for transportation in Egypt; concentrated solar power projects in Egypt, Tunisia, Morocco, and Algeria; the establishment of the first two Arab green building councils in the United Arab Emirates and Egypt; the large-scale afforestation program in the UAE; the first completely carbon-free city in Abu Dhabi; and the pioneering carbon capture and storage project in Algeria. In addition, Jordan has adopted tax and fee exemptions to encourage the use of hybrid vehicles. In a particularly promising development, the International Renewable Energy Agency (IRENA), recently established, selected Masdar City in Abu Dhabi as its headquarters.

Cooperation among Arab countries can also be enhanced in areas such as energy efficiency, renewable energy, the use of compressed natural gas as a transportation fuel, and investment in carbon capture and storage.
(Tolba & Saab, 2009, p. 16.)

Second: The Tourism Sector

There are numerous ways through which the Arab tourism sector can respond to climate change, as in many cases it adds value by promoting improved efficiency in energy and water use, or by reconsidering the marketing of tourist destinations. These adjustments are beneficial even without the additional momentum of climate change.

For example, green tourism, based on energy- and water-efficient activities and infrastructure, represents a significant opportunity in this regard. Similarly, some new forms of tourism, such as medical and therapeutic tourism, are currently expanding and

demonstrate resilience to climate change impacts. Moreover, they generate additional benefits for host countries by improving medical and related services. These high-growth and climate-resilient tourism opportunities should therefore be pursued. (Werner, (n.d.). (Report No. 64635))

Third: The Transport Sector

Policies and measures developed by Arab countries aim to establish sustainable transport systems. These include developing comprehensive road transport plans, introducing new systems for managing traffic congestion in cities to reduce wasted time, and improving transport infrastructure.

Technological measures include introducing lower-carbon fuel alternatives, such as public vehicles powered by compressed natural gas and liquefied petroleum gas, adopting vehicle emission standards, fuel economy standards, and shifting from diesel to electric traction on railway lines.

The use of public transport is a particularly promising option and has already been implemented in practice. For example, the establishment of the underground metro system in Cairo has contributed significantly to alleviating traffic congestion in the city. Plans are also underway to develop light rail systems in Damascus, Amman, Alexandria, Dubai, Algeria, Morocco, and Tunisia. (Tolba & Saab, 2009, p. 40.)

Fourth: The Waste Sector

Arab countries seek to coordinate requests for financial and technical support available under international environmental agreements related to hazardous resources and waste. They support Kuwait's request to host the regional center for the Arab region under the Stockholm Convention, as well as Morocco's request to host the regional center for Africa under the same convention.

Arab countries are currently taking joint measures to build capacities and develop human resources for the preparation and implementation of national action plans. Most Arab countries have also acceded to the Rotterdam Convention concerning the Prior

Informed Consent Procedure for certain hazardous chemicals, participate in activities of the Globally Harmonized System for chemical classification and labeling at the international level, and call upon the United Nations to form a fact-finding committee regarding suspected Israeli waste smuggling and burial in the occupied Palestinian territories. (AMF, Unified Arab Economic Report, 2006. p.212)

Fifth: The Industrial Sector

The industrial sector is among the most energy-consuming sectors in the Arab world. Most Arab countries, especially those rich in hydrocarbon resources (oil and gas), depend primarily on these resources to supply energy for their industries. Energy-intensive industries such as oil refineries, mineral extraction, chemicals, and petrochemicals have flourished in oil-producing countries.

Certain technologies have proven globally appropriate, both technically and economically, for improving energy efficiency in the industrial sector. These include industrial process control, waste heat recovery, improved combustion efficiency, energy management systems, combined heat and power systems, high-efficiency lighting, and many others. Several Arab countries have successfully adopted programs to improve energy efficiency in the industrial sector, including building national capacities for conducting and reviewing energy audits and deploying energy-efficiency technologies.

Energy efficiency has been adopted and promoted as a key strategy across various sectors of the Egyptian economy, and it is expected that energy consumption in the industrial sector could be reduced by approximately 25% or more with favorable returns. In the United Arab Emirates, measures include energy-saving systems for industrial motors. Measures to reduce greenhouse gas emissions and improve energy efficiency have been documented in Lebanon's First National Communication, including high-efficiency motors, improved combustion in heating processes, and enhanced efficiency in the cement industry. (T (Tolba & Saab, 2009. p.42)

As for Algeria, it places particular importance on developing the industrial sector, which is closely linked to the energy sector, especially in petrochemical industries. The national strategy for reducing greenhouse gas emissions is based on strengthening partnerships between the public and private sectors, as well as between local and international actors, to enable broader access to cleaner production technologies and promote their widespread use at reasonable costs. The plan includes the following components: (Bousbaïne T. , 2015,p.p. 244-255)

- Conducting environmental audits of industries emitting greenhouse gases.
- Establishing environmental management systems at the institutional level.
- Developing systems for measuring and monitoring greenhouse gas emissions.
- Strengthening and enforcing laws related to reducing environmentally harmful emissions
- Establishing a sector-wide database.

Section Four: Assessment of efforts undertaken to address Climate Change in Arab Countries and their challenges

In light of the environmental degradation witnessed across Arab countries - most notably the damage caused by climate change phenomena- Arab states have resorted to undertaking concerted efforts aimed at confronting this phenomenon and mitigating its adverse effects, through the pursuit of effective solutions to reduce the impacts of climate change.

Subsection One: Assessment of Efforts Undertaken to Confront Climate Change

Despite the efforts exerted by Arab countries to address climate change, Arab environmental cooperation remains limited and, at present, is largely confined to coordinating Arab positions in international environmental forums.

Sub-subsection One: Positive Aspects

1. Arab countries have, to varying degrees, adopted ambitious plans and programs for the development of the environmental sector and the combatting of pollution. The

implementation of these plans and programs has been entrusted to specialized research centers, such as the Environment Affairs Committee of the League of Arab States, the Regional Organization for the Protection of the Marine Environment headquartered in Kuwait, and its affiliated Emergency Information Exchange Center based in Bahrain.

2. Under the auspices of the League of Arab States, and with the support of international agencies and specialized civil society organizations, the Council of Arab Ministers Responsible for Environmental Affairs prepared key background papers for negotiations on international environmental agreements. The Council played an active role in these negotiations, particularly with regard to climate change. Moreover, the League of Arab States adopted a regional strategic framework for sustainable development, in addition to regional strategies on water, agriculture, climate change, and other related fields.

3. At the level of public policy, sustainable management of natural resources has been incorporated into development agendas in several Arab countries. A major policy shift has been reflected in recent reforms of energy and water pricing across the region, including in major oil-producing countries of the Gulf Cooperation Council, alongside reforms of subsidy policies. The region has also made progress in adopting sustainable energy policies, such as energy efficiency targets and action plans, green building regulations, and renewable energy policies.

4. Given that the Arab region is among the most economically and environmentally vulnerable to the impacts of climate change, the commitment of Arab countries to the international process of addressing climate change, culminating in the Paris Agreement, has been evident. All 22 members of the League of Arab States signed the Agreement, with the exception of Syria; fourteen countries ratified it, and thirteen submitted their first nationally determined contributions.

Sub-subsection Two: Shortcomings

1. The regional strategies adopted by the League of Arab States have had limited impact on national efforts aimed at achieving sustainable development.

2. In order to achieve the objectives and action plans related to energy efficiency, green building regulations, and renewable energy policies, regional institutions need to move beyond rhetorically ambitious declarations toward effective implementation on the ground. Arab countries also need to strengthen their legislative and institutional frameworks.

3. Despite Arab countries commitment to the climate change process, the regional approach to addressing climate change has failed due to the absence of binding political commitments to regional cooperation.

4. The fragility of Arab economies has hindered numerous development projects in the region, as most countries lack serious programs for rural development, pastoral and rangeland development, farmer support and empowerment, as well as well-designed programs for disaster risk reduction and the care of displaced persons and refugees. Moreover, the failure to integrate environmental concerns into core national development plans, particularly poverty reduction strategies, has impeded effective environmental governance in Arab countries.

5. Climate change adaptation measures have failed in several critical areas, such as water resources, food security, energy security, and the management of coastal and marine resources, as reflected in development plans, policies, and strategies adopted by Arab countries at both the national and regional levels.

6. The weakness of local civil society institutions, such as trade unions, associations, media outlets, universities, and the private sector—has limited their potential influence at the regional and sub-regional levels in exerting pressure on Arab governments to adopt effective environmental policies aligned with sustainable development goals.

7. Despite the efforts undertaken by Arab countries to address the impacts of climate change, these efforts remain disproportionate to the magnitude of the risks, as there is no single Arab institution specifically dedicated to addressing climate change impacts in the region.

8. Environmental protection continues to occupy a low priority on the agendas of Arab governments.

9. Notwithstanding the progress achieved, significant knowledge gaps persist regarding exposure, sensitivity, adaptive capacity, and the rate at which physical, ecological, and social systems are affected by climate change.

10. The majority of Arab countries continue to rely on a "command-and-control" approach in environmental governance, a policy that has demonstrably failed to bring about tangible improvements in the state of the Arab environment.

11. There is a lack of specialized Arab scientific entities dedicated to specific environmental issues of relevance to the Arab world, and research efforts in environmental studies remain fragmented and confined to a limited number of Arab countries.

Subsection Two: Challenges in Addressing Climate Change

The formulation of general strategies to address the impacts of climate change remains insufficient unless accompanied by the establishment of concrete mechanisms and operational tools capable of achieving the defined objectives related to mitigation and adaptation. The practical implementation of such strategies faces several challenges, which can be outlined as follows:

1. Reducing greenhouse gas emissions requires the activation of mechanisms for technological exchange without undermining the process of economic development. This can be achieved through strengthening agreements between universities and international and local research centers in order to acquire advanced technologies, particularly in the field of renewable energy, which constitutes a promising sector worthy of development given Algeria's significant potential. Encouraging investment in renewable energy is therefore a strategic priority.

2. To effectively confront future environmental challenges, Arab countries are called upon to adopt concrete measures to support partnerships with the private sector, enhance its participation in environmental policymaking and strategy formulation, create an

enabling environment for investment in cleaner production projects, develop appropriate economic instruments to support environmental compliance among small and medium-sized enterprises, and work toward harmonizing environmental standards and specifications across Arab countries. (AMF, Unified Arab Economic Report, 2006. p.213)

3. The environment in the Arab region faces numerous challenges, including water management, combating desertification, reducing air pollution, and addressing the degradation of coastal environments, in addition to emerging environmental threats such as the increasing frequency of natural disasters and other environmental issues. In this context, the Council of Arab Ministers Responsible for Environmental Affairs was established in 1987 and has since adopted several decisions aimed at improving quality of life and promoting development in the Arab region. Among its initiatives are the launch of the Sustainable Development Initiative in the Arab Region and the Arab Ministerial Declaration on Climate Change, in addition to other decisions related to behavioral change, environmental awareness, legislation, and disaster risk reduction, particularly in the context of climate change. (Moussa, 2010, p. 16)

4. The lack of allocated and readily available financial resources constitutes one of the main challenges to disaster risk reduction. In most Arab countries, national budgets do not include specific allocations for disaster risk reduction, as governments face severe budgetary constraints, particularly in low-income countries where financial conditions are extremely strained. (Reduction, 2015, p. 9)

5. The Arab region also faces challenges resulting from industrialization processes, population growth, and increased reliance on private transportation in affluent societies, compounded by weak public transport systems and the aging vehicle fleets in some countries. Energy consumption has risen due to population and economic growth, industrial development, rising living standards, and urban expansion, alongside insufficient generation of clean energy and limited use of locally sustainable and environmentally friendly building materials. Moreover, several Arab countries lack

integrated systems for solid waste and wastewater collection, treatment, and safe disposal, leading to significant health and environmental problems. Climate-related risks and natural hazards in urban areas require deeper understanding, and it is essential to adopt measures that enhance resilience to climate change impacts and reduce disaster risks, which in turn necessitates cooperation among states to address these challenges. (States, 21–22 December 2017, p. 2)

Subsection Three: Proposed Solutions and Mechanisms to Address Climate Change

In order to confront the risks associated with climate change, a number of proposed solutions can be identified as follows:

1. Strengthening international cooperation to improve access to modern energy services and reduce reliance on biomass, which remains the primary energy source for approximately 2.5 billion people.

2. Reducing the rate of growth in carbon emissions in Arab countries through reinforcing energy sector reforms supported by financing and technology transfer.

3. Integrating carbon finance on a project basis through the Clean Development Mechanism and other flexible mechanisms under the Kyoto Protocol within programmatic, sectoral, and national strategies to support the transition toward low-carbon production.

4. Providing substantial financing for Arab cooperation in the field of coal, while developing incentives to promote and disseminate integrated gasification combined cycle technologies and carbon capture and storage.

5. Enhancing the capacity to assess climate change risks and mainstreaming adaptation across all aspects of national planning.

6. Exploring innovative financing options to mobilize support for adaptation, including carbon taxation, levies on tradable emission permits under cap-and-trade schemes, aviation taxes, and broader fiscal measures.

7. Developing a robust water management strategy in light of the anticipated economic, social, political, and security challenges associated with water scarcity.

8. Moving toward diversification of technical partnerships in environmental and climate cooperation, benefiting from foreign expertise, particularly European experience, and establishing partnerships with other countries to combat the impacts of climate change.

9. Establishing networks for the exchange and monitoring of environmental and climate-related information with other countries.

10. Recognizing that water, food, and energy form a complex nexus of interrelated systems, whereby policies and subsidies in one sector strongly affect the other two. Arab policymakers should therefore reassess current and future development strategies through this nexus lens, which would contribute to more effective achievement of sustainable development goals.

11. Facilitating access to reliable climate-related information and ensuring its public dissemination. Without accurate data on temperatures and precipitation levels, assessing current climate conditions and forecasting future trends becomes extremely difficult. Agriculture, for example, is not merely a victim of climate change itself, but primarily suffers due to insufficient preparedness and inadequate response mechanisms.

12. Establishing supportive policies and an institutional framework for adaptation, as core prerequisites for effective development—such as the rule of law, transparency, accountability, participatory decision-making, and reliable public service delivery aligned with international quality standards—can significantly enhance development outcomes and adaptation efforts. Climate adaptation also requires the development or revision of climate-smart policies and institutional frameworks at all levels.

13. Sound planning for adaptation, strong cooperation between governmental and non-governmental actors, and the availability of adequate financial resources are all essential factors in building adaptive capacity to climate change.

14. Financing climate-friendly projects that achieve tangible reductions in greenhouse gas emissions, such as renewable energy projects and energy efficiency initiatives.

15. Rationalizing the consumption of fossil and non-renewable energy sources, promoting conservation, and pursuing a gradual, systematic transition toward renewable energy.

16. Expanding tree-planting initiatives, as a single tree can absorb substantial quantities of atmospheric carbon dioxide while releasing enough oxygen to meet the needs of four individuals.

17. Developing an integrated public policy for the management and development of coastal zones, taking into account the potential rise in sea levels, accompanied by continuous monitoring—such as through remote sensing techniques—and the availability of corrective implementation mechanisms when necessary.

18. Encouraging scientific and technological research across all climate change–related fields, supported by clearly defined plans and dedicated funding.

19. Enacting national legislation in line with the decisions of the Paris Agreement to ensure compliance by both public and private sectors in mitigation and adaptation efforts.

20. Establishing specific mechanisms to monitor industrial activities in order to prevent deliberate non-compliance with emission limits specified in nationally determined contributions.

21. Assigning high priority to identifying environmental protection measures that yield economic returns and ensuring their prompt implementation.

22. Activating climate change reporting mechanisms in cooperation with the United Nations Environment Programme, with the aim of building national expertise in each country and strengthening capacity in greenhouse gas monitoring, clean technology use, and emission reduction.

23. Raising levels of environmental awareness and culture among different segments of society to foster generations capable of actively contributing to environmental protection and conservation.

The Arab region is considered one of the areas most exposed to risks generated by climate change. The impacts vary from one area to another, which has resulted in the region facing diverse environmental challenges. Based on the issues examined in this chapter, the following conclusions can be drawn:

- Although Arab countries possess significant economic resources, they continue to suffer from underdevelopment and economic dependency on developed countries.

- The Arab region is experiencing rising waves of surface temperatures, and this climatic change is expected to have negative effects on various aspects of life.

- Despite being among the regions that contribute least to climate change due to the relatively low volume of greenhouse gas emissions generated by their economic and social activities, the Arab region is nevertheless among the most vulnerable to the impacts of climate change.

- Economic sectors in Arab countries, particularly agriculture and energy, are among the most affected by climate change, which has contributed to the continuous decline of the Arab economy.

- Arab countries are making considerable efforts to address the challenges of climate change through mitigation and adaptation measures; however, these efforts remain insufficient to effectively confront the risks and impacts of climate change affecting the region.

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