About the book:
The book aims is to study the impact of climate change on achieving some of the global Sustainable Development Goals 2015-2030 (SDGs). It provides an explanation of the nature of climate change, its causes, and its significant manifestations observed in the past few decades, in Egypt, the African continent, developing countries, developed countries, and their future expectations. The most significant socio-economic impacts of climate change on water availability, food production, land resources, infrastructure, and the environment are presented.
More specifically, the book provides a discussion of the impact of climate change on achieving the goals of eradicating hunger and extreme poverty, access to quality education, health and well-being, women's empowerment, and gender equality. In view of the growing impact of climate change on increasing the phenomenon of migration, asylum, and displacement worldwide, a detailed debate on the issue is included. Lastly, the foundations of building policies and programs aiming to mitigate and adapt to the impact of climate change are summarized.

Prof. Khaled Hassan is an international expert in economics and demography. He holds Ph. D. in Economics. He is the Vice-President of the Egyptian Society for Migration Studies. Formerly, he was a demographic advisor at UNDP-Kuwait. He has many publications in the fields of population and development, labor force and migration, and climate change.

9 786204 977560

Khaled El Sayed Hassan

Khaled El Sayed Hassan

Climate Change and the Global Sustainable Development Goals

LAP LAMBERT Academic Publishing

Khaled El Sayed Hassan

Climate Change and the Global Sustainable Development Goals

Khaled El Sayed Hassan

Climate Change and the Global Sustainable Development Goals

LAP LAMBERT Academic Publishing

Imprint

Cover image: www.ingimage.com

Publisher:
LAP LAMBERT Academic Publishing
is a trademark of
Dodo Books Indian Ocean Ltd., member of the OmniScriptum S.R.L Publishing group
str. A.Russo 15, of. 61, Chisinau-2068, Republic of Moldova Europe
Printed at: see last page
ISBN: 978-620-4-97756-0

Climate Change and the Global Sustainable Development Goals

By:

Khaled El Sayed Hassan

June, 2022

Dedication:

To the soul and Joy of my heart

My grandchildren (Hamza, Norina, and Selim)

My end-of-service gratuity!!!

Index

Foreword:

Despite the unprecedented, remarkable, and rapid development in all fields of science and knowledge that enhance the well-being of humans and the planet, there are always some challenges that distort the image and limit the results. Climate change is one of the phenomena representing the most significant challenge to humanity during the twenty-first century. The challenges related to climate change include but are not limited to the escalation of global warming, energy production, water scarcity and its impact on agricultural production, environmental pollution, conflicts and wars over land, resources, water, and food, the loss of biodiversity, deforestation, fisheries, overfishing, and waste and recycling management, and the problem of extinction. It is noted that climate change has a negative impact on all economic and social aspects related to the life and existence of human beings on the surface of this planet.

The seventeen Sustainable Development Goals (SDGs), formulated by the United Nations bodies on 25th September 2015 reflect the economic, social, and environmental ambitions and the international cooperation of human society. The 17 Sustainable Development Goals are complementary (i.e. the actions in one goal will affect results in others), so development must balance social, economic, and environmental sustainability. The time frame for implementing these goals extends from 2015 to 2030.

We found that it is of great importance to study global climate change; its causes and most essential manifestations; its current evidence and future expectations; its economic and social impacts. Additionally, we found that the interrelation between global climate change and some SDGs, and how it can affect the ability of the international community to achieve these goals are worth to be studying, analyzing, and interpreting. Eliminating hunger and extreme poverty, providing quality education, empowering women and gender equality, and good

health and welfare were selected to assess the impact of global climate changes in achieving each one of them.

In view of the growing impact of climate change in increasing the flows of global migration, refuge, and displacement during the past two decades, and the expectations of increasing their numbers during the next three decades without the least legal and humanitarian protection for them, we have decided to address the impact of global climate changes on the phenomena of migration, refuge, and displacement in a separate chapter in this book.

It is worth noting that migration, refuge, and displacement are not among the 17 SDGs, but they have been implicitly referred to within the sub-targets of some SDGs. The referral was not either negatively or positively, but rather to the necessity of providing, an organized, safe, and responsible means of migration to preserve one's humanity and dignity. Lastly, the foundations of global policies to mitigate and adapt to the impact of climate change were clarified and explained in the last chapter of this book.

This is the fourth book of my publications. I hope it receives your appreciation, and be useful to researchers and experts in the fields of climate change, sustainable economic and social development, and environmental affairs. Moreover, I am looking to this book to be a reference for them with its contents of documented data, evidence, and indications, and to add more to their experiences and knowledge.

The author

Khaled El Sayed Hassan

Cairo, Egypt.

6/6/2022

Chapter 1
Climate Change and Global Sustainable Development Goals
(Interrelations and Interactions)

What is the Climate Change?

Climate change is a term that refers to “The changes that occur in climate and attribute directly or indirectly to human activity and lead to the observed change in the composition of the Earth’s atmosphere, in addition to the natural variability of climate, over similar time periods”. The causes of climate change vary between:

Natural causes:

- The changes that occur to the Earth's orbit around the sun and the resulting change in the amount of solar radiation that reaches the Earth. It is an important cause of climate change, occurs throughout history.

- Volcanic eruptions, which represent another environmental cause of natural climatic changes.

Abnormal causes:

- Represents various human activities such as cutting timber, deforestation, and human use of traditional energy such as coal, gas, oil, etc. Such activities lead to increasing the carbon dioxide rate in the atmosphere and thus increase the temperature of the earth, or the “Global Warming" phenomenon.

The imbalance in the components of the atmosphere appeared at the end of the nineteenth century and the beginning of the twentieth century, As a result of increasing the human activities since the industrial revolution until the present day, due to its dependence on fossil fuels "coal, oil, natural gas as the primary source of energy and the use of chlorine and fluorocarbon gases in industries in a large way "Global Warming". If the current patterns of fossil fuel use, development, and population increase continue, there will be a continuous change in the climate that will have serious effects on the environment and thus on human life. This impact will extend in the future to include all aspects of human life on earth.

Manifestations of global climate change:

When the topic of global climate change is raised, most of us think only of environmental manifestations, such as rising temperatures, melting polar icebergs, and rising sea and ocean levels. There is no doubt that these environmental manifestations of global climate changes do affect the daily lives of people, but it is also a certain fact and has become firmly proved that the planet is gradually getting warmer and the main reason for this is the greenhouse gas emissions released by human activities.

If the current patterns of fossil fuel use, development, and population increase continue, there will be a continuous change in the climate that will have serious effects on the environment and thus on human life. This impact will extend in the future to include all aspects of human life on earth. The most important manifestations of climate change are as follows:

Global warming:

It is known as the greenhouse effect. It is defined as "the gradual increase in the temperature of the lower layer of the atmosphere near the Earth's surface, caused by the increase in the emission of greenhouse gases." Most studies confirm that climate change related to global warming has become a reality and that the potential for an increase in the problem is growing. Evidence at the global level indicates that:

- The eleven years of the period 1995-2005 were classified as the warmest in the global surface temperature record since 1850. The period 2001-2005 recorded an increase in the Earth's temperature by 0.95 °C. (WHO, 2008).

- Currently, an increase in the ocean's temperature has been observed at a depth of 3000 meters compared to 1961, which means a relative decrease in the ocean's abilities to absorb heat, with the possibility of expansion of seawater due to the increase in its temperature.

- A decline in the sizes and areas of snow mountains and snow-covered areas in the northern and southern hemispheres, as a result of the melting of ice due to the rise in global temperature, and consequently the rise in sea level.

Melting glaciers and rising sea levels:

Over the past decade, sea levels have increased at a faster rate than over the past 30 years, and a global reduction in mountain glaciers and snow-covered areas has been observed.

Changing precipitation patterns:

During the past century, precipitation rates increased significantly in the eastern parts of North and South America, Eastern Europe, and eastern and central Asia, while they decreased in the regions of the African Sahel, the eastern Mediterranean, southern Africa, and parts of southern Asia. Globally, the area affected by drought is likely to have expanded since the 1970s. It is believed that heatwaves have become more frequent in most of land areas, heavy precipitation has increased in most areas, and sea level has been rising worldwide. There is also some data indicating an increased intensity of tropical cyclone activity since 1970 (Hadley Research Center, 2008).

High levels of carbon dioxide :

The finger points to human activities as the main cause of climate change. It is highly likely that most of the observed increase in temperature since the mid-twentieth century is due to concentrations of greenhouse gases released by human activities, particularly carbon dioxide emitted from burning fossil fuels. Carbon dioxide levels have increased from 280 parts per million in the pre-industrial era to 379 parts per million today, representing the highest concentration on Earth since the Ice Ages. Rates of increase in Carbon dioxide concentration accelerated between 1995 and 2005, with an annual average of 1.9 ppm (OHCHR, 2009).

Climate change caused by human activities will continue for at least the next few decades. Even if greenhouse gas emissions can be stopped immediately, temperatures are expected to rise by 0.6 °C this century. Certainly, the development paths the world chooses have a strong influence on this increase. Expectations indicate that if the world wakes up to the danger of using fossil energy in sustainable development and turns to the use of renewable, and clean energy sources, the Earth's temperature will rise by

about 1.8 °C (weighted range: 1.1-2.9 °C), but if the world's concentration continues on the use of fossil energy in development in the current form or more broadly, the Earth's temperature will rise by approximately 4.0 °C (weighted range: 2.4 - 6.4 °C) with an increase in the potential for sudden effects.

In a report published by the World Meteorological Organization (WMO); climate around the world was analyzed based on documented information and data collected by 80 local meteorological institutions around the world, it indicated that 2016 was the warmest year in documented history, where temperature recorded the highest increase in the history by about 0.06 °C, over its counterpart in 2015, which was the highest before 2016, which means that for the second year in a row, the Earth's temperature continues to break known limits and record new unprecedented levels. Moreover, the rate of carbon dioxide emissions reached unprecedented levels, and the snow level at the poles, during the winter season, recorded its lowest rate in history. Beginning of 2017, climate change continued to break records and reach unprecedented levels. Comparing the current climate pattern with the prevailing climate pattern during the period 1961-1990, we find that Earth's temperature has increased by 0.83 °C more than what was expected, which means an increase of 1.1 °C, over the temperature of the planet during the pre-industrial era.

The study also indicated that the temperature of the poles increased 3 °C more than those levels during the reference period (1961-1990). In the Svalbard region and the Danish islands around the Arctic, the average increase was 6.5°C for the whole year. The most influential factor in temperature increase was the rise in carbon dioxide emissions. The rate of increase in carbon dioxide emissions in 2016 was the fastest in recorded history, reaching 3.4ppm of air during the year. This is in addition to the effect of the El Nino phenomenon, which affected the accumulation of organic carbon in some areas, and led to an additional increase in carbon dioxide emissions caused by human

activity. This explains the extreme weather phenomena around the world during 2016, including drought in southern and eastern Africa and Latin America, and Hurricane Matthew in the North Atlantic region which was one of the largest natural disasters related to climate lifted hundreds of deaths and widespread destruction in Haiti.

According to the organization's analysis, the climate continued to be constantly extreme during 2017. At least, the Polar Regions were exposed to three waves of hot winds during the winter season, resulting in increasing the ice melt rates, which affected different regions of the world. Also, an increase in temperature rate was observed in some regions of the United States during 2017 and recorded as unprecedented in the country's history (Matt McGrath, 2017).

In 2017, The World Economic Forum's "Global Risks Report," which compiles assessments from 750 scientists and experts, found that the world's fifth-largest threat is weapons of mass destruction while the first four risks are all related to the climate. These risks are the drastic change in the weather, water crises, major natural disasters, and failure to mitigate and adapt to the effects of climate change (Amanda Ruggeri, 2017).

Changes in seasonal temperature, precipitation, wind, and humidity are the most important manifestations of the current global climatic changes and can involve cooling or heating. While the term global warming refers to the increase in average temperatures of the earth due to human activity, which causes an increase in the volume of greenhouse gases in the atmosphere and contributes to global warming, and threatens very serious environmental and health problems and complications. The most prominent of these greenhouse gases are carbon dioxide, methane, and chlorine fluoride. These are gases that result mainly from energy production activities using fossil fuels (coal,

petroleum, and natural gas), which leads to a rise in temperature above the Earth's surface, and in turn, leads to climate change.

Quantitative estimation of greenhouse gases in Egypt:

According to the data of the Central Agency for Public Mobilization and Statistics (CAPMAS), Egypt, the quantitative estimate of greenhouse gases in Egypt indicates 197 million tons of carbon dioxide equivalents, as an annual average during the period 2012-2014. The electricity sector is the main source of carbon dioxide emissions resulting from the consumption of petroleum products, as it accounted for about 8.40% of the total emissions, followed by the transportation sector with a rate of about 6.17%, then the industrial sector at a rate of about 7.16%, while the road and contracting sector contributed the least by about 3.2% of the total emissions. The average contribution of the agricultural sector to the amount of carbon dioxide emissions during the mentioned period was about 15%. Although Egypt's emissions of greenhouse gases represented only 0.56% of the world's total emissions in 2014, it is one of the most influenced countries by the effects of climate change.

Climate change and the African continent:

The African continent is the most vulnerable region in the world to the risks of climate change for several reasons, including poverty, ignorance, and lack of political stability in most countries, as well as the lack of financial resources to confront these risks. The most important evidence and repercussions of climate change on the African continent are as follows:

- Climate experts anticipate North Africa and the Sahel to suffer severe droughts, and an increase in desertification, which will come on 75% of the agricultural plains in

the coastal strip of the Maghreb. This will lead to a greater depletion of the groundwater reservoir and the consequent political tensions.

- The Nile Delta will be vulnerable to the rise in sea level, which will drown important parts of the fertile agricultural lands and the salinity of the remaining lands will increase.

- Climate change in the Horn of Africa will lead to a decrease in rainfall and a rise in temperatures that will lead to a decrease in agricultural production, and the spread of conflicts and instability.

- Most regions of the African continent began to suffer from the consequences of climate change, as the Horn of Africa witnessed during the period 1961-2001 a significant decrease in rainfall and clear changes in temperature led to more intensity in high regions than in low regions; For example, the temperature increased in Kabale, Uganda by about 2 °C in the past three decades, caused a gradual melting of the mountains of Kenya and Uganda.

- Somalia, Djibouti, northern Kenya, and Ethiopia are witnessing successive droughts due to the lack of precipitation. The intensity of the cyclones also pulled moisture away from the Horn of Africa, which led to the spread of epidemic vectors such as malaria.

- Kenya recorded the highest temperature since the beginning of the twenty-first century in 2012.

- Djibouti faced a severe water shortage in 2011 to the extent that one in eight people needed aid.

Climate change and developing countries:

- Developing countries need to spend about 5% of their GDP to face the current effects of climate change.

- The deterioration of farm incomes will exacerbate poverty in developing countries.

- Millions of people will be exposed to various dangers from floods, droughts, desertification, and sea-level rise, as well as increased rates of disease.

- The losses from sea-level rise in India and Southeast Asia will reach 9-13% of GDP by the end of the century; about 145-220 million people will live on less than $2 a day; Child mortality due to low incomes is expected to range between 165 - 250 thousand annually in South Asia and the African coast by the year 2100.

Climate change and developed countries:

- Countries located at higher latitudes will benefit from increased agricultural production; fewer deaths caused by cold, and increased tourism activity when temperatures rise between 2-3°C. Then agricultural production and biodiversity will soon be affected by the increase in temperature.

- Developed countries at lower latitudes, such as the countries in southern Europe, will experience a drop in their water resources by 20% and agricultural production will decrease.

- Hurricane winds in the United States are expected to increase by 5-10% annually, resulting in an average annual loss of 13.0% of GDP, until the end of the century.

- In the UK, with a temperature increase of 3-4°C Losses due to floods are expected to increase from 1.0% to 2.0-4.0% annually.

- The number of victims of heatwaves will increase in Europe, as happened in 2003 when their number reached about 35 thousand people.

- The overall average loss in global GDP due to climate change will be around 1% by the middle of the century. It is difficult to predict costs in the long run; however, these estimates should be treated as general indicators of climate change outcomes, and not as actual estimates of costs or losses.

The economic and social effects of climate change:

Here it is worth mentioning what Sir Nicholas Stern, a former economist at the World Bank, stated in his report entitled "A Review of the Economics of Climate Change" published on October 30, 2006. The most important items of this report were also reviewed in the study prepared by the Arab Planning Institute in 2007. Entitled "The Economics of Climate Change: Impacts and Policies". The report cited the following points as the most important economic and social impacts of climate change:

Effects related to water: The report expects that the suffering in areas suffering from drought and water scarcity will increase, and the time period for the occurrence of drought cycles will decrease from about one hundred years to ten years. In regions that suffer from drought cycles (such as Central and Eastern Africa), the number of drought cycles will increase by four times its current level. Drought cycles in southern Europe will occur every 10 years instead of currently occurring every 100 years.

It is expected that rainfall rates will decrease in the Mediterranean basin and areas of South Africa and South America by about 30% when the temperature rises by 2°C, this reduction in rainfall rates will increase to 40-50% when the temperature raises by 4°C.

Many areas (such as some areas in India, China, Canada, western states of the United States, and Western Europe) that depend on water from melting snow will suffer the loss of the regularity of their water resources due to the rapid melting of large amounts of snow at once, and in turn, will suffer from floods at times and water scarcity at other times. In Western Europe, these risks do not have a significant impact on the adequacy of water resources. Accordingly, the estimated number of people suffering from a severe shortage of water resources will range from 1-4 billion.

Impacts on food production: At higher latitudes (in the northern United States, Siberia, northern parts of China, and Australia) agricultural production will increase when temperatures rise by 2-3°C. The relative length of the agricultural season, the snowmelt in lands that were outside the cropped areas and agricultural production, and the increase in the impact of carbon dioxide on land fertility, are the most important reasons behind the increase in agricultural production in these areas. The increase in agricultural production is mainly reflected in the production of cereals, the most important of which is wheat, and it is expected that the increase in production will be in the range of 20%.

On the other hand, agricultural production will decrease sharply in developing countries (especially the Middle East and the continents of Africa and Central America) when the temperature rises between 2-3°C and perhaps less than that. As a result of the already high temperatures in these areas, the impact of carbon on soil fertility will decrease sharply, leading to a decrease in agricultural production by 25-35%.

The rise in temperature and the diminishing of water resources; together will have a determining role in the future of agricultural production in warm regions in general and in Africa in particular. Thus, it can be expected that more than 100 million people will suffer from the risk of famine almost permanently.

Effects related to health: It is normal for average summer temperatures to reach about 45°C in the northern and eastern regions of the Indian subcontinent, and western Asia, which are at the maximum limits that a person can tolerate. When the temperature increases more than that, it is expected that the number of deaths will increase. On the other hand, the number of deaths due to cold in Russia, Canada, Northern Europe, and the United States will decrease with a rise in temperature between 2-3°C. With the increase in the temperature even higher, the chances of getting malaria will increase. According to estimates by the World Health Organization (WHO), since 1970, about 150 thousand people die annually in Africa and other regions of developing countries, due to bacterial diseases, malaria, and malnutrition associated with climate change. An increase in the Earth's temperature by just 1°C would be enough to double that number. This estimate does not include expected deaths from rising temperatures, or from famine, or floods.

Effects related to land resources: The report focused on the direct impact of sea-level rise on land. These effects were divided into two parts: the impact on the coastal lands that lie below sea level and the economic use of land.

The coastal lands below sea level: It covers an area of about 2 million square kilometers and is home to about 200 million people, and its assets will be exposed to a value of one billion dollars in loss. At any slightest rise in sea level, these lands are subject to lose. It can be said that the problems of these lands have already begun. Some

researchers have noticed the beginning of these problems in Egypt, in the areas of Rashid, Adko, Edfina, Lisan Ras El Bar, and the areas near Lake Burullus, whether because they are at a level lower than sea level or at the same level.

In the Deltas of rivers (such as the Nile River delta), the impact does not stop only at the flood but goes beyond that to land erosion, which deepens the ground level and expands the flooded areas. A quarter of the area of Bangladesh, where about 35 million people live, suffers from this situation.

Until the mid of the twenty-first century, there are 22 of the 50 most important cities in the world (including Tokyo, Shanghai, Hong Kong, Mumbai, Calcutta, Karachi, Buenos Aires, St. Petersburg, New York, Miami, and London) under the threat of coastal lands that will be affected by sea-level rise. If these cities are protected against sea-level rise, they will remain below sea level.

One of the most vulnerable regions of the world due to sea-level rise is South and East Asia, due to their extensive coasts and densely populated. Millions will also be at risk on the African coast, in the Nile delta, and on some coasts of the Caribbean.

The problem of the islands is one of the most important and most dangerous problems, not because of the size of the great economic or human losses, but because of the danger of its complete disappearance from the world map, such as the Solomon Islands, the Maldives, Marshall and French Polynesia in the Pacific.

Some estimates have gone to the possibility of 150 to 200 million people losing their cities and villages, and turning them into refugees by the middle of this century, due to sea-level rise, frequent floods, and the impact of drought.

The economic uses of land: although the economic use of land is more related to local activities than problems on a global scale. The effects of climate change, from the lack of water resources and the increase in evaporation rates, will increase the degree of soil drying. Additionally, the increase in carbon dioxide concentration will undoubtedly affect the arable areas in the world. Add to that the risk of desertification.

These factors were not mentioned by the Stern Report when talking about the threats to the lands, although they are directly related to the reduced rainfall, deforestation, and the decline in agricultural activity.

Effects related to Infrastructure: Infrastructure losses are linked to two main factors: the impact of storms and hurricanes on the one hand, and the impact of sea-level rise on the other. Tropical storms will intensify as the temperature of the ocean surface rises. The wind speed will increase by 15-20%. Ocean surface water temperature will increase by about 3 °C in the tropics. On the other hand, the infrastructure losses resulting from sea-level rise will be three times the value of the losses caused by storms. The losses resulting from storms, floods, and sea-level rise are the largest losses ever and represent about 90% of the total expected losses from climate change.

Effects related to Environment: The ecosystem will be severely affected by climate change. The risks that threaten living species and associate with temperature rise can be presented as follows:

- When the Earth's temperature increases by 1°C, at least 10% of the living species on Earth will face the risk of extinction. Coral reefs are also being degraded. Many species in tropical mountainous regions are losing their natural habitats.

- When the Earth's temperature increases by 2°C, about 15-20% of the living species on Earth will face the threat of extinction. However, at this stage of rising temperatures, the danger will include a number of important and influential species in the natural environment, as the risk includes between 25-60% of mammals in southern Africa and about 15-25% of butterflies in Australia. There are also many areas of coral reef degradation, and thus millions of people have lost their source of livelihood. At this level of warming, half of the tundra plains and a quarter of the coniferous forests will be affected.

- When the Earth's temperature increases by 3°C, 20-50% of the living species on Earth will face the risk of extinction. Thousands of species will be lost in areas of biodiversity concentration in the world. It is expected that about 40% of the endemic species will be lost in national parks in Africa, in the wetlands of the Mediterranean basin, in the United States, and in Southeast Asia. At this level of temperature increase, the loss of mangroves trees and large areas of coral reefs is expected due to rapid sea-level rise (5 mm per year), and the Amazon forest with all of its rich biological stock (the largest stock of biodiversity in the world) will deteriorate. (UNFCCC, 2011).

Sustainable Development Goals (SDGs):

On September 25, 2015, the efforts made by the United Nations bodies crystallized in the development of 17 goals that represent the sustainable development agenda for the period 2015 - 2030. Sustainable Development Goals (SDGs) are a global call and framework for action and coordination of efforts to eradicate poverty and total hunger, ensure education for all, gender equality, empower women, good health and well-being, ensure prosperity for all, and other goals to be achieved during the period 2015-2030. Climate change and combating its effects have strongly captured the

world's attention in the past three decades and were crowned as one of the global sustainable development goals (SDGs).

These seventeen goals build on the successes achieved in achieving the Millennium Development Goals (MDGs, 2000 - 2015), and also include new areas such as climate change, economic inequality, promoting innovation, sustainable consumption, peace, and justice, Among other priorities.

A small part of these goals has achieved remarkable successes and progress during the implementation period of the Millennium Development Goals (MDGs 2000 - 2015). Millions of lives have been saved and living and development conditions have improved (UN report on the Millennium Development Goals, 2015).

Global Sustainable Development Goals 2015-2030.

The Sustainable Development Goals started to be implemented in January 2016 and they will continue to guide UNDP policy and financing for the next 15 years in nearly 170 countries and territories. The UNDP Strategic Plan focuses on several key areas, including poverty eradication, strengthening democratic governance and peacebuilding, addressing the effects of climate change, disaster risk, and economic inequality. UNDP provides support to governments to integrate the sustainable development goals into their national development plans and policies.

The interdependence between the sustainable development goals is noted. Success in achieving one goal is often linked to success in addressing issues related to other goals. For example, poverty issues will not be resolved in isolation from achieving tangible successes in the area of other goals such as education, health services, equality, and women's empowerment.

The impact of global climate change on development efforts:

Opinions differed on the impact of global climate changes on development efforts. Some believe that what we are witnessing of current climate changes is only an episode in a successive series of extreme heat or cold waves that strike different parts of the world in semi-regular cycles and the role of human activity in them is non-existent or may be significantly limited. Their evidence for this is that any observer to the change in the average temperature of the Earth during the past 100 years will notice that it has increased at a rate of 0.4 to 0.6 °C only. The succession of such waves of extreme heat or cold, and the accompanying of other climatic changes such as fluctuations in rainfall amounts, wind speed and directions, rising sea levels, floods, hurricanes, desertification, drought, and other climatic phenomena did not prevent the march of development and human progress during the past hundred years.

Their evidence for this is that the most exposed places to the influence of unfavorable climatic factors throughout history are the ones that achieve the highest rates of human and economic development. The exposure of Scandinavian and northern European countries to low temperatures throughout the year, ice throughout the winter, and river floods during the summer did not prevent them from achieving the highest rates of global human development. Successive storms and hurricanes, droughts, and massive forest fires did not prevent North America from achieving high rates of development as well. If we moved to the east, we will find that the Asian tigers' region has also achieved unprecedented rates of human and economic development and has been excluded from the list of poor countries to the promising economies list, despite what is sweeping them periodically of devastating hurricanes (tsunami) and droughts that wreck the lives and capabilities of hundreds of thousands of people.

On the other hand, some believe that climate change has a significant impact on the world's development efforts, especially in poor countries. The great industrial progress in Europe, America, and East and South Asian countries, which began and grew since the middle of the last century, and the accompanying increase in the generation and use of energy from fossil sources that produce high carbon dioxide, have a great contribution to the exacerbation of the severity and impact of global warming. Which in turn led to an increase in the Earth's temperature and the consequent melting of polar ice, rising sea levels, sinking shallow coastal areas, decreasing rainfall rates, changing wind directions, and the growth of hurricanes, floods, drought, and desertification, which led to the elimination of many environmental and natural resources, and to the displacement of hundreds of thousands of citizens of poor countries, and thus most of the development efforts in these affected areas are lost.

The negative impact of such unfavorable climatic phenomena on human and economic development is most noticeable in poor countries; perhaps the evidence is

clearer in the group of Saharan countries, North and East Africa, and some areas of South Asia such as the Philippines .The pathetic and global controversy issue is that these countries did not contribute from far or near to the phenomenon of global warming. For example, Egypt's total contribution to global warming does not exceed 0.5%, while two countries such as the United States of America and China contribute nearly half of the volume of greenhouse gases generated globally.

There is no doubt that climate changes in general and global warming, in particular, have negative impacts of varying and sometimes uncertain degrees, on the ability of countries to achieve the global goals of sustainable development. Global warming at its current rates may exacerbate existing economic and social challenges, especially for societies that depend on resources sensitive to climate change.

The current study aims to explain the current and future effects of climate change and global warming on the efforts of countries, especially developing countries, in achieving some of the global Sustainable Development Goals (SDGs). More specifically, the study aims to determine the current and future impacts of climate change and global warming on achieving the following global sustainable development goals:

- Eradication of Hunger and Extreme Poverty
- Access to quality education
- Health and Well-being

- Women's empowerment and Gender Equality

While the last two chapters will be devoted to:

- Climate change and migration, asylum, and displacement, and
- Foundations of policies, programs dealing with climate change.

References:

- Intergovernmental Panel on Climate Change (IPCC), (2013), "The Physical Science Basis: Summary for Policymakers", Working Group I, Contribution to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change.
- McGrath, M. (2017), "Historical figures on climate change recorded in 2016", BBC News Arabic, March 21, 2017. Link on the internet: https://www.bbc.com/arabic/science-and-tech- 39342011 .(In Arabic).
- Noaman, M. (2007). "The Economics of Climate Change: Implications and Policies". Development Experts Meeting Series B, Arab Planning Institute, Kuwait. Issue 24, 2007. (In Arabic).
- Ruggeri, A. (2017), "How will climate change affect our lives in the future?" BBC news Arabic, August 29, 2017. Link online: https://www.bbc.com/arabic/vert-fut-41077752. (In Arabic).
- Sarhan, S. (2015). "An economic study of climate change and its effects on sustainable development in Egypt", The Egyptian Journal of Agricultural Economics, June 2015 issue. (In Arabic).
- The Working Group on Climate Change and Development, (2005). "Africa Up in Smoke?" The second report, New Economic Foundation, London, UK. June 2005. Up in Smoke layout (waccglobal.org)
- United Kingdom Government Met Office. HadCRUT3 annual time series, Hadley Research Centre, 2008, http://hadobs.metoffice.com/hadcrut3/diagnostics/global/nh%2Bsh/index.html
- United Nations (UN), (1992), "Framework Convention on Climate Change".
- United Nations, (2015), "Sustainable Development Goals: 17 Goals to Transform Our World", General Assembly, 21 October 2015. Link: http://www.un.org/sustainabledevelopment/

- United Nations Framework Convention on Climate Change (UNFCCC), (2011), “Fact sheet: Climate change science - the status of climate change science today”, February 2011.
- United Nations High Commissioner for Human Rights (OHCHR) (2009) Report on the relationship between climate change and human rights, Human Rights Council, Tenth Session, January 2009, p.04. (In Arabic).
- World Health Organization (2008). “Protecting health from climate change”, World Health Day 2008. Web link https://www.who.int/world-health-day/toolkit/report_web_full_ar.pdf?ua=1 .(In Arabic).
- World Resource Institute: WRI Data. 2005. www.wri.org.
- Zarniz, A. (2012). "Environmental Migration as a Result of Climate Change and Ecosystem Degradation - Case Study of Africa" Climate Change Forum and its Impact on International Security and Sustainable Development, University of Guelma, 2012, p.02. (In Arabic).

Chapter 2

Climate Change and the Eradication of Hunger and Extreme Poverty

Relation between poverty, hunger, and climate change:

Poverty and hunger are intertwined. Hunger perpetuates poverty by reducing the productivity of individuals, while poverty limits individuals' ability to produce and prevents them from obtaining needed food. Statistics of the prevalence of poverty in the Arab countries and their interrelationship with the spread of hunger indicate that poverty rates (less than two dollars per day) exceed the rates of hunger and nutritional deficiencies in Sudan, Syria, Lebanon, Egypt, Saudi Arabia, Kuwait, and Mauritania, and they are almost equal in Yemen, while the rate of hunger is higher than extreme poverty (less than one dollar a day) in Jordan, Algeria, and Morocco (World Bank, 2015a).

Poverty is a serious issue that affects millions of people. In 1990, there were about 35% of people living in poverty, roughly 1.8 billion people. In addition to more than 700 million people (representing 10% of the world's population), living in extreme poverty, which means they were struggling to meet their basic needs. In 2020, nearly half of the world's population lives on less than $2.50 a day, in addition to 1.3 billion people living on less than $1.25 a day.

Although we have come a long way in reducing poverty around the world, many people still suffer. People who live on less than $1.90 a day are mostly concentrated in sub-Saharan Africa. Most of the world's poor people live and inhabit rural areas. The poverty rate in rural areas is 17.2%, which is three times higher than in urban areas (FFL, 2021).

There are many causes of poverty, but the most important causes are inadequate access to clean water and nutritious food, conflict, and civil unrest, low job opportunities, lack of education, poor infrastructure, and climate change. More than 2 billion people do not have access to clean water at home, and more than 800 million people go hungry.

Poverty and hunger locked their victims in an inescapable cycle, where poverty prevents access to good food and clean water while hunger and associated health problems due to lack of food and water make it difficult to escape from poverty.

The climatic changes that witnessed the world over the past three decades have increased the misery of the poor. This is the conclusion of the Intergovernmental Panel on Climate Change (IPCC) report assessing the world's capacity to adapt to the inevitable effects of climate change. The report indicated that these effects are not distributed evenly, they fall heavily on the poor and people least able to adapt to climate changes.

The same was reported by the World Bank group of experts in the areas of poverty and climate change, where they reported that the efforts made to end extreme poverty will extend beyond 2015 and will be included in the development goals until 2030 and it will focus on combating climate change and improve the living conditions of the poor and needy groups.

The report is also stated that persons, who live around the poverty line, are the most vulnerable to the risks arising from climate change and they have little to adapt to climate shocks or recover from their effects quickly. Poor persons, in many cases, live in the most vulnerable lands because of their cheap prices, such as houses on the sides

of flooded rivers, on the edges of hills prone to landslides, or in farmlands that do not have access to clean drinking water.

Weather vagaries in the past decade have doubled the environmental disasters, which have affected the lives of about 2 billion people. It is estimated that under global warming conditions, more than 1 billion people will be affected by floods, 22 million will be subject to coastal flooding, and 20 million will be exposed to hunger annually. Disasters, cyclones, floods, and droughts will have a greater impact on developing countries.

In 2015, the World Bank estimated that climate change alone could push more than 100 million people into poverty by 2030. According to their estimates, sub-Saharan Africa and South Asia (two regions that already suffer from some of the worst forms of poverty in the world) will be the hardest hit. . Extreme weather events such as droughts, floods, and severe storms can paralyze poverty-stricken communities.

Impacts of climate change on poverty and hunger:

Global climate change is already undermining global food security and threatening the world's ability to eradicate hunger and exacerbating global extreme poverty. The following are some phenomena and studies results that support this statement:

- The severe climatic changes that damage the homes and businesses of the poor are often the main reason behind their fall into poverty or impede their exit from poverty. A household survey conducted over a period of 25 years in India showed that 44% of households who fell into poverty indicated climatic conditions as the

main reason for this and 14% of households managed to escape from poverty, while 12% of Households are getting poorer.

- Hurricane Mitch (the most powerful and destructive hurricane in 1998) destroyed three-quarters of Honduras' annual gross domestic product (GDP) within a few days. Hurricane Mitch destroyed agricultural capacity (70% of crops destroyed, damages to crops and agricultural products amounted to about a billion dollars), homes (35,000 homes completely destroyed plus another 50,000 damaged, leaving 1.5 million people homeless), infrastructure, and Industries (70-80% of the transport network was destroyed, and the total damage to transportation, communications, and public utilities, including energy and water, was estimated at 665 million Dollar), which led to a two-decade de-development in Honduras (the Caribbean, 1999).

- The British-based Chatham House research center indicates that agriculture, by itself, causes about 14.5% of global greenhouse gas emissions. This percentage is very high in some countries. For example, agriculture in Uruguay causes about 40% of gas emissions locally, especially in light of the presence of livestock estimated at 12 million head of cattle and 11 million head of sheep that produce methane.

- Climate change is one of the most important factors leading to the emergence and spread of diseases in livestock, because climate change and fluctuations increase the vulnerability of animals to diseases, especially livestock and cows. Climatic factors also affect the sustainability of the fishery wealth, especially in light of the high salinity, the rise in sea levels, and the high temperature. All of these factors are causes of various diseases that threaten the sustainability of fisheries and thus threaten the sustainability of food security or can be transmitted to humans through eating seafood.

- Other symptoms of climate change such as melting ice and rising sea levels are affecting agricultural land. On the other hand, the increasing demand for meat as human food is facing difficulties with climate threats in light of heat stress and diseases that kill thousands of animals. In addition, meat production depends on the abundance of agricultural land for the production of fodder and on the availability of water for drinking and irrigation, and these factors are linked and threatened by the repercussions of climate change.

- The study "Climate Change and Food Systems: Assessing the Systemic Implications and Implications for Food Security and Global Trade", conducted by the Food and Agriculture Organization in 2015, indicates that global warming will have long-term consequences for the regions and ways of food production in the world. It will weaken the nutritional properties of some crops, which will negatively affect policies to combat hunger and poverty and will affect the global food trade. The study expects a decrease in agricultural production in warmer and drier regions near the equator. The study also highlights the potential negative effects of climate change through the exacerbation and spread of what is known as "hidden hunger", that is, chronic vitamin and mineral deficiencies and the spread of obesity.

- Global climate change increases malnutrition rates and contributes to increasing poverty. One in four people is still malnourished in sub-Saharan Africa. The number of hungry people in the world has reached about 795 million. More than a million people are facing severe food shortages in Eritrea and Ethiopia. Cereal production in 2002 was reduced by nearly 25% due to drought, and large amounts of food aid are always required to prevent famine.

- The Intergovernmental Panel on Climate Change (IPCC) has predicted that food production in South Africa will halve by 2020 due to global warming, which will

raise temperatures and droughts on the continent. In some African countries, the production of rain-fed crops has decreased by 50%. In general, it is expected that agricultural production in many African countries will be exposed to a major threat due to climate change, which negatively affects the availability of food and leads to a state of food poverty and malnutrition. It is also expected that the arid and semi-arid areas will increase by 5%-8% by 2080 and the exposure of 75-250 million people to water stress due to climate change in 2020.

Poverty, hunger, and food security:

The concepts of hunger and poverty have been linked to a third term or concept, which is food security. The first official attention to the concept of food security was given by the Committee on World Food Security in 1974, after the global crisis of 1970. Food security became a central issue of great importance, especially in light of the increase in food imports by developing countries in order to meet the food needs of the population. The concept of food security is differed according to thinkers and bodies. We find the definition of the Committee on World Food Security as "the ability to provide an adequate supply of food" (Fawaz et al. 2015). It is clear that the focus of this definition was only on providing food and its sufficiency for people, regardless of the ways to provide this food, whether through local production or importing.

The World Food and Agriculture Organization (FAO), defined food security as "the enjoyment by all people, at all times, of the material and economic ability that enables them to obtain sufficient, safe and nutritious food that meets their needs and suits their food tastes in order to lead an active and healthy life" (Noman, 2007). According to this definition, there are four main dimensions for analyzing the food security situation of a country, which are summarized by the Organization in:

1. The abundance of food in adequate and appropriate quantities, by local production, importing, or food aid.

2. The physical ability of individuals to obtain adequate and suitable food.

3. The ability of individuals to use the food obtained in their daily activities.

4. Stability of food supply at quantitative, qualitative, and temporal levels all over the year.

Climate change affects the four dimensions of food security: food availability, access, use, and stability. In a quantitative measure of food availability, the increase in carbon dioxide concentrations is expected to affect the productivity of many crops. Climate change will exacerbate the volatility of agricultural production in all regions. With the exacerbation and recurrence of severe weather events, the poorest regions will experience the highest levels of instability and inadequacy in food production. It is estimated that food prices will keep pace with the moderate rise with slight increases in temperature until 2050, and then the picture will change as a result of subsequent increases in temperature, which will result in a significant decrease in the agricultural production capacity of developing countries, and the consequent higher price increases. On the other hand, climate change is likely to involve modifications in food security and safety conditions with increasing pressures of diseases transmitted, imported through incubators, water, and those carried by the food itself. This may result in a significant decline in agricultural productivity and labor productivity and may lead to an exacerbation of poverty and an increase in mortality rates.

We should distinguish between two levels of food security, as follows:

- **Absolute food security:** means food production within the country equal to or greater than domestic demand, and this level is synonymous with the term *"full self-sufficiency"*. Achieving this level of food security faces many criticisms as being unrealistic.

- **Relative food security:** It means the ability of the state to partially provide foodstuffs and ensure the minimum of those needs on a regular basis. This level of food security is synonymous with the term *"partial self-sufficiency"*. It basically means to provide the basic foodstuffs necessary that partially meet the needs of society members and to try to provide the remaining part of these needs through other products (Page, 2002).

Climate change and food security in Egypt:

Egypt is not far from the impact of climatic changes. Climate changes will be more impactful on two main natural resources, characterized by relative scarcity, namely the land and water, which leads to a direct and long-term impact on the agricultural sector. Climatic changes will affect the supply of food in the world, which leads to an escalation of global food prices, and consequently, an increase in the Egyptian food bill, thus increases pressures on the general budget of the country. Egypt's food security will expose to external risks, as Egypt is a net importer of food (Sherif, 2009).

Egypt's agriculture is sensitive to climate changes, as it is located in a semi-arid environment and mainly depends on the waters of the Nile River, Therefore the agriculture sector will be negatively affected by climate changes as follows:

- Rising temperatures and changing the timing and frequency of hot and cold waves will lead to a decrease in the agricultural productivity of some crops.

- Change in average temperature will lead to a reduction in the quality of agricultural production of some crops.

- Increasing temperatures will lead to an increase in evaporation, and consequently an increase in water consumption.

- Increasing rates of desertification, especially for marginal agricultural areas.

- Social and economic effects, such as labor migration, and the spread of poverty in marginal agricultural areas.

- Lost agricultural land due to drowning or salinization: Studies conducted at Alexandria University estimated that 12% - 15% of the high-quality agricultural land in the delta region will be lost as a result of drowning or salinization with the rise of sea level by half a meter only.

The Nile River Delta will be exposed to the double effect of climate change. On one hand, the rise in sea level will flood essential parts of the fertile agricultural lands, and on the other hand, the increase in the salinity of the remaining lands.

In view of the climatic effects of sea-level rise in Egypt; some studies expected that there will be a rise in the surface of the Mediterranean by about one meter during the current century. If we take into consideration that the northern coasts of Egypt are the lowest areas in Egypt, we find that the areas prone to drowning range between 10-15% of the delta. In addition to the impact of the rise of surface water level and the

increase in salt in water and soil on the cultivated lands in Delta and the adjacent areas. (Hassan, K. 2015).

In another study conducted by The United Nations Environment Program (UNEP) to assess the impact of the expected rise in sea level on the Egyptian coast, specifically, the most likely areas to risk drowning and found that the most affected regions are Alexandria, Buhaira, South Burullus, and South Manzala on the Mediterranean.

Climate change, poverty, and hunger in Africa:

The African continent is the most vulnerable region globally to the dangers of climate change for several reasons, including poverty, ignorance, lack of political stability in the most prominent countries of the continent, and the lack of financial resources to confront this problem. According to climate experts, the North African region and the countries on the West Coast will be exposed to severe droughts and an increase in desertification, which will come on 75% of the agricultural lands, and on the rest of the green lands, especially in the coastal strip of the Maghreb. This will lead to a great depletion of the groundwater aquifer and the rise of political tensions on water sources.

The problem of climate change in the Horn of Africa will lead to a decrease in rainfall and a rise in temperatures that will decrease agricultural production and spread conflicts and political and economic instability.

Most of the regions of the African continent have already begun to suffer from the consequences of climate change. From 1961-to 2001, the Horn of Africa witnessed a significant decrease in the amount of rainfall and clear changes in temperature, which

became more intense in the higher regions than in the lower regions. For example, the temperature increase in the Kabale region of Uganda has been estimated at about 2°C in the past three decades. The countries of the region are also witnessing successive droughts, the cause of which is due to the lack of precipitation in Somalia, Djibouti, northern Kenya, and Ethiopia. The severe cyclones have drawn moisture away from the Horn of Africa. Kenya recorded the highest temperature since the beginning of this century in 2012, and Djibouti faced a severe water shortage.

Global climate change increases malnutrition rates and contributes to increasing poverty. One in four people is still malnourished in sub-Saharan Africa. The number of hungry people in the world has reached about 795 million. More than a million people are facing severe food shortages in Eritrea and Ethiopia. Cereal production in 2002 was reduced by nearly 25% due to drought, and large amounts of food aid are almost always required to prevent famine.

East Africa is facing the worst food crisis of the 21st century, according to Oxfam. 12 million people in Ethiopia, Kenya, and Somalia are suffering from acute food shortages, as rainfall was below average during 2010-2011, which was considered the driest year since 1950 -1951. It is serious problem for the continent that depends entirely on rainwater for agriculture (Al Badil Newspaper, 2015).

The Intergovernmental Panel on Climate in its report for the year 2007 expects that food production in South Africa will halve by 2020 due to global warming, which rise the temperatures and droughts on the continent. Some African countries will experience a 50% decrease in the production of rain-fed crops. Agricultural production in many African countries will be exposed to a major threat due to climate change, which negatively affects the availability of food and leads to a state of food poverty and malnutrition. Arid and semi-arid areas will increase by 5%-8% by 2080. It is also

expected that 75-250 million people will expose to increased water stress due to climate change in 2020.

The floods in Mozambique that occurred during the months of February and March 2000 displaced 463,000 homeless, including 46,000 children less than five years of age, and killed about 700 people. About 1,400 square kilometers of arable land were affected, and 20,000 head of livestock were lost. The total damage was estimated at $500 million, the worst in the past 50 years, and disrupted much economic progress.

The drought that swept Ethiopia in 1988 and the following years killed about 1.4 million people and caused the displacement of about 9 million others due to the destruction of food resources and the death of about 90% of the livestock herd. This drought coincided with the spread of epidemics such as smallpox, the outbreak of intense wars, and the great Ethiopian Famine that afflicted Ethiopia from 1988 to 1992 and affected nearly a third of its population.

Crop production in sub-Saharan Africa is expected to decrease by about 20% in light of global warming, and malnutrition cases in the region will worsen. Areas that suffer from limitations in achieving food security for their citizens will face additional challenges and possibilities of more insecurity and rising crises under the conditions of climate change, which will make eradicating hunger or poverty an unattainable goal.

Drought negatively affects the abundance of agricultural and livestock production alike. It also leads to a decrease in the quantities of groundwater. With the lack of rainfall, the production of food crops used for local consumption or export declines, and consequently their prices rise and become more difficult to obtain. Most African countries, especially those souths of the continent are suffering from drought. Since 2006, Kenya has been subjected to severe droughts that have affected the availability of

food. Other countries such as Ethiopia and Somalia are also affected by droughts and exposed to a state of chronic food poverty (Bosabeen, 2015).

Climate change affects the quality of agricultural production and food crops. The increase in temperature and carbon dioxide concentration can lead to damage to agricultural crops and many diseases. Changes in rainfall in sub-Saharan Africa cause the migration of desert locusts to northern countries, destroying crops and making them of poor quality (Amina, 2014).

It is worth noting that the causes of high rates of global hunger are not limited to climate changes but extend to the impact of political strikes, civil wars, economic crises, low-income levels, and steady population growth, which add other dimensions to a problem that affect one person out of every six people around the world, according to United Nations estimates.

Despite the efforts made internationally and regionally to reduce its effects, food security in Africa is still the most intractable problem. This is returned to the multi-dimensions of this problem. One of these dimensions is related to the geographical nature of the region in terms of climate and agricultural lands; another dimension includes the low level of technological and economic use and its lack of development, the high population growth rates unsuitable to the rates of development and the capabilities of most countries, represents another dimension to the problem of food security in the continent.

Suggested policies and recommendations:

The growing threat of climate change to the food supply, and the exacerbation and spread of hunger and extreme poverty, especially in developing countries, requires

urgent and coordinated policy responses. Among the proposed policies and recommendations are the following:

- Developing a variety of cereals and essential crops that are resistant to the different climates resulting from global warming that will face developing countries during the next two decades.

- Better land-use planning and improve infrastructure can reduce vulnerability to future climate changes.

- One of the solutions that Arab countries have begun to implement is heat-resistant plants. The research center's efforts are recently directed to separating the gene responsible for heat tolerance from its distinct plants and transferring it to other food plants.

- Switching to water-saving crops. For example, Egypt has announced a trend towards water-saving crops, reducing the cultivated areas of water-consuming plants such as rice and sugar cane, and offering the “stevia” plant as an alternative to sugar cane in this context. The cultivation of this plant is good in areas with high temperatures, where high temperatures help to increase vegetative growth. This plant only needs one-fifth of the land required for the production of reeds, and it also needs 90% less water. The productivity of one acre of this plant is equivalent to the production of 80 acres of sugar beet, so it is the ideal choice for countries that suffer from water scarcity (Badawi, 2020).

- The trend toward saline crops: The United Arab Emirates is currently moving towards saline crops, which are irrigated with seawater, in an attempt to overcome water scarcity due to climatic changes. Experiments carried out by the International

Center for Bio-saline Agriculture in Dubai in cooperation with the UAE government showed the success of cultivating Salicornia using seawater. Salicornia is a salt-loving plant that is used as food and forages for livestock, as well as being used in the production of biofuels, and it is one of the most salt-tolerant plants. Another effort being made in this regard is the production of the Chinese salt-tolerant rice variety in the Dubai desert. Tests showed that the highest yield of this salinity-tolerant and alkaline-tolerant hybrid rice exceeded 7.8 tons per hectare.

- Develop special food policies that focus on the vulnerable groups of the poor in both urban and rural areas.

- Implement development policies consistent with the economic, social, and environmental conditions of each region separately.

- Implementing economic and financial reforms that guarantee the fair distribution of wealth and balanced development in all economic and social sectors, with special attention to the poorest segments.

- Imposing additional taxes on carbon-generating activities and using them to support the poor. For example, British Columbia District demonstrated how revenue from a carbon tax could adequately support the poor, lower-income, and business tax. As a result, it currently had the lowest level of income tax in the country, a thriving environmentally friendly economy, and lower gaseous emissions. Likewise, governments can reduce harmful fossil fuel subsidies and direct their savings to support the poorest in need. Fossil fuel subsidies are inefficient and counterproductive, as the richest 20% in low- and middle-income countries get about six times what the poorest 20% get in these countries!!! (WB, 2014).

- Climate mitigation and adaptation actions will bring new income opportunities. Many of these ecosystem-based measures require labor-intensive activities such as reforestation and soil fertility restoration. Policies that encourage green industries also bring new opportunities through retraining and diversification of economic activities and trade patterns.

Strengthening regional and global cooperation between importing, producing, and exporting countries of food crops as follows:

- Importing countries that have the ability to invest in research and development should work to support scientific research and technological innovation to improve crop production in the current producing countries.

- Importing countries should also provide the technology to develop equipment and facilities to reduce storage losses, estimated at about 20% of the rice crop produced in Southeast Asian countries.

- Food-importing countries and global financial centers can play a greater role in providing the financial measures needed to adapt to climate change, mitigate its effects, and insure against its effects. These endeavors include the use of market mechanisms to enhance risk management in food production sectors.

- Supporting the regional cooperation to develop monitoring and early warning systems for climate disasters and participating in regional cooperation and dialogue on food production systems.

- Current policies of food storage often depend on short-term climate forecasts. Therefore, the development of a long-term forecasting system of climate changes can help in reducing fluctuations during periods of weak production crops.

We have a short period of time to implement policies related to climate change and social protection that can reduce the effects of climate change while protecting the poor. Failure to do so will increase costs and risks for everyone.

References:

- Al- Badeel Newspaper, (2015). "How does climate change affect Africa", 30 August 2015. Cairo, Egypt. http://elbadil.com/
- Amina, D. (2014). The impact of environmental threats on the reality of human security in Africa. Master's Thesis, Mohamed Khider University of Biskra: Faculty of Law and Political Science, 2014. p. 134. (In Arabic).
- Badawy, M. (2020). "The Impact of Climate Change, Drought and Desertification on the Future of Food Security". https://www.agri2day.com/.22 February 2020. (In Arabic).
- Busabeen, T. (2015). The effects of climate change on sustainable development in Algeria - a prospective study), University of Boumerdes: Faculty of Economics, Commercial and Management Sciences, 2015, p. 07. (In Arabic).
- Center for Climate and Energy Solutions (CCES), (2011),"Extreme weather and Climate Change", edited by Daniel Huber and Jay Gulledge, December 2011.
- Economic Commission for Latin America and the Caribbean (ECLAC),*(1999),* "Honduras: Assessment of the damage caused by hurricane Mitch 1998". Implications for economic and social development and for the environment (Report). April 1999.
- Edward a. P. and Michael R. (2002). "human Security and Environment, Edward Elgar publishing ,British ,2002 ,p29
- Fawaz, M. & Suleiman, S. (2015). "An economic study of climate change and its effects on sustainable development in Egypt". The Egyptian Journal of Agricultural Economics, June 2015 issue. (In Arabic).
- Food and Agriculture Organization of the United Nations (FAO), (2015a), "The State of Food Insecurity in the World 2015", Roma

- Food and Agriculture Organization of the United Nations (FAO), (2015b). “Climate Change and Food Systems: Global assessments and implications for food security and trade”. By Elbehri, A.; Office: Economic and Social Development Department.
- Food for Life Global (FFL) (2021). Facts about Poverty in the World – Food for Life Global (ffl.org).
- Hassan, K. (2015). "Global climate change and the eradication of hunger and extreme poverty (2/7)". Al-Hiwar Al-Modden - Issue: 4920 - 2015 / 9 / 9 - 14:34. (ahewar.org). (In Arabic).
- Intergovernmental Panel on Climate Change (IPCC), (2013), “The Physical Science Basis: Summary for Policymakers”, Working Group I, Contribution to the Fifth Assessment Report of the Intergovernmental Panel on Climate Chang.
- Middle East Newspaper, (2014), “Limit the intake of meat and dairy products slows down climate change”, Issue No. 13156, 5 December 2014. https://archive.aawsat.com/details.asp?section=54&article=796987&issueno=13156#.YHrMsh0zbDd .
- Noman, M. (2007). "The Economics of Climate Change: Implications and Policies". Development Experts Meeting Series B, Arab Planning Institute, Kuwait. Issue 24, 2007. (In Arabic).
- *Save the Children* (2000). "Mozambique Emergency Bulletin 3: 07 Mar 2000". https://reliefweb.int/report/mozambique/mozambique-emergency-bulletin-3-07-mar-2000
- Sherif, F. (2009). “Impact of Population and Climate changes on Food Crisis in Egypt”. Afro-Asian Journal of Rural Development, Vol. 42, No. 1, January-June 2009.
- The World Bank, (2014). “Fighting Climate Change & Poverty at the Same Time”, December 4, 2014. https://www.worldbank.org/en/news/feature/2014/12/04/fighting-climate-change-and-poverty
- The Word Bank, (2015a). “World Development Indicators 2015”, World Bank group.

- The World Bank, (2015b). “Climate Change Complicates Efforts to End Poverty”. February 6, 2015. https://www.worldbank.org/en/news/feature/2015/02/06/climate-change-complicates-efforts-end-poverty
- The World Bank, (2016), *“Shock Waves” Managing the Impacts of Climate Change on Poverty*”, edited by: Hallegatte, Stephane; Bangalore, Mook; Bonzanigo, Laura; Fay, Marianne; Kane, Tamaro; Narloch, Ulf; Rozenberg, Julie; Treguer, David; Vogt-Schilb, Adrien. Climate Change and Development, Washington, DC: World Bank. https://openknowledge.worldbank.org/handle/10986/22787.
- United Nations Office for the Coordination of Humanitarian Affairs (UNOCHA), (2000). "Mozambique: Ross Mountain praised media's role and international solidarity floods". https://reliefweb.int/report/mozambique/mozambique-ross-mountain-praised-medias-role-and-international-solidarity
- United States Agency for International Development (USAID), (1989), “Evaluation of the 1988 Ethiopian Drought Assistance Program”, by: Nancy Metcalf, Ellen Patterson Brown, Michael Glantz and Hope Sukin, March 1989.

Chapter 3
Climate Change and Access to Quality Education

Education is critical to social and economic development. It hones skills, increases employment, and helps people improve their living standards. Education supports gender equality. Despite these crucial benefits, access to education remains a challenge, particularly in the world's poorest countries.

In 2016, there were about 263 million school-aged children out of school (i.e. one out of every five children globally). The United Nations hopes, as part of the Sustainable Development Goals, to achieve complete basic education (primary and secondary) for all children around the world by 2030, but global climate change may make this goal more difficult to achieve.

Floods, hurricanes, torrential rains, droughts, high temperatures, humidity, global warming, and other manifestations of severe climatic changes pose an indirect challenge and negatively affect the educational process. The most important of these negative effects are represented in weak enrollment rates, low school- attendance rates, poor educational attainment, and repetition of school failure which usually ends with dropping out of education.

In this chapter, we will discuss a simplified explanation of the indirect effects of climate changes on the educational process and a review of some of the manifestations of these effects, and we conclude the chapter with a vision of how to confront the negative impact of climate changes on the educational process.

Impact of climate change on education:

Climatic conditions can affect the educational process of children and young adults in many different ways. More specifically, extreme weather events such as tropical cyclones may destroy or damage school buildings, or use them to house people who have been displaced from their homes, leaving children temporarily unable to go to school, while some children may never go back to school.

- Farming families suffering from low income and food insecurity due to drought or heat waves may not have enough money to pay school tuition, and they may withdraw their children from school to help earn additional income.

- During periods of severe drought, girls may miss school because they have to walk long distances to fetch water or maybe married at a young age, which often coincides with educational dropouts. In addition, entire families may migrate in search of food, water, and work, taking their children out of schools.

- Climatic conditions can also affect the outcome of the educational process in indirect ways. The harsh weather that occurs in the pregnancy period and during early life can affect children's education years later, by shaping birth outcomes as well as a child's health and nutrition. The prenatal period and the first few years of life are the periods when the brain develops most rapidly, so adequate nutrition during this period is critical to the well-being of children. Studies have found that both low birth weight and malnutrition in early childhood are associated with impaired cognitive development and lower educational attainment later in life (Heather, 2019).

- Climatic disasters are often accompanied by the destruction of educational infrastructure, which destroys local capacities to maintain and continue the educational process.

- Climate changes usually result in the spread of famine and the displacement of many families and the spread of the phenomenon of environmental asylum (lack of housing and permanent shelter). The least able families to re-establish their lives are often the same families that are least able to provide education for their children, and thus their children's chances of going to school and getting an education are undermined. Global estimates suggest there will be more than 150 million environmental refugees worldwide by 2050 (The Guardian, 2009).

- Reports issued by Save the Children (2008) and UNICEF (2008) indicate that the negative impacts of climate change are more likely and more quickly to disrupt the education process. Periods of extreme heat will prevent children from going to school, and this is also done by severe sandstorms, the most common climate phenomenon in the Arabian Gulf region. The floods are also one of the manifestations of severe climatic changes that will cause block roads, preventing students from reaching their schools and disrupting the educational process. The floods that struck Yemen in 2009 are the best evidence of this. Power outages which are one of the potential side effects can harm the educational process by disrupting schools and their activities.

- One of the indirect effects of climate change, especially rising temperatures, on education is the change in the geographical distribution of disease vectors, especially mosquitoes. Hence, the exposure risk of the population, especially children and young individuals of basic school age, to malaria and dengue fever increase, which

in turn affects the continuity and regularity of the educational process and increases the cases of school absenteeism for infected children.

- The suspension of agricultural activities and low agricultural yields are one of the secondary effects of climate change. It leads to an increase in the scope of malnutrition among children, which includes a complex and disturbing effect on the educational process. This effect represents by poor achievement resulting from poor concentration, low cognitive functions and early dropout from Educational process.

- The negative impact of climate change is interlinked with many other unfavorable economic and social effects, leading to high rates of poverty, deterioration of living conditions, and an increase in the pressures driving migration and leaving the place. In all cases, these factors are likely to influence, to disproportionate degrees, the possibility of access to quality and equal education for all children.

- The UNESCO report "Education for All: Global Monitoring Report 2010" indicates that girls are often more vulnerable to climate change than boys, and the first of these impacts is their dropping out of the educational process.

Despite our inability to well measure or estimate the cumulative impact of these climatic disturbances on the educational process, it is certain that the irregularity of students in going to their schools will negatively affect their educational attainment and the educational process as a whole.

Some evidence of the negative impact of climate change on education:

- There is strong evidence that school-age children who are hungry or seriously deficient in the protein component of their diet, or who are deficient in some

nutrients and vitamins (particularly iron, iodine and vitamin A), or who are suffering from diseases such as malaria, diarrhea, or Worms, they lack the ability to learn comparing with healthy, well-nourished children. (Child Poverty Action Group Inc., 2011).

- Cyclone Sidr, which struck Bangladesh in November 2007, destroyed 74 government primary schools, and damaged 8,817 other schools, and the number of affected children was estimated at about 664,000 children. The estimated cost of reconstruction and renovation amounted to more than 82 million dollars. (Russell, K. et al, 2016)

- The Cambodian floods in 2000 destroyed nearly 18% of schools in the country, and about half a million children were absent from the educational process. The rehabilitation process cost about 1.6 million dollars. Subsequent research in Cambodia indicated that school absenteeism and dropout were higher in flood-prone areas than in other areas, and that education usually stopped for periods ranging from one to one and a half months as a result of the floods in schools located in flood-prone areas (Phnom Penh Post, 2000).

- Research conducted in India concluded that women born during the flood years in the seventies of the last century were less likely to enroll in basic education by 19% than other Indian women (UNDP, 2007).

- In a study of rural areas in Ethiopia, it was found that more rainfall during the main agricultural season, as well as cold springs and summer in early childhood were positively associated with completion of at least one year of school (Heather, 2019).

- There is an expected negative impact of climate change on education among children through exposure to extreme temperatures and precipitation conditions. Census data for 29 countries across the tropics were linked with high-resolution climate data to understand how climatic conditions that occurred during prenatal and early childhood periods affect achievement Education at ages 12 to 16. The results showed that exposure to above-average temperatures during the antenatal and early childhood period was associated with fewer years of schooling in Southeast Asia. In this region, a child exposed to temperatures above average by 2-SD (two standard deviations) would be expected to have 1.5 years less schooling than a child exposed to average temperatures. Age is positively correlated with continuing education in West and Central Africa as well as Southeast Asia, and negatively correlated with continuing education in Central America and the Caribbean.

- Contrary to what is expected that children belongs to more educated families will be protected from the negative effects of climate change on their enrollment and continuation in the educational process. We have discovered that they face greater educational obstacles when exposed in their early life to the hotter or drier climatic conditions. It was found that children belongs to more educated families in West and Central Africa, who grow up in very precipitous climatic conditions, are expected to have 1.8 years less schooling, while the difference is only 0.8 years for children belongs to less educated families. These findings suggest that development and educational gains in the tropics could be undermined by climate change, even for well-off households. (Heather and Clark, 2019).

- More than a million classrooms across Latin America and the Caribbean are at risk of being lost as a result of weather-related disasters and climate change (Hassan, K. 2015).

- The financial burden imposed by a rapid and emergency response to unfavorable climate changes is usually accompanied by undermining investment in improving the quality of education (UNESCO, 2016).

Impact of climate change on education in the Arab region:

We have previously explained that the Middle East and North Africa region is one of the regions most affected by climate change, despite its weak participation in these changes, and therefore it stands in the front lines of the confrontation with climate change. According to a 2012 World Bank report, the region's temperature and drought rates are rising steadily. Five Arab countries are among the nineteen countries recorded new increases in temperature in 2010 (the year that witnessed the highest global temperature rise since records began in the nineteenth century). The countries of the Maghreb have become vulnerable to drought, while Cyclone Phet on the Persian Gulf region in June 2010 killed 44 people in the Sultanate of Oman and inflicted losses of 700 million dollars. The long-term effects of climate change will be just as severe. In a region with some of the lowest levels of fresh water in the world, it is estimated that 80-100 million people will be under water stress by 2025. The groundwater resources being used faster than rainfall can compensate. With the increasing number of people who will be affected by climate change, some recent studies have focused on the potential impact of climate change on education, as the first major stage of human development (World Bank, 2012).

The negative effects of climate change are more likely to manifest themselves more quickly in hampering the education process. Periods of extreme heat will prevent children from actually going to school, the same effect as severe sandstorms, which are most common in the GCC region. As for areas of hard land due to drought, it will be unable to absorb rainwater and produce torrents that will cause the cut off roads,

preventing students from reaching schools (the floods that struck Yemen in 2009 are the best example). One of the possible side effects is power outages, which will force schools to disrupt their activities. In extreme cases, infrastructure damage can occur. Although the cumulative effect of these disorders on students' educational performance is not well known, it is certain that students' irregular attendance will negatively affect the results of the educational process.

In the long-term, climate change, when linked to other factors such as high rates of poverty (which is widespread in the Arab region), is expected to cause environmental degradation, deteriorating living conditions, and increasing pressures on the population to migrate. Research indicates that, in all cases, these factors are more likely to affect children's safety, care and ability to achieve quality and equitable education for all.

We can't ignore the impact of other non-climate factors on the educational process. The UNESCO report "Education for All: Global Monitoring Report 2010" indicated that there are about 72 million children around the world who are still out of school as a result of slowing economic growth and high rates of poverty, which further marginalize the importance of Education (UNESCO, 2010).

Proposed recommendations and programs:

More research and studies still needed to understand how climatic conditions affect education in different places and among different populations.

For example, a study in rural East Africa might find that the impact of drought on agricultural production and household income is the main driver behind the unstable relationship between climate and education. There are many possible solutions that

could make children from farming or livestock families in such areas less vulnerable. For example:

- Agricultural research can provide drought-tolerant crop varieties.

- Programs that help farmers diversify sources of income can extend their activities to include non-agricultural income sources.

- Crop or livestock insurance programs can provide payments to farmers during droughts to prevent income losses.

- Governmental programs can provide cash transfers to poor families, helping to protect their income during periods of environmental stress. In Kenya, a cash transfer program targeting the most vulnerable families has helped families keep their girls in school during droughts.

There are many other potential pathways between climate and education—such as exposure to extreme heat, hurricanes, floods, and other adverse weather events—and each of these pathways will require specific strategies to ensure that children stay in education and go to school.

A better understanding of climate change and awareness of its adverse effects at the regional and local levels will allow policy makers to improve “climate education systems” and will help improve schools' preparedness for weather-related disasters. The term *"climate-friendly education systems"* should include:

- Reviewing the existing infrastructure to ensure its safety in the face of unfavorable weather events.

- Develop a disaster risk management plan for schools.

- Better assessment of potential environmental risks when making decisions about new school sites.

- Choosing the educational infrastructure systems that are most resilient to climate change.

Simultaneously with building the resilience of education systems to the impacts of climate change, focus must be given to the role plays by the education itself in adapting to climate change.

Article 6 of the United Nations Framework Convention on Climate Change, called the New Delhi Action Program (2002-2012), stated that "education, training and public awareness are an integral part of the response to climate change". This call was renewed in 2012 through the Doha Work Programme. Indeed, climate change has been added as a scientific branch of science in middle and high schools all over the world, but we do not know exactly whether it is taught in schools in developing countries that are most vulnerable to the risks of climate change or not? Australia made the first notable attempts to popularize the topic by including modules on climate change in all relevant subjects.

There is an ongoing and growing debate about the role can play by education in combating climate change. The question that arises in this context revolves around the purpose of such educational programs? Is it spreading the concepts and foundations of respect for the environment and the causes of climate change as one of the modern and emerging life sciences that people plays a large and important role in shaping, or

teaching people how to confront these climate changes by adopting appropriate behavior, such as recycling waste, rationalizing energy, or reducing carbon dioxide emissions.

In general, a combination of the two objectives will be required to meet the many challenges related to climate change, as follows:

- The development of education systems that provide students with the required skills and knowledge to deal with future challenges, including climate change, and reorientation of existing educational systems to stimulate critical thinking that would create local and global solutions to the phenomenon of climate change.

- Strengthen non-formal education programs through media, networking and partnerships to increase awareness and understanding of climate change to public and encouraging them to change their consumption habits and behaviors toward better deal with environment.

UNESCO and Climate Change Education for Sustainable Development:

UNESCO and its UN partners aim through the "Climate Change Education for Sustainable Development programme" to enhance the contribution of education to the international response to climate change. The program aims to help individuals understand the current impact of global warming and promote climate education among young people by:

- Strengthening the capacity of Member States to provide quality education in the field of climate change for sustainable development, with a focus on primary and secondary education.

- Encouraging the adoption of innovative pedagogical methods to integrate quality education in the field of climate change for sustainable development into school curricula.

- Raising awareness of the issue of climate change and promoting non-formal education programs through media, networking and partnerships.

The program also aims to improve understanding of key concepts related to sustainability and to support the four main directions of education for sustainable development as follows:

- Providing quality basic education because droughts, floods and sea level rise as a result of climate change are factors affecting enrollment and enrollment rates in basic education.

- Reorient existing educational programs to stimulate critical thinking that will generate local and global climate change solutions.

- Increase public awareness of climate change and enhance understanding of the issue in order to encourage a change in consumer habits and behaviors associated with energy use.

- Providing training for effective responses to climate change that also depends on professional development and training.

References:

- Badawy, M. (2020). "The Impact of Climate Change, Drought and Desertification on the Future of Food Security". https://www.agri2day.com/. 22 February 2020. (In Arabic).
- Busabeen, T. (2015). The effects of climate change on sustainable development in Algeria - a prospective study), University of Boumerdes: Faculty of Economics, Commercial and Management Sciences, 2015, p. 07. (In Arabic).
- Child Poverty Action Group Inc. (2011). "Hunger for learning: Nutritional barriers to children's education", New Zealand.
- Consortium for Research on Educational Access, Transitions and Equity (CREATE) (2008). "Impact of Health on Education Access and Achievement" online link: http://www.create-rpc.org/pdf_documents/Policy_Brief_3.pdf
- Environmental Justice Foundation (EJF), (2012). "A nation under threat - The impacts of climate change on human rights and forced migration in Bangladesh". Environmental Justice Foundation, London. ISBN No. 978-1-904523-26-0. Online link: https://www.oceanfdn.org/sites/default/files/A_Nation_Under_Threat.compressed.pdf
- Fawaz, M. & Suleiman, S. (2015). "An economic study of climate change and its effects on sustainable development in Egypt". The Egyptian Journal of Agricultural Economics, June 2015 issue. (In Arabic).
- Hassan, K. (2015). "Global Climate Change and Education 3-7". Civil Dialogue Forum, link http://www.m.ahewar.org/s.asp?aid=486775&r=0 (In Arabic).
- Heather R. (2019). "Climate Change May Weaken Children's Education in the Tropics". The Wilson Center, New Security Beat, May 7, 2019.

- Heather R. and Clark, G. (2019). “Climate change and educational attainment in the global tropics”. PNAS April 30, 2019 116 (18) 8840-8845; first published April 15, 2019; https://www.pnas.org/content/116/18/8840
- Noman, M. (2007). "The Economics of Climate Change: Implications and Policies". Development Experts Meeting Series B, Arab Planning Institute, Kuwait. Issue 24, 2007. (In Arabic).
- Phnom Penh Post, (2000). “Floods affect nearly 3 million Cambodians”, Susan Postlewaite, Fri, 13 October 2000. Online link: http://www.phnompenhpost.com/national/floods-affect-nearly-3-million-cambodians
- Russell, K. et al (2016). “Climate Change Impact: The Experience of the Coastal Areas of Bangladesh Affected by Cyclones Sidr and Aila”. Journal of Environmental and Public Health, volume 2016, article ID 9654753, 9 pages. Online link: http://dx.doi.org/10.1155/2016/9654753
- Thacker, S. (2013). “Climate Change and Education in the Middle East and North Africa”. World Bank Blogs, 11/09/2013. Online link: https://blogs.worldbank.org/ar/arabvoices/education-and-climate-change-middle-east-and-north-africa (In Arabic).
- The Guardian, (2009), “Global warming could create 150 million 'climate refugees' by 2050”. Tuesday 3 November 2009. Online link: https://www.theguardian.com/environment/2009/nov/03/global-warming-climate-refugees
- The World Bank (2012). Turn Down the Heat Report, November 2012. Online link: https://www.worldbank.org/ar/news/press-release/2012/11/18/new-report-examines-risks-of-degree-hotter-world -by-end-of-century. (In Arabic).
- The World Bank (2013). “Education and Climate Change in the Middle East and North Africa” an article published by Thacker, S. , 9 October 2013.

Online link: http://blogs.worldbank.org/arabvoices/education-and-climate-change-middle-east-and-north-africa

- United Nations Education, Science and Culture Organization (UNISCO), (2010a), “EFA Global Monitoring Report Education for All 2010: Reaching the mongrelized”. Paris, France.
- United Nations Education, Science and Culture Organization (UNISCO), (2010b). “Reaching the marginalized: EFA global monitoring report, 2010”, EFA Global Monitor Report, 2010.
- United Nations Education, Science and Culture Organization (UNISCO), (2016). “Education for people and planet: creating sustainable futures for all”, Global education monitoring report, 2016.
- United Nations Education, Science and Culture Organization (UNESCO), (2017), “Climate Change Education for Sustainable Development at UNESCO”, 2017.

Chapter 4
Climate Change and Health and Well-being

There is a widespread near-universal consensus that the planet is warming due to human-caused emissions of greenhouse gases. The current global trends of using energy and the pursuit of development and accompanying population increase, will inevitably lead to continuous and more severe climate changes.

There is no doubt that the current and expected future climatic changes will inevitably affect the basic requirements for the protection of health, which are at least represented in water, clean air, and safe food quantities for the present and future humans.

World Health Organization (WHO) indicates that about 800 thousand person die every year due to air pollution, especially in cities and industrial areas; 1.8 million people die from diarrhea caused mainly by lack of access to clean water supplies, lack of treatment, and poor personal hygiene; 3.5 million person die from malnutrition Food shortages, and about 60 thousand person dies as a result of natural disasters (WHO, 2008).

There is no doubt that the increased possibilities of climate fluctuations and global warming threaten to raise the levels of some pollutants in the air and increase the spread of diseases through water pollution and food contamination, as well as damage to agricultural production and its insufficiency to achieve food security for the population, especially in the least developed countries.

Climate change also raises new problems with regard to combating infectious diseases and diseases that are highly sensitive to climate changes in terms of

temperatures, rainfall, and high humidity, including cholera, diarrheal diseases, malaria, dengue fever, and other vector-borne diseases. Accordingly, “climate change threatens to slow down the pace of progress made by public health services worldwide in combating many of these diseases, but also threatens to halt or reverse that progress” (WHO, 2008).

With climate change, all population groups will become vulnerable, but to varying degrees. It is expected to be more severe among the elderly and people with special conditions and chronic diseases. Children, the poor, and women, in particular, are likely to be the most vulnerable and least bear to the burden of diseases caused by climate change.

In addition to climatic changes, we cannot ignore the role of globalization, which makes it more difficult to contain infectious diseases, and even increases the speed of their spread as a result of the rapid and successive movements of the population from one place to another around the world.

The worst health effects may not result from natural disasters or epidemics but result from the gradual escalation of pressures on the natural, economic and social systems that support health, which is weak in most developing countries. These pressures include freshwater scarcity, declining food production, and rising sea levels. Such changes are likely to drive population displacement and migration and increase the risk of civil unrest.

Manifestations of the impact of climate change on health:

Climate change will adversely affect some of the basic determinants of good health, namely clean air, clean water, adequate food, adequate shelter, and safety from

disease. Developing countries are most exposed to the risks of climate change and most vulnerable to its negative impacts on achieving health-related Sustainable Development Goals.

Heat: High temperatures directly contribute to deaths from heart and respiratory diseases, especially among the elderly. For example, more than 70 thousand additional deaths were recorded during the heat wave that occurred in the summer of 2003 in Europe. WHO statistics showed that globally, during the period 1998 - 2017, more than 166 thousand people died due to heat waves, including the heat wave that killed 60 people in Egypt in 2015.

Rising temperatures also increase levels of ozone and other air pollutants that exacerbate cardiovascular and respiratory diseases. In extreme heat, the levels of pollen and other allergens in the air rise. This can cause asthma, a disease that affects nearly 300 million people. This burden is expected to increase due to the continuous increase in temperatures.

At the same time, rising temperatures are accelerating the evaporation of surface waters, which provide fresh water for much of the population. The lack of freshwater harms the general health of individuals and increases the rates of diarrhea, while the severe cases of water scarcity cause drought and famine. Increased water in the form of floods pollutes freshwater supplies, increases puddles and swamps, and increases the chances of breeding insects that transmit diseases such as mosquitoes (Robine J.M. et al. 2008).

A study conducted in Riyadh in 1998 showed that dust in sandstorms is a major cause of respiratory diseases. As a result to changing wind patterns, the levels of airborne allergens such as pollen, dust, mold, germs and materials that cause lung and

skin infections will raise in the air, especially in extreme heat. The burden of this diseases increases due to the continuous increase in temperatures. The increase in temperatures also causes an increase in ground ozone, which increases the rate and severity of asthma attacks, and causes irritation of the nose and eyes, coughing and respiratory infections.

The average temperature in the Middle East will increase by 1-2^{O}C by 2050. The rise in summer temperatures contributes to an increase in diseases and deaths from heart and respiratory diseases. WHO statistics showed that globally, during the period 1998-2017, more than 166 thousand people died due to heat waves, including the heat wave that killed 60 people in Egypt in 2015. An analytical study in Kuwait concluded that the incidence of urinary retention increased during periods of hot weather 1998-2001. Also, prolonged exposure to extreme heat is associated with fainting, heat stroke, and convulsions. In addition, the greenhouse gases caused a thinning in the ozone layer, which led to a decrease in its absorption of harmful rays, thus increasing the risk of sun exposure, skin damage and sunburn, and doubling the risk of skin cancer (Abboud, 2014).

It is estimated that rising temperatures and changing rainfall patterns will reduce crop yields in many developing countries, putting pressure on food supplies. As for persons who depend on subsistence agriculture or that do not get enough income to buy food, it is expected that they will suffer more from malnutrition and undernutrition, and malnutrition diseases, in turn, exacerbate the severity of many infectious diseases, especially among children (Arnell NW, 2004).

Rain and Flooding: The expected increase in rainfall patterns is likely to affect the freshwater supply. The lack of clean water can harm the general health of individuals and increase the risk of diarrhea. Diarrhea kills 60,000 children under the

age of five every year. In severe cases of water scarcity, we may reach the stage of drought and famine. It is likely that by the nineties of this century climate change will increase the area affected by drought and double the frequency and duration of severe droughts (Arnell NW, 2004).

As for floods, an increase in their frequency and severity will be observed. Floods pollute freshwater supplies, increase the risk of waterborne diseases and create breeding grounds for disease-carrying insects, such as mosquitoes. It also causes drowning, bodily injury, destruction of homes, and disruption of the delivery of medical supplies and the provision of health services.

During the third decade of the current century, it is likely that rising temperatures and changing precipitation patterns will reduce the production of basic foods by 50% in many of the poorest areas in African countries. This will lead to an increase in the prevalence of malnutrition and undernutrition, which currently causes the death of about 3.1 million people annually (IPCC, 2007).

Natural disasters: Since the 1960s of the last century, the reported incidence of weather-related natural disasters has more than tripled globally. These disasters cause more than 60 thousand deaths annually, most of them in developing countries. In light of the fact that more than half of the world's population lives within 60 km of the sea, rising sea levels and the increasing occurrence of extreme weather events will destroy homes, medical facilities, and other essential services. People may be forced to relocate, which may increase the risk of adverse health effects, ranging from communicable diseases to mental disorders, hence increasing environmental and social pressures in their new locations.

Not all of the effects of climate change will be harmful, but overall it is estimated that the harm to health will outweigh its benefits. A warmer climate is expected to benefit some populations, such as lowering winter morbidity and mortality and increasing local food production, particularly in high northern latitudes. However, estimates by both the World Health Organization and the Intergovernmental Panel on Climate Change indicate that the negative impacts of climate change on health are greater and are supported by stronger data than those indicating potential benefits. Moreover, the negative effects are concentrated in poor population groups with weak health potentials, and thus the gap between the rich and the poor is widening (WHO, 2002 and IPCC, 2007).

Tropical Storms: tropical high winds bring death and destruction with them. Available data indicate a marked increase in the number of powerful hurricanes in recent decades, and this trend is likely to continue. Studies indicate that doubling the level of carbon dioxide in the atmosphere within the next 80 years will cause an increase in the speed of hurricanes by 6% only, but will cause an increase in their frequency and amplitude by about 300%.

Climate change and mental health:

In a recent study, published by the Journal of the National Academy of Sciences (PNAS), data of daily meteorological combined with information collected from nearly two million US residents over an entire decade.

The information was collected from residents in areas devastated by Hurricane Katrina, which occurred in late August 2005 and led to one of the worst disasters in the

history of the United States and affected millions of individuals in American cities on the Gulf Coast of Mexico.

During the study, respondents answered questions about their mental health, including stress, depression, and emotional problems. The researchers examined three types of environmental stresses likely to be produced by climate change, namely exposure to short-term weather events, multi-year warming, and acute exposure to natural disasters, in order to investigate the historical relationship between climate change and mental health.

The study indicated three main factors that determine the psychological safety of a person, namely the social status, economic status, and physical condition. Climate change, through the threat of these three determinants, leads to the occurrence of psychological disorders, which in turn worsen public health, reduce productivity, and reduce the quality of life. The research team found that:

- Living in hot temperatures and high levels of precipitation exacerbate the rates of mental health conditions.

- Exposure to multi-year of warming has been associated with the increase of prevalence of mental health problems.

- Exposure to tropical cyclones, which is likely to increase in frequency and intensity in the future, is also related to mental health problems.

- Many people who suffer from symptoms of mental health disorders as a result of climatic factors often do not seek treatment or do not find appropriate attention to their condition if they suffer from symptoms and seek treatment.

- High temperature and dehydration increase the risk of suicide, and the rate of visits to psychiatric hospitals increases during periods of high temperatures.

This is in addition to the danger of rising temperatures on physical health, harming economic activity, stimulating social conflict, and causing forced migration.

Consistent with the findings of this study, another study published in April 2018, by the journal of "Nature Climate Change", pointing to the dangers of what it called "ecological grief," which is defined as a natural response to environmental losses that may become more common as the effects of climate change intensify. The study underscores that climate change is not just a scientific concept, but also a source of much unrecognized emotional and psychological pain. The study shows that those with pre-existing psychological conditions, lower socioeconomic levels, as well as women, are most at risk of psychological and mental risks. According to the results of the study, the mental health of low-income individuals may be further affected by climate change.

This bearing in mind that the study was conducted on individuals from the United States of America, which is a rich country and tends to have an adequate climate in most parts, which means that areas with harsh climates and fewer resources, will fare worse psychological for residents.

In general, we can say that mental production depends on multiple factors to reach either a productive mood or a turbulent state. of course, the climate is among these factors. In line with this hypothesis, the idea of (adaptation) was put forward, which changes the mental state of people's moods and makes them more stable, even in the face of harsh climatic conditions.

Diseases related to climate change:

The spread of many diseases is closely related to climatic changes. Despite the remarkable scientific progress in eliminating many diseases, it is feared that climatic changes will spoil this achievement, as many deadly diseases are very sensitive to changing temperatures, humidity, rain, and other climatic manifestations, which leads to their spread. It is expected that climate change increase the spread of various infectious diseases as follows:

- **Foodborne illnesses**: such as Listeria (Listeria is a foodborne illness caused by Listeria monocytogenes, a bacterium that can cause serious and sometimes fatal infections in young children, elderly people, and other individuals with weakened immune systems).

- **Waterborne diseases**: such as cholera.

- **Airborne diseases:** Increased summer temperatures can increase the risk of Legionellosis, especially if extreme heat causes an increase in the use of air conditioning. The most severe form of Pneumonia is Legionnaires' disease (an infection caused by bacteria known as Legionnaires' disease). Most people get Legionnaires' disease by inhaling bacteria in water or soil. Older adults, smokers, and people with weakened immune systems are at greater risk of getting Legionnaires' disease.

- **Diseases transmitted by intermediate families:** such as mosquitoes, ticks, flies, rodents, and snails. These families are highly sensitive to climatic conditions, including temperature. These diseases include:

- **Malaria:** transmitted by Anopheles mosquitoes. An increase in malaria transmission has been observed in the highlands of Tanzania, Kenya, Madagascar, and Ethiopia.
- **Dengue fever:** transmitted by the bite of the Egyptian mosquito. Heavy rains and high temperatures increase the transmission of this fever.
- **Leishmania:** transmitted by the sand-fly, other types of which have reappeared in certain parts of the world.
- **Schistosomiasis:** Climate change is expected to widen the geographical area in which schistosomiasis is transmitted by snails.

- **Other diseases transmitted by rodents:** such as Hantavirus pulmonary syndrome. It becomes more prevalent with the increase in the number of rodents carrying this disease during heavy rains and floods.

- **Animal diseases:** Climate change leads to an increase in the emergence of some diseases among animals, mostly related to global warming, that are contagious to humans, including the West Nile virus and Rift Valley fever.

Response and adaptation measures:

It is no longer permissible to consider climate change merely as an environmental or development issue. Rather, it is more important to view these climate changes as a threat to human health and limit the possibility of preserving and improving them. Accordingly, such risks should be given more importance when setting development policies and community participation programs to ensure their effectiveness. Countries

of the world should take response and adaptation measures to reduce the health consequences of climate change and reduce its devastating effects, including:

- Capacity building, strengthening, and development of health systems to ensure their adaptation and readiness to respond to climate change.

- Transition to low-carbon cities: by shifting to renewable energy sources, adopting green buildings, protecting biodiversity, and sustainable management of land, water, and waste.

- Reducing the use of cars, enhancing the use of public transportation, developing the transportation sector in a sustainable manner, cycling and walking, and expanding the production and use of electric cars, which would reduce carbon emissions and air pollution, with many benefits in the field of health.

- Preparing disaster management plans and mapping high-risk areas such as arid lands, coastal cities, and densely populated cities.

- Carrying out research in order to assess climate changes and their impact on health, assessing each country's ability to adapt, and facilitating access to information in this field.
- Awareness of the dangers of climate change to human health.

Certainly, climate change will bring many new and previously unknown problems in the control and treatment of infectious diseases. Many deadly infectious diseases borne by water, contaminated food and insects are usually highly sensitive to climatic and weather conditions. Global climate change threatens to slow, halt or reverse progress in combating many of these infectious diseases.

References:

- Abboud, N. (2014). "The impact of climate change on health". Environmental and Development Perspectives Magazine. 01 June 2014. (In Arabic).
- Al-Saeed, M. (2018). “Climate change harms mental health”. Scientific American, 11/8/2018. (In Arabic).
- Arnell N.W. (2004). “Climate change and global water resources: SRES emissions and socio-economic scenarios”. Global Environmental Change ,Human and Policy Dimensions, 2004, 14:31–52.
- Booth, M. (2018), “Climate Change and the Neglected Tropical Diseases”, Elsevier Public Health Emergency Collection, Published online 2018 Mar 28. DOI: 10.1016/bs.apar.2018.02.001. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7103135/
- Drawer Blog (2020). "How does climate anxiety harm our mental health?" Translated from the Guardian, 27/2/2020 (In Arabic).
- Intergovernmental Panel on Climate Change (IPCC), (2007). “Climate change 2007. Impacts, adaptation and vulnerability”. Geneva, (Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change).
- Patz, J., et al. (2005). “Impact of regional climate change on human health”, Nature, 438(7066), pp.310-317.
- Paul, E. (2005) “Climate change and Human Health,” New England Journal of Preventative Medicine 353 (2005): 1433-1436.
- Robine, J.M., et al. (2008). “Death toll exceeded 70,000 in Europe during the summer of 2003”. PMID: 18241810. DOI: 10.1016/j.crvi.2007.12.001. https://pubmed.ncbi.nlm.nih.gov/18241810/

- United Kingdom Government Met Office. HadCRUT3 annual time series, Hadley Research Centre, 2008, http://hadobs.metoffice.com/hadcrut3/diagnostics/global/nh%2Bsh/index.html
- Voice Media Group (2020). “Climate change harms mental health” prepared by Sean Dcdermott and translated by Hussein Farouk 22/9//2020 (In Arabic).
- World Health Organization (WHO), (2002). “The world health report 2002 – Reducing risks, promoting healthy life”. Geneva.
- World Health Organization (WHO), (2008). “Environmental health in emergencies”. Geneva, 2008. Online link: http://www.who.int/environmental_health_emergencies/en/
- World Health Organization (2019). "Health, Environment and Climate Change". Draft Action Plan on Climate Change and Health in Small Island Developing States, 25 Seventy-second World Health Assembly, 25/4/2019 (In Arabic).

Chapter 5

Climate Change and Women's Empowerment and Gender Equality

When a flood or a hurricane occurs, or when drought prevails and desertification increases, the damage affects all the citizens in the affected areas. But is everyone affected at the same level? Women suffer from climate change more than men!

Both women and girls are the first line of defense against the effects of climate change, and they are the most vulnerable to the effects of climate change. Women, especially in developing countries, depend more on agricultural activities, animal husbandry, and livestock, and they are more vulnerable to poverty, scarcity of food, and less education, in addition, they are less likely to own land or personal property, which make them more vulnerable to disasters natural. Unbalanced power relations and cultural norms cause women to remain underrepresented in decision-making, thus making it difficult to ensure better opportunities for them in the future.

It is estimated that 60% of people suffering from chronic hunger are women and girls. Women constitute, on average, 43% of the agricultural labor force in developing countries. If it had the same access to productive resources as men, it would have contributed to increasing the crops on its farms by 20-30%. This could have contributed to an increase in total agricultural production in developing countries between 2.5-4%, which in turn would reduce the number of people suffering from hunger in the world by 12-17% (Mary Halton, 2018).

Women depend more heavily on forests and natural resources than men for their livelihoods. About 18% of global carbon dioxide emissions stem from house uses especially biomass and charcoal cooking stoves which emit high amounts of carbon dioxide and other pollutants in developing countries, causing about 2 million deaths each year. The health burden of these coal kilns falls disproportionately on women and children.

Statistics issued by more than 33% of governments around the world indicate that citizens have regular access to clean water, while the same is not achieved for the rest of the countries around the world. This is primarily a female issue, given that women, especially in rural areas, spend many hours collecting water (CSW fact sheet, 2014).

With the limited adaptive capacities and the absence of coping mechanisms available, women and girls struggle to build their resilience in the face of climate change. As the effects of climate change worsen, the gender gap is likely to grow even larger. Current efforts aimed at addressing climate change and energy issues do not fully recognize these gender dimensions. As a result, national and global policy frameworks do not adequately take into account a gender perspective and fail to provide the needed protection and opportunities to women and girls.

Problems facing women due to climate change:

Water: In many countries, women are responsible for collecting water for the family. If there is a water shortage due to drought, women have to travel long distances to find water. This represents an increase in the workload placed on women and the time available to them to complete other tasks and work. There is also a danger of young

girls leaving school in order to help their mothers in collecting or finding sources of water.

Agriculture: In developing countries, many women work in agriculture and are responsible for producing food for the family. Usually, women depend in their agricultural activities on natural resources due to the unavailability of economic resources, therefore women in such places cannot, for example, invest in modern irrigation systems that make them benefit more from rainwater. Access to natural resources is affected by climate change. If the harvest fails or is reduced due to climate change, these women will earn less money and will also have less food for their families, this will also affect the health of women and their families.

Diseases and Health: High temperatures and floods can have an impact on health in general, as more diseases are expected for individuals, especially young people. This will affect women as they are the main caretakers of family members and will therefore devote more time to this care. For example, higher temperatures or more precipitation can cause malaria mosquitoes to spread more, and pregnant women become more susceptible. Such health conditions can adversely affect the menstrual periods and the mental health of women. Climate change can cause an increase in deaths from heat-related illnesses, especially respiratory allergies. Moreover, polluting practices such as forest fires and dumping toxic chemicals into seas or rivers contribute to climate change but also affect the health of the community's residents. Shortage of (clean) water may be one of the ramifications of climate change, which may affect women's personal hygiene. When the shortage of water occurs, the water will be used mainly for drinking and cooking. Little or old water will be the only available for cleaning and sanitation, which affects the healthy living conditions of people and increase the risk of disease. Moreover, in the aftermath of natural disasters, there is always a higher risk of disease spread, as a result of poor hygiene due to poor living conditions.

Disasters: Climate change can lead to more extreme weather and natural disasters. In general, disasters are more harmful to females than males. There are many reasons for this, including the low social and economic status of women. Poor women cannot take preventive measures against natural disasters. The traditional role of women as caretakers also makes it difficult for women to escape because they also have to protect children and the elderly. Moreover, their chances of survival are affected by women's traditional roles in society, examples of which include women not learning to swim, the need for permission from their husbands or families before leaving the home, or traditional clothing restricting women's movement and speed. Due to the lack of financial resources for most of the poor women, they also face more difficulty in recovering their lives and rebuilding their houses after the disaster. Additionally, in the aftermath of disasters, there is also a higher risk of sexual violence against girls and women.

In front of these climatic changes and natural disasters, women may have no choice but to migrate. Migration can take place in two forms: either the man of the family migrates only or the women migrate with their families. The migration of men alone leads to additional stress on women. Women will have to take over the men's responsibilities in addition to their traditional roles in the families, while they do not have the same property rights and access to resources as men, which creates an additional burden on women. When women migrate with their families, they are exposed to threats and risks of violence.

Some evidence of how climate change affects women:

Studies show that women are more likely than men to be affected by climate change. More than 70% of the people displaced by floods in Pakistan in 2010 were women and

children. Women represent about 80% of climate refugees. 20 million people out of the estimated 26 million displaced persons due to climate change were women (Mary Halton, 2018).

- More than 70% of the people who died in the 2004 Asian tsunami were women. Similarly, Hurricane Katrina, which hit New Orleans (USA) in 2005, mostly affected poor African Americans, especially women. Women do not have easy and convenient access to funds to cover losses or weather-related coping techniques. They also face discrimination in access to land, financial services, social capital, and technology (UNDP, 2016).

- 2 million women and children die annually - four per minute - prematurely due to disease caused by indoor air pollution, especially breathing the smoke produced during cooking with solid fuels (tree wood and agricultural residues). (UNDP, 2016).

- After Hurricane Katrina in 2005, African American women were among the worst affected by floods in Louisiana. "In New Orleans, there was great poverty among the African-American population before Hurricane Katrina, and more than half of the city's poor households were headed and supported by single mothers. They depend on community networks for their daily survival and resources. The displacement that occurred after Hurricane Katrina has essentially eroded those networks. It puts women and their children at much greater risk", says Jacqueline Litt, professor of women's studies and gender at Rutgers University.

- In the aftermath of the 2004 tsunami, an Oxfam report found that men outnumbered women by a ratio of about 3:1 in Sri Lanka, Indonesia, and India. While there was no clear reason for this, there were similar patterns across the region. At the time of the evacuation, men were better able to swim, while women gave more attention to the

care of children and other relatives, and women mostly lost their savings and valuables things in the evacuation.

- Based on the results of a 20-year study, catastrophic events reduce the life expectancy of women more than men; and more women die at younger ages. In countries where women have greater social and economic potential, the difference has decreased (Mary Halton, 2018).

- In a sample of 141 countries during the period 1981-2002, it was found that gender differences in deaths caused by natural disasters are directly related to the economic and social rights of women. In unjust societies, more women than men die from disaster (Neumayer, 2007).

- Women and children are 14 times more likely to die than men during a disaster. Women made up 61% of the deaths caused by Cyclone Nargis in Myanmar in 2008, and between 70-80% of the deaths as a result of the Indian Ocean tsunami in 2004, and about 91% of deaths as a result of the 1991 cyclone in Bangladesh (UNDP, 2013).

- Women in developing countries are often more vulnerable to the risks posed by severe climate changes because they are less mobile than men, less benefit from traditional means of communication, and more exposed to the risks associated with malnutrition and waterborne diseases. 90% of the victims of the Cyclone disasters in Bangladesh in 1991, which killed 140,000 people, were women (Hassan, K. 2016).

- Poor people are more vulnerable to the effects of climate change. The majority of people who live on one dollar or less daily (estimated by1.5 billion people) are women (UNFPA, 2009).

- The agricultural sector is one of the most important sectors that are usually affected by climate change. Many women in developing countries work in the agricultural sector, which negatively affects the lives of their families. The percentage of female workers in the agricultural sector exceeds 50% in Sudan and Morocco, and 25% in Tunisia. (Hassan, K. 2016).

- Women in developing countries participate disproportionately in subsistence agriculture, and fuel and water collection. With droughts, floods, and other extreme weather events, the burden on women responsible for their families to meet water and food increases. The women's time spent collecting water around the world in 2012 was estimated at 40 billion hours. (UNFPA, 2009).

- During and after disasters, levels of sexual violence against females often rise. After two tropical Cyclones hit Vanuatu's Taff District in 2011, the Tana Women's Counseling Center reported a 300% increase in new domestic violence cases. It has been found that human trafficking increases by 20-30% during disasters. (UNEP, 2011).

- After climatic disasters, women usually suffer from health and psychological problems including poor psychosocial health, increased vulnerability to insect-borne diseases, infectious diseases, and other health effects. This not only affects women's health directly but also affects their abilities to care for dependents and other injured and ill family members. (WB, 2012).

How women affect climate change:

Besides the difference in how men and women are affected by climate change, there is also a difference in the extent to which each contributes to global warming, particularly the emissions of greenhouse gases. It is believed that women have a lower environmental footprint due to differences in consumption. For example, women travel shorter distances in their daily activities, use public transportation, and consume less energy than men.

The European Institute for Gender Equality (EIGE) report of 2012 about women and the environment argued that men and women may also think differently about solutions to global warming. Based on the results of population surveys, women are more willing to make changes in their personal lives to reduce the effects of climate change. Women are also more willing to buy eco-friendly products and pay a higher price for these products. They are also trying to choose low-carbon practices. Conversely, men may prefer technical solutions such as electric cars. Men are more open to using nuclear power as an alternative energy source, while most women do not support nuclear power due to the higher risks. Additionally, tax measures such as higher energy taxes are not favored by women. This can be explained by the fact that women usually have less income than men and therefore have less money to spend on energy consumption (EIGE, 2012).

Some successful experiences of women in leading sustainable development and reducing the risks of climate change:

- The Waorani Women's Association of the Ecuadorean Amazon is an association that encourages women in the region to grow organic cocoa as a wildlife protection measure and a path to sustainable local development. With the support of the United

Nations Development Program (UNDP), the association manages its lands collectively. It has made a great achievement in the framework of forest protection, and the rate of deforestation. Currently, the deforestation rate is close to zero. It also seeks to protect animals, birds, and endangered species in the wild. In the process, women play a major role in building community capacity by investing revenues from cocoa cultivation and organic chocolate production in developing local projects for health, infrastructure, and education and successfully guiding the local economy away from the economy of deforestation, logging, timber trade, and bush meat markets through unjust hunting in the forests (Hassan, K. 2016).

- Another model is the Koolel-Kab Association and its members are indigenous women in Mexico. The association has begun a program for sustainable development and disaster risk reduction at the local community level with the support of the United Nations Development Program (UNDP). The association has succeeded in establishing a community on an area of 5 thousand hectares of forest land, managed and occupied by advocates of stopping deforestation, who offer alternatives to commercial agriculture. The association also participates in a pilot project for organic beekeeping in more than 20 tribal communities and provides an economic alternative to illegal logging (Hassan, K. 2016).

- Another example of empowering women is the Al Rahad locality, which is located north of Kordofan State in Sudan, which has suffered like other regions in the African Sahel region from high temperatures, uneven distribution, fluctuation in the level of precipitation, and drought. This situation has affected the livelihoods of shepherds and farmers, which prompted the men to migrate to the capital, Khartoum, or to other cities in search of work. On the other hand, women whose traditional roles revolved around caring for children and performing household chores, have

moved on to the role of family headers and by renting fields for livestock and crops, they become able to sell goods in the markets and earn a small income.

To help address the effects of climate change, a joint program called “Promoting Gender-responsive Approaches to Natural Resource Management for Peace in North Kordofan”. It was implemented by UNEP, UN Women, and UNDP. The project spent the first two years of its life training women in agriculture, natural resource management, and conflict resolution. The project made efforts to train women in the use of rain-fed farming techniques, harvesting the Arabic gum, which is one of the main exports of the region, acquiring land through the Native Administration, obtaining sesame and corn seeds from the Ministry of Agriculture, and obtaining advances from financial institutions.

A study conducted after the end of the project revealed that 87% of the participating women reported that there was an increase in income from the crops that they sold in the market and that the agriculture in the areas around the houses produced enough food to meet their daily needs and that the cooperative farms also included women from the pastoral groups and agricultural groups, which created a stronger social unit and facilitated discussions of natural resource management.

The number of women farmers practicing traditional male roles has increased due to the effects of climate change and environmental degradation. “Women are on the front lines of climate change and climate-related conflict. Climate change is driving shifts in livelihood patterns that lead to men migrating away from their communities to find alternative employment opportunities, or changing migration patterns in a way that keeps women in their communities instead of traveling with men.” Celia Haley, Joint Program Coordinator.

On the other hand, the program has indirectly helped mitigate the conflicts resulting from climate change. The tension between farmers and pastoralists has risen in past years over limited land and resources. According to the Rahad Center for Conflict Mediation and Peace building, 9 bloody conflicts occurred in 10 months (the period between July 2017 and April 2018), which caused 24 deaths. Because of cultural taboos, women have suffered from exclusion from the Judiya meetings (meetings to solve problems and conflicts), but now, with the emergence of women-dominated communities, they have become the caretakers and breadwinners of their families, participants in local government, and are of high esteem. Through the project, women were able, for the first time, to lead forums to encourage dialogue between farmers and herders about natural resources and how to find solutions to the most pressing environmental problems.

By the end of the project, women farmers of the local community are regularly involved and an essential part of all phases of negotiation and Judiya meetings. In addition, a new community peace building body has been established called the Natural Resources Management Subcommittee, which is composed of 8 women and 4 men. As a result, the comparison between women and men witness a major transformation, making 100% of the community members participating in the study agrees that women have an important role in resolving conflicts related to natural resources. The project has clearly demonstrated that in light of climate change, natural resources are a powerful gateway to the inclusion of women in peace building processes and that inclusion of women can lead to sustainable peace.

Following the end of the project, local women on their own initiative mobilized their communities and local authorities to plant 6,000 trees to help combat soil degradation (UNEP, 2019).

Suggested policies and recommendations:

The aim of this section is to shed light on the recommendations and proposed policies to achieve gender equality, combat climate change, achieve the Millennium Development Goals, enhance the effectiveness of measures related to climate change, and strengthen legislation that takes into account the gender dimension (male/female) on climate change and energy. The following are the most important recommendations and policies:

- Conducting an in-depth analysis of the roles of women and men in sectors affected by climate change and their strategies in dealing. Understanding the knowledge, roles, and capacities of men and women will provide a solid foundation for policies and programs addressing and combating climate change (UNDP, 2013a).

- Integrating the gender dimension into climate change programs is essential for effectively addressing the needs and priorities of women and men, ensuring the full and meaningful participation of women, and achieving gender-equitable outcomes. Climate change action must be based on consulting with women, building and integrating their skills and knowledge, and providing opportunities to improve health, education, and livelihoods. Increased participation of women would lead to more environmental and productivity gains and creates mutual benefits and greater returns through the Millennium Development Goals. Likewise, greater participation of women in adaptation and mitigation efforts would enhance the effectiveness and sustainability of these efforts. The gender dimension and women's issues, needs, and contributions should be integrated into all phases of the planning and implementation cycle of climate change policies and projects. (Hassan, K. 2016).

- Ensuring that mitigation and adaptation efforts also address sources of gender-based vulnerability, gender inequality, and poverty. Economic, legal, and socio-cultural constraints can limit women's capabilities, and therefore climate change responses need to address women's historical and current disadvantages. All programs and policies should recognize, acknowledge and include the key role of women in environmental, social, and economic development. Women's empowerment and gender equality are beneficial to family and community well-being and livelihoods as well as to enhance resilience of economies and societies. Procedures, techniques, and strategies must be supportive of the poor in their design, implementation, monitoring, and evaluation. (UNDP, 2013a).

- Inclusion of the gender dimension in national and international financing strategies and mechanisms to confront climate change. Gender-based criteria for allocating funds should be established, including project identification, design, objectives, and performance. Gender must play an essential role in efficient, effective, and inclusive financing. Financing mechanisms to support gender-sensitive projects and programs that support the adaptation and mitigation of climate change and address the historical, political, social, and economic constraints that hinder women and stand in the way of achieving the Sustainable Development Goals should be developed. (UNDP, 2013a).

References:

- AGORA, (2018). "Gender equality, climate change and energy", online link: https://agora-parl.org/resources/aoe/climate-change-energy-and-gender
- Deutsche Welle (DW), (2010). "Even climate change oppresses women". Online link: https://p.dw.com/p/O4Nl
- European Institute for Gender Equality (EIGE), (2012), "Gender Equality and Climate Change: Report". Online link: https://eige.europa.eu/sites/default/.../Gender-Equality-and-Climate-Change-Report.pdf
- Georgetown Institute for Women, Peace and Security (GIWPS), (2015), "Women and Climate Change: Impact and Agency in Human Rights, Security, and Economic Development". Online link: https://www.climateinvestmentfunds.org/sites/cif_enc/files/knowledge-documents/georgetown_women_and_climate_change_2015.pdf
- Hassan, K. (2016). "Global Climate Change, Women and Gender Equality (4/7)". Civil Dialogue Forum, Issue 5069, 8/2/2016, link: http://www.ahewar.org/debat/show.art.asp?aid=504166
- Mary, H. (2018). "Climate change 'impacts women more than men". BBC News, 8 March 2018. Online link: https://www.bbc.com/news/science-environment-43294221
- Neumayer, E. and Plümper, T. (2007), "The gendered nature of natural disasters: the impact of catastrophic events on the gender gap in life expectancy, 1981–2002", Annals of the Association of American Geographers, 97 (3). pp. 551-566. ISSN 0004-5608
- The Commission on the Status of Women (CSW58), (2014) "Fact Sheet 2014". https://p.dw.com/p/O4Nl

- The World Bank (WB), (2012) “Making women's voices address gender issues in disaster risk management in East Asia and the Pacific”. Online link: http://documents.worldbank.org/curated/en/282521468027576152/Making-womens-voices-count-addressing-gender-issues-in-disaster-risk-management-in-East-Asia-and-the-Pacific
- United Nations Development Program (UNDP), (2013a). “Overview of linkages between gender t and climate change”. Policy brief 1. Online link: https://www.undp.org/content/dam/undp/library/gender/Gender%20and%20Environment/PB1-AP-Overview-Gender-and-climate-change.pdf
- United Nations Development Program (UNDP), (2013b). “Gender and disaster risk reduction”, policy brief 3. Online link: http://www.undp.org/content/dam/undp/library/gender/Gender%20and%20Environment/PB3-AP-Gender-and-disaster-risk-reduction.pdf
- United Nations Development Program (UNDP), (2016). “Gender and Climate Change: Overview of linkages between gender and climate change”. policy brief 1. Online link: http://www.undp.org/content/dam/undp/library/gender/Gender%20and%20Environment/UNDP%20Linkages%20Gender%20and%20CC%20Policy%20Brief%201-WEB.pdf
- United Nations Environment Program (UNEP), (2011). “Women in the front line of climate change - gender risk and safety”, online link: http://www.grida.no/publications/198
- United Nations Environment Program (UNEP), (2019). “Empowering women on the frontlines of climate change”. 8 March 2019. Online link: https://www.unep.org/news-and-stories/story/empowering-women-frontlines-climate-change
- United Nations Population Fund (UNFPA), (2009). “The State of the World's Population 2009: Facing a Changing World, Women, Population and Climate”.

- Women's Earth & Climate Action Network (WECAN), (2018). “Why Women”, Online link: https://wecaninternational.org/why-women-are-key

Chapter 6

Climate Change and Migration, Asylum, and Displacement

Despite the fact that migration and asylum are not among the sustainable development goals, they were only referred to within the purposes of goal no. 10, which is related to "reducing inequalities", more specifically in the purpose no.7 of this goal which states "migration facilitation and the movement of persons in an orderly, safe, regular and responsible manner, including through the implementation of planned and well-managed immigration policies." However, we have seen that the current and expected future global climate changes may cause unorganized, insecure, or irregular flows of migration (internal and external), displacement, and asylum without pre-planned policies, which greatly hinders the achievement of this purpose. Therefore, we found it necessary to devote a chapter to discussing the impact of global climate changes on migration and asylum that greatly affect the population.

The relationship between climate change, migration, and asylum:

The relationship between climatic change and human migration was usually missing until many experts in the past few decades suggested that the climatic conditions that cause unrest (political, and economic unrest), and civil wars are responsible for the migration and displacement of populations. However, the scientific evidence has not been sufficient to support these claims.

In a study published in "Global Environmental Change" magazine on the global environment, supervised by researchers from the International Institute for Applied Systems Analysis in Austria, the College for International Development in the United Arab Emirates, and the University of East Anglia in Britain, in addition to researchers at Shanghai University. The results of this study were found to support this view.

The study aimed to find links between climate change and migration and the nature of those links. The researchers found that, in certain circumstances, climatic changes lead to an increase in migration, but indirectly, due to conflicts resulting from those changes. They added that climate changes played a significant role in displacement between 2011 and 2015 due to a severe drought associated with the outbreak of severe conflicts.

Dr. Raya Matarak, a researcher at the British University of East Anglia and the United Arab Emirates, suggests that "the impact of climate change on the emergence of conflicts is important, especially in the West Asia region, which includes the Arab Mashreq in the period 2010-2012, where the so-called Arab Spring" occurred. This assumes that the relationship between climate changes and migration and asylum is specific to that period. The Arab Spring revolutions occurred in Tunisia, Libya, Yemen, and Syria, and led to civil wars in the last three countries. In Syria, drought and water scarcity caused by climatic changes led to the repeated loss of agricultural crops and the displacement of the rural population towards the cities, which led to the overcrowding of the population and increased unemployment, then to unrest, and finally the civil war. The same thing happened in sub-Saharan Africa at the same time. (Al-Sharq Al-Awsat Newspaper, 2019).

Jesus Crespo Quaresma, the economics researcher at the University of Vienna stresses that “Climate changes do not cause conflict and therefore displacement and migration. However, in conditions of poor government leadership and declining democracy, severe climate changes can generate conflicts over scarce resources” (Al-Sharq Al-Awsat Newspaper, 2019).

"We are now living in an era where catastrophic climate events are linked to human activity and this is likely to have a major impact on the way we decide to migrate to a place and settle down."

The Atlas of Environmental Migration, dating back more than 45,000 years, provides evidence that environmental changes and natural disasters have played a role in how populations have been distributed on the planet throughout history, but nevertheless, it is very likely that human settlement patterns will change dramatically due to unwanted environmental changes, arising directly from climate change. The future degradation of agricultural lands, disruption of fragile ecosystems and depletion of precious natural resources such as fresh water, will directly affect the lives of people and their families.

According to the Internal Displacement Monitoring Centre of the International Organization for Migration (IOM), the climate crisis affects displacement and migration, where 17.2 million people were forced to leave their homes in 2018 due to disasters that negatively affected their lives. Slow environmental changes, such as ocean acidification, desertification, and coastal erosion, also directly affect people's livelihoods and their ability to survive in places of origin.

The head of the Migration, Environment, and Climate Change Division at IOM predicted that there is a strong possibility that more people will migrate in search of better opportunities because living conditions are getting worse in their places of origin. She states that "There are predictions for the 21st century that more people will have to leave as a result of these adverse climate impacts. The Intergovernmental Panel on Climate Change has repeatedly emphasized that "changes caused by the climate crisis will affect migration patterns". The World Bank put forward projections of internal migration as a result of climate change by about "143 million people by the year 2050,

in three regions of the world, if no action is taken on climate change." (UN News, 2019).

Climate migration is now a reality, but the situation in “at-risk countries” presents a particular challenge. The countries at risk are the least developed countries (LDCs), landlocked developing countries (LLDCs), and small island developing states (SIDS). These countries are disproportionately affected by the negative effects of climate change and are often the least able to adapt due to structural limitations and geographic flaws. At the same time, they are the least contributing to climate change. These countries are among the strongest advocates of more robust actions on climate migration because they face very real challenges that affect all aspects of the daily lives of their inhabitants.

Climate migration challenges take many forms in these vulnerable countries. In the least developed countries (LDCs), which are the poorest and most vulnerable segment of the international community, the pressures of climate change can intersect with many development-related challenges as well as security issues. The combination of these factors often leads to migration in search of a better or safer life. For example, the Lake Chad Basin is currently experiencing serious environmental degradation, in a context where the population is facing violence linked to the presence of groups such as Boko Haram. Migration patterns in that region have been reshaped by these factors. Some least developed countries, such as Ethiopia and Bangladesh, sometimes suffer from the "double stress" of having to deal with internal climate migration, while hosting large numbers of refugees from neighboring countries.

Landlocked developing countries (LLDCs) often suffer from scarce water resources, which are increasingly depleted by the effects of climate change. This can put pressure on residents to migrate in order to improve access to water. For example, nomadic shepherds often have to change their traditional ways and travel longer

distances and for longer periods in search of water and land resources. Climate change also affects livelihoods, such as in Mongolia, where extreme cold winters deplete livestock and destroy cultivation opportunities, forcing rural people to migrate to urban districts.

Small Island Developing States (SIDS) are a special case of sustainable development because they face greater risks of marginalization due to their small size and remoteness. It also has fragile natural environments, and natural disasters such as storms and hurricanes have a devastating impact on the population. The negative effects of climate change have contributed to the migration of thousands of people in small island developing states in the past decade alone. One type of migration identified in this context is the planned movement of people, whereby entire communities need to move, generally inland, to escape the effects of climate change such as coastal erosion. In Fiji, following Tropical Cyclone Winston in 2016, more than 60 villages were relocated to reduce people's exposure to further risks. (Traore, 2019)

It is clear that the current situation is worrying. Priority must be given to mitigating the effects of climate change and promoting adaptation to climate change in places where populations are at risk of forced migration. However, it is also clear that in some places it will not be possible for residents to remain in their original locations and it is important to consider how to present legal immigration options to these immigrants. It is also important to consider the positive role that can play by migrants in fighting against climate change, such as facilitating remittances and transferring skills and knowledge toward climate action.

Evidence of migration and asylum due to climate change:

It has become the prevailing belief now that climatic changes are usually linked to other factors and determinants that motivate individuals to migrate from one place to another. So far, there are only a few cases in which climate change is the sole driver of migration. The clearest examples are:

- On March 14, 2019, Tropical Cyclone Idai made landfall near the city of Beira, Sofala Province, Mozambique, causing human casualties, massive destruction of infrastructure and homes, and massive internal displacement. The disaster exacerbated pre-existing vulnerabilities in the affected areas. The United Nations High Commissioner for Refugees reports that 1.85 million people are in need of assistance. 146,000 people were internally displaced, and Mozambique rushed to house them in 155 temporary sites. The hurricane and subsequent floods destroyed 100,000 homes, and one million acres of crops, and destroyed $1 billion in infrastructure. This is caused by one storm in one place over the course of one day! While Cyclone Idai was the worst storm in Mozambique's history, the world may face many of these "unprecedented" storms in the future. Large-scale human migration due to scarcity of resources increased frequency of extreme weather events, and other factors, especially in developing countries, has become one of the global challenges and critical issues that the international community must confront. (UNHCR, 2019).

- In 2018 alone, 17.2 million new disaster-related displacements were recorded in 148 countries and territories (International Displacement Monitoring Center, IDMC). 764,000 people in Somalia, Afghanistan, and many other countries were displaced due to drought, and many people displaced cannot return to their homes due to drought (International Organization for Migration, IOM).

- In 2018, the World Bank estimated that three regions (Latin America, Sub-Saharan Africa, and Southeast Asia) will generate 143 million climate-related migrants by 2050 (Kumari et all. 2018). In 2017, 68.5 million people were forcibly displaced (more than at any time in human history). Approximately one-third of this figure (22-24 million people) have been forced to relocate due to "sudden" weather events (floods, wildfires, droughts, and severe storms), while the remaining two-thirds of displacements are the results of other humanitarian crises (McDonnell, Tim, 2018).

- In the Western Pacific islands, sea levels are rising at a rate of 12 millimeters annually. Eight islands have already been submerged, and two more are on the verge of disappearing, resulting in a wave of migration to larger countries (Nunn et all 2017 & Roy et all. 2019). It is estimated that 48 islands will disappear due to rising oceans by 2100. In 2015, one of the affected families (escaping from the disappearing island of Kiribati) applied for refugee status in New Zealand. It was the first asylum application explicitly attributed to climate change, the case was taken to the Supreme Court of New Zealand and was eventually rejected (Law Library of Congress, 2015).

- The islands in the Federated States of Micronesia have shrunk dramatically, drifted into uninhabitable states; their fresh waters polluted by seawater influx, and disappeared in the past decade. The relatively small size of the islanders' population (2.3 million people spread across 11 countries). Their remote location in the Pacific islands may be the cause of receiving little international action, despite the attention they receive in the media. (World Bank, 2019).

- In South Asia, rising temperatures, rising sea levels, increased frequency of cyclones and floods in river systems, and other extreme weather events are exacerbating

current internal and international migration patterns. In addition, rapid economic growth and urbanization are accelerating and amplifying the impact and drivers of climate change. Energy demand in this region is expected to grow by 66% by 2040. To make matters worse, many of the expanding urban areas are located in low-lying coastal areas, already threatened by sea-level rise (Prakash, 2018). The World Bank predicts that the economy of the South Asia region (Bangladesh, Bhutan, India, Maldives, Nepal, and Sri Lanka) will lose 1.8% of annual GDP due to climate change by 2050 (UNFCCC, 2014) The New York Times also reported that the living conditions of 800 million people in this region could seriously deteriorate and this would lead to an increase in the drivers of mass migration, to an unprecedented level (The New York Times, 2018).

- Northwest African countries are facing rising sea levels, drought, and desertification. These conditions will add more migrants to the already large number of seasonal migrants and will put additional pressures on the country of origin, as well as on the countries of destination and the migrants' routes. The destabilizing climatic effects should be seen as a major concern. Climate and security experts often cite the effects of a severe drought in Syria that preceded the 2011 civil war. The security community also highlights the relationship between climate change and terrorism, for example, linking the deterioration of agricultural and pastoral livelihoods to the effectiveness of financial recruitment strategies by al-Qaeda (Podesta, 2019).

It becomes clear that climate change contributes to so-called slow events such as desertification, sea-level rise, ocean acidification, air pollution, shifts in rain patterns, and biodiversity loss. This deterioration will exacerbate many humanitarian crises and may lead to greater mobility of people (UNFCCC, 2021).

International institutions, development agencies, and international law must do more to examine the challenges of climate change. To date, there is no multilateral strategy or legal framework to deal with climate change as a driver of migration. Climate change will be an important driving factor in human migration patterns.

Sustainable development goals and migration, asylum and climate change:

While there are no legally binding international regimes that protect climate migrants, there are voluntary charters that can be used to support them. Notably, 193 countries have adopted the 2030 Sustainable Development Goals (SDGs), which address both migration and climate change.

Many of the 169 targets set by the Sustainable Development Goals are broad targets that can be used to protect climate migrants. The goal No. 13 of the sustainable development goals on climate action sets many targets that can address the climate crisis, including:

1.13: Enhancing resilience to climate-related hazards and natural disasters in all countries.
2.13: Integrate climate change measures into national policies, strategies, and planning.
3.13: Improving education, awareness, human and institutional capacities for climate change mitigation, adaptation, mitigation, and early warning.

Although the SDGs do not explicitly link climate change and migration, target 7.10 of the SDGs, as explained earlier, calls on signatories to "facilitate orderly, safe and responsible migration of people, through the implementation of well-planned and managed policies."

To achieve these ends, large-scale multilateral development assistance will be required. Developed countries and international organizations must take a strategic approach to focus development aid and direct more resources to achieve these goals and targets, and to reach climate-resilient societies that keep people in their societies.

A variety of medium-term investments (5 to 10 years) can create greater resilience to the effects of climate change. For example, climate change that lead to migration in northwest Africa can be addressed (in part) by supporting irrigation infrastructure, providing food supplies, strengthening regional water cooperation, and supporting livelihood security (Werz et all. 2012).

The legal status of climate change migrants and refugees:

With the gradual deteriorating weather patterns, and extreme weather events, the movement of people increases. People who choose to move due to climatic changes will do so with little legal protection. The current system of international law is ill-equipped to protect climate migrants, as there are no binding legal agreements to support climate migrants.

Although the climate migrants fleeing from impossible-to-livable conditions being like refugees, the legal protection granted to refugees does not extend to them. In the aftermath of World War II, the United Nations established a system to protect civilians who were forced to leave their countries of origin due to political violence. Today, there are approximately 20.4 million refugees who are officially placed under the protection of the United Nations High Commissioner for Refugees (UNHCR), however, there is an additional group of about 21.5 million people who have fled their homes as a result of the sudden weather each year and do not receive the same protection (UNHCR, 2018).

UNHCR so far refuses to grant these people a refugee status; instead, it classifies them as "environmental migrants". This is due to their lack of resources to meet their needs. But with no organized effort to supervise these desperate migrants they go where they can, not necessarily where they should or want to be. As their numbers become increasingly larger, it will become difficult for the international community to ignore this challenge. As climate changes become more severe and more frequent, displacements will increase and include more people, which may force the international community, either to redefine “refugees” to include climate migrants, or create a new legal category and accompanying institutional framework to protect climate migrants.

The following are some of the main aspects and features that define human mobility (migration/asylum) in the context of climate change and environmental degradation and that shape their identity and legal status:

- **Climate migration is mostly internal:** When migration is internal, the people who move are under the responsibility of their countries; they do not cross borders and do not seek protection from a second country or at the international level.

- **Migration is not necessarily forced:** especially for the very slow climate changes in which migration is still a matter of choice, so countries need to think first about migration management and agreements rather than refugee protection.

- **Isolating environmental/climatic causes from human, political, social, economic, or conflict factors is difficult, or sometimes impossible**, and may lead to lengthy and unrealistic legal proceedings.

- **Establishing an "environmental or climate refugee" status may have opposite effects to what is needed as a solution:** it can lead to the exclusion of groups of people in need of protection, particularly the poorest migrants who move due to climate change and a combination of other factors, due to Their inability to prove a link to climate and environmental factors.

- **Opening the 1951 Refugee Convention could weaken refugee status**: it will be a tragic situation, given the state of our world, where so many people need protection due to persistent persecution and conflict.

- **Creating a new agreement may be a lengthy political process and may undesired from all countries:** yes, there are many responses already highlighted in the 2011 International Dialogue on Migration and the Global Compact for Safe, Orderly, and Regular Migration, and the Nansen Initiative, which was launched to look into the protection gaps for people displaced across borders by disasters. These consultations concluded with a document that proposes a "toolkit" for immigration policies rather than recommending the creation of a new status for these persons.

- **Discussions of climate migration should not lose focus on preventive measures:** the main objective is to invest in climate and environmental solutions for our planet so that people do not have to leave their homes in a forced manner in the future.

- **Encouraging the full use of all laws and tools that already exist:** whether they are binding or non-binding in humanitarian, human rights, or refugee laws and instruments relating to internal displacement, disaster management, legal migration, and others.

- **Human rights-based approaches are the key to addressing climate migration:** Every country should seek to protect its citizens who move due to environmental or climate causes by applying human rights-based approaches.

- **Regular migration pathways can provide adequate protection for climate migrants and facilitate migration strategies in response to environmental factors:** There are many migration management solutions available to respond to the challenges posed by climate change, environmental degradation, and disasters, and can provide a situation for people who move in this context, such as humanitarian visas, temporary protection, leave to remain, and the regional and bilateral free movement agreements (UN, 2019).

Recommendations and suggested solutions:

During the past decade, political awareness of issues and challenges related to environmental and climate migration increased. As a result, many countries have signed landmark agreements, such as the Paris Agreement on Climate Change, the Sendai Framework for Disaster Risk Reduction, and the Global Compact for Migration. These international agreements chart a clear path for governments to move forward in addressing climate and migration.

Global Compact for Migration (Roadmap for Governments): The Global Compact for Migration includes many references to environmental migration, including an entire section on measures to address environmental and climate challenges, representing an overarching view of how countries should deal with the impacts of climate change, disasters and environmental degradation on international migration. When it comes to addressing environmental migration, the primary concern for states should be to "minimize the harmful factors that compel people to leave their country of

origin, particularly natural disasters and the adverse effects of climate change and environmental degradation". In other words, the main priority is to find solutions that allow people to stay in their homes and give them the means to adapt to changing environmental conditions. This approach aims to avoid desperate migration situations and the tragedies associated with them.

But in case of severe climate change, the priority is to "enhance, provide and resiliency for regular migration pathways," allowing people to leave safely and through organized channels.

However, one last preventive measure that countries can use is to carry out orderly population transfers (displacement), which means organizing the relocation of entire villages and communities away from the areas under the effects of climate change. (UN News, 2019).

Addressing the challenges of environmental migration, in the way that benefits countries and societies, including migrants and refugees, are a complex process involving many different actors.

Solutions to this process can range from changing immigration practices, such as visa regulations, to putting in place human rights-based protections. There is no single solution to the challenge of environmental migration, but there are many solutions that address different aspects of this complex equation. Nothing meaningful can be achieved without the active and robust participation of civil society actors, who often know what is best for them.

References:

- Asharq Al-Awsat Newspaper, (2019). "Climate changes have contributed to conflicts and revolutions." Issue 14667, 1/24/2019. The link: Climate change contributed to conflicts and revolutions | Middle East (aawsat.com), (In Arabic).
- Dina, L. (2019). "Migration and the climate crisis: the UN's search for solutions". UN News, 31/7/2019. Online link: Migration and the climate crisis: the UN's search for solutions | | UN News
- John, P. (2019), "The climate crisis, migration, and refugees". Brookings 25/7/2019. Online link: The climate crisis, migration, and refugees (brookings.edu)
- Kumari, R. et al. (2018). "Groundswell: Preparing for Internal Climate Migration". The World Bank. https://openknowledge.worldbank.org/handle/10986/29461.
- Law Library of Congress, (2015). "New Zealand: Climate Change Refugee Case Overview". July 29, 2015. https://www.loc.gov/law/help/climate-change-refugee/new-zealand.php
- McDonnell, Tim. "The Refugees the World Barely Pays Attention To." June 20, 2018. https://www.npr.org/sections/goatsandsoda/2018/06/20/621782275/the-refugees-that-the-world-barely-pays-attention-to.
- Nunn, P.D., Kohler, A. & Kumar, R.((2017). "Identifying and Assessing Evidence for Recent Shoreline Change Attributable To Uncommonly Rapid Sea-Level Rise in Pohnpei, Federated State of Micronesia, Northwest Pacific Ocean." Journal of Coast Conservation (2017) 21: 719. https://doi.org/10.1007/s11852-017-0531-7
- Prakash, A. (2018). "Boiling Point". Finance and Development, September 2018, Vol. 55. No. 3. International Monetary Fund. https://www.imf.org/external/pubs/ft/fandd/2018/09/southeast-asia-climate-change-and-greenhouse-gas-emissions-prakash.htm
- Roy, E. A. and Sean, G. (2019). "One day we'll Disappear: Tuvalu's Sinking Islands" The Guardian. May 16, 2019. https://www.theguardian.com/global-

development/2019/may/16/one-day-disappear-tuvalu-sinking-islands-rising-seas-climate-change

- Somini, S. and Popovich, N. (2018). "Global Warming in South Asia: 800 Million at Risk." The New York Times. June 28, 2018. Online link: https://www.nytimes.com/interactive/2018/06/28/climate/india-pakistan-warming-hotspots.html
- Traore M. (2019). "Climate Change and Migration in Vulnerable Countries", United Nations (UN), Sustainable Development Goals, 3/9/2019. Online link: Climate Change and Migration in Vulnerable Countries – United Nations Sustainable Development
- United Nations (UN), (2019). "Let's Talk About Climate Migrants, Not Climate Refugees – United Nations Sustainable Development". 6/6/2019. Online link: Let's Talk About Climate Migrants, Not Climate Refugees – United Nations Sustainable Development
- United Nations Framework Convention on Climate Change (UNFCCC), (2014). "Climate Change Danger to South Asia's Economy.". August 19, 2014. Online link: Climate Change Danger to South Asia's Economy | UNFCCC
- United Nations Framework Convention on Climate Change (UNFCCC), (2021). "Slow Onset Events". Online link: Slow onset events | UNFCCC
- United Nations High Commissioner for Refugees (UNHCR), (2018). "Global Trends: Forced Displacement in 2018." June 20, 2019 UNHCR. Online link: https://www.unhcr.org/en-us/statistics/unhcrstats/5d08d7ee7/unhcr-global-trends-2018.html
- United Nations High Commissioner for Refugees (UNHCR), (2019), "Factsheet: Cyclone Idai, 15 August 2019". May 2019. Online link: https://reliefweb.int/report/mozambique/unhcr-mozambique-factsheet-cyclone-idai-15-august-2019

- United Nations News (2019), "Climate Crisis and Migration", 2/8/2019. The link: The climate crisis and migration. The United Nations search for solutions to the issue of the time | United Nations News (un.org). (In Arabic)
- Werz, M. and Laura, C. (2012). “Climate Change, Migration, and Conflict in Northwest Africa.” Center for American Progress. April 2012. Pg 3.
- World Bank, (2019). “The World Bank in Pacific Islands.”. April 8, 2019. Online link: https://www.worldbank.org/en/country/pacificislands/overview

Chapter 7

Foundations of Policies and Programs Dealing with Climate Change

The report of Sir Nicholas Stern, former economist at the World Bank, "A review of the economics of climate change" published on October 30, 2006, expects that climate changes will affect various aspects of the economic and social life of people in different parts of the world, and the impact increases as the severity of climate changes increases, especially temperatures rose. The report predicts an increase in the global temperature by about 5 °C during the current century due to the increase in the stock of greenhouse gases.

The report presented two main policy areas to confront the climate change challenge:

The first field: policies to mitigate climate change:

It includes a set of policies aimed at reducing emissions, stabilizing at a certain level of concentration of greenhouse gases, carbon pricing policies, policies to encourage technical innovation, and policies to encourage the transition to a new economic environment.

Studies on the emissions and evolution of greenhouse gas from its main sources until 2050 have yielded the following results and predictions:

- Energy production activities are the most responsible for emissions (24% of total global emissions), resulting from burning fossil fuels to mainly produce electricity. It is the fastest growing source of emissions. Emissions increased during the period

from 1990 to 2002 at an annual growth rate of 2.2%, and emissions from this activity are expected to increase by about four times of their current level until 2050.

- Emissions resulting from land use represents the second source of emissions (18% of the total global emissions), mainly from activity of deforestation. This is not due to the burning of forest wood and its use as fuel (although the emissions from forest fires are included in the proportion of emissions), but the reason for this is the ability of trees to retain a high percentage of carbon dioxide, which is released in the case of cutting trees. It is expected that carbon emissions from deforestation will drop sharply until 2050, due to the supposed stop of deforestation, especially after cutting 85% of forest cover.

- Agricultural, Industrial, and transportation activities are equal in their proportion of emissions (14% of total global emissions). It is expected that the carbon emissions resulting from the agricultural activity will double until the year 2050. It is also expected that no significant increase in the emissions resulting from the industrial activity will occur until the year 2050, while the emissions resulting from the transport activity will more than double until the year 2050

- Human activities contribute about (8% of the total global emissions), which are the emissions resulting from heating and cooking operations. Emissions from these activities are expected to increase by two-thirds through 2050.

- It is noticeable that energy activity is the most influential activity in the future. This explains the focus of the new European policy to reduce greenhouse gas emissions on energy uses by introducing the use of alternative non-carbon sources of renewable energy.

The accumulation of greenhouse gas emissions has led to its concentration in the shape of carbon dioxide equivalent to 430ppm (part per Million), which is a very high concentration. It actually led to a rise in temperature of about 1 °C (according to the estimates of the Kyoto Agreement). This concentration was around 280ppm in 1850. If there is no intervention to reduce emissions rates, the concentration of greenhouse gases will reach 550ppm by 2035, and it may even exceed that.

It is of great importance to determine the relative importance of the sources of emissions and their expected development, so that policies to mitigate and control the problem can be conceived, as well as assessing the impact of these policies in the future. (World Resource Institute, 2005).

The foundations of climate change mitigation policies:

Three foundations for mitigating climate change policies were formulated: carbon pricing, technical modernization, and lifting of barriers or restrictions that prevent change. In light of these three foundations, four packages of policies were also developed, namely:

- Reducing the demand for goods and services whose production requires the release of intense emissions of greenhouse gases.

- More depend in energy sources with low emissions.

- Saving money, i.e. further reducing of production costs.

- Reducing the emissions resulting from non-energy-generating activities, such as avoiding deforestation activities, and moving towards low-emission technologies for transportation, heating and production.

Carbon Pricing Policies: Carbon pricing means calculating the social value of carbon. In general, the higher the level of concentration of emissions in the atmosphere, the greater the damage caused by them and thus the higher the carbon price. Carbon pricing is usually in the form of taxes or surcharges levied on products and final outputs with greater greenhouse gas emissions.

Technological innovation policies: Technological innovation policies are expected to focus on energy generating activities, transportation activities, industrial activities, some agricultural operations, and human activities. Technological innovation efforts in the field of land use (deforestation activities) and controlling the emissions from waste may seem as few and limited due to their low contribution rates to global emissions (8%) and (3%), respectively. Although the deforestation activities is reduces over time due to Increasing awareness of its importance in protecting the environment, but we cannot ignore the importance of waste recycling, or the processes of disposing of it through closed systems. The real challenge for technological innovation policies may be transportation activities, especially the development of low- or zero-carbon fuels for cars, trains, planes and ships.

Carbon pricing policies will be useful in stimulating technology innovation policies, as long as the marginal return from technological innovation processes to reduce carbon is greater than the marginal cost of damage, expressed in the social cost of carbon (carbon pricing basis).

Policies of eliminating restrictions and barriers to change:

Just as climate change transforms the natural environment into new and unknown phases, the economic and technological measures required to mitigate the phenomenon, or limit its repercussions, will move people to a new, unfamiliar economic environment. Accordingly, it is necessary to accept and adopt such economic and technological changes in the global economy. In view of this group of policies, the following sub-policies emerge:

- **Regulatory policies and administrative standards:** Such policies to regulate economic actions and reactions are necessary for improving the state of markets and increasing the effectiveness and efficiency of economic instruments. These policies regulate transitional phases, help set investment controls, and standards for technological modernization, reduce uncertainty for investors and consumers, and help set standards for low-carbon goods. The priority activities are in reducing greenhouse gas emissions, helping to overcome various difficulties in making decisions, stimulating competitiveness and technological modernization.

- **Information policies:** the first aspect of information policies is raising awareness of all the features of the problem and its repercussions, and making this information available to all people. The second aspect is providing markets with all information about low-carbon goods, and the processes of competition in the production of these goods and services. Such information is suggested to include on the labels of the goods, with the development of quality indicators that include the carbon level of emissions resulting from the production of the good or the development of the service. Information policies can contribute to reducing modernization costs or moving to low-carbon production by providing producers with all necessary information and preventing monopoly on knowledge as much as possible.

- **Financing policies to mitigate the problem:** It is intended to provide financial support for long-term technological innovation projects that aim to reduce emissions, such as new energy projects, and finance initiatives that create new areas of work, and new areas of technological innovation.

Distributing the burdens of confronting the phenomenon of climate change among all countries of the world will be a fair act. While the developed industrial countries are responsible for the accumulation of emissions in the past, the developing countries are responsible now and in the future.

World Energy Organization estimates that developing countries are responsible for three-quarters of emissions during the period 2004-2030, and this is justified by the fact that China is currently responsible for about one-third of global emissions. The United Nations Climate Committee has put forward the same idea since 1993. The view was that the responsibility of developing countries starts from that time. The main argument for this is that developing countries have ambitious plans for growth in the field of industrial production and expansion of infrastructure, which will increase emissions rates. Especially since these countries do not have the technological base capable of developing technologies that use less energy or emit low emissions, as the developed countries have reached today. Hence, the responsibility and role of the developed industrial countries in providing the developing countries with clean technologies with low emissions, to collectively reduce heat emissions on the planet.

The second field: Policies of Adaptation to Climate Changes:

The Intergovernmental Working Group on Climate Change defines adaptation policy as “any process of adjustment in nature or the human system, in response to real,

projected changes to the climate or its effects, in order to reduce damages or explore opportunities for potential benefits."

The ability of societies to adapt to current and future climate changes depends on the level of wealth in society, education, the strength of institutions, and the ability of access to modern technologies. We should not place high hopes on the process of adapting to climate changes, as there are natural constraints that prevent this. For Example, the rise in sea levels in coastal areas results in the displacement of millions of people who will lose their original homeland and the situation of island states where an entire homeland becomes an uninhabited area. Adaptation policies will not work if rising temperatures affect biodiversity by threatening the survival or elimination of thousands of species. It is also not easy to calculate the costs of adaptation accurately due to uncertainties, rapid technological development expectations, and the difficulty of calculating future costs and benefits.

The adaptation process can be managed through two levels:

- **Capacity building:** It includes providing information, institutional structures, human capacities, and setting standards measure to the expected risks, and the ability to develop appropriate solutions to confront them. As well as the capabilities of research institutions to prepare studies and suggest the best methods of work to confront climate changes and their effects.

- **Directing adaptation processes:** represented in the institutional capacity to plan work programs and manage adaptation processes, and the ability to deal well with the proposed technical solutions.

The costs of climate change adaptation policies:

The costs of adaptation in the OECD countries are estimated at 5 - 150 billion dollars annually, or at a rate of 0.5% - 5.0% of the GDP (Ian Burton, 2006). On the other hand, adaptation policy proposals for developing countries are not specific, too general, and it is difficult to estimate their total cost for three reasons:

- **The first reason:** is the impact of expected climate change in developing countries is wider than that of developed countries which usually occupy high latitudes. Developing countries will suffer from the same risks that will occur in developed countries (storms, floods, sea-level rise, heat waves) but at much greater rates when the temperature rises between 2-3^{O}C, in addition to the lack of freshwater resources, and the deterioration of agricultural production, and a wider spread of bacterial diseases. Therefore, the risk area is wider and more diverse.

- **The second reason:** represents in the institutional weakness, severe lack of information, and low scientific forecasting capabilities. So there is no good basis for determining the extent of the damage and the best way to counteract it.

- **The third reason:** is related to development problems in developing countries, as these countries see that, adaptation policies are not very different from development policies, especially since many have linked adaptation and development policies.

Accordingly, the combination of adaptation policies and mitigation policies for climate change is more likely and appropriate.

References:

- Burton, I. et al. (2006). "Adaptation to Climate Change: International Policy Options". Advancing the International Effort against Climate Change, November 2006. Online link: https://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.578.7463&rep=rep1&type=pdf
- Clarkson, R. & Deyes, K. (2002): "Estimating the Social Cost of Carbon Emissions". Government Economic Service, Working Paper 140, January, 2002. UK.
- Elaine, K. (2019). "The challenging politics of climate change". Brookings, Report. Monday, September 23, 2019. Online link: The challenging politics of climate change (brookings.edu)
- Intergovernmental Panel on Climate Change (IPCC). (2007). "Climate change 2007. Impacts, adaptation and vulnerability". Geneva, (Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change).
- Lumi, M. (2020). The politics of confronting climate change in the Gulf States in the midst of a global pandemic. The Arab Gulf States Institute in Washington. 9/25/2020. Link: AGSIW | Policies to confront climate change in the Gulf countries in the midst of a global pandemic . (In Arabic).
- Montagni, J. (2019). Climate Change, Conflict and Resilience: A Policy Dialogue. Al-Insani Magazine, Regional Center for Information, International Committee of the Red Cross, Cairo. 13/8/2019. The Link: Climate Change, Conflict and Resilience... A Policy Dialogue - Al-Insani Magazine | The Humanitarian Magazine (icrc.org). (In Arabic).
- Noman, M. (2007). "The Economics of Climate Change: Implications and Policies". Development Experts Meeting Series B, Arab Planning Institute, Kuwait. Issue 24, 2007. (In Arabic).

- Pearce, D. (2003). “The Social Cost of Carbon and Its Policy Implications. For: Environmental Policy Seminar”. *Oxford Review of Economic Policy*, Volume 19, Issue 3, September 2003, Pages 362–384. Online link: https://doi.org/10.1093/oxrep/19.3.362
- The Washington Post (2019) “How we can combat climate change”. January 2, 2019. Online link: Climate change: 11 policy ideas to protect the planet in 2019 - The Washington Post
- The Working Group on Climate Change and Development, (2005). “Africa Up in Smoke?” The second report, New Economic Foundation, London, UK. June 2005. Up in Smoke layout (waccglobal.org)

About the author

Prof. Khaled El-Sayed Hassan is an international expert in the field of economic and statistical demography. He holds Ph. D. in Economics from Sadat Academy for Administrative Sciences (SAMS), Cairo, Egypt, and a Master of Philosophy in demography from the Demographic Center in Cairo (CDC), Egypt. Currently, he is the Vice-President of the Egyptian Association for Migration Studies and a consultant to many international and national organizations. Formerly, he served as a demographic advisor at the United Nations Development Program in Kuwait, a visiting professor of demography and economics at Cairo the Demographic Center, and a statistician consultant at the US Naval Medical Research Unit No. 3 (NAMRU3), Cairo, Egypt. He has many publications (books, scientific research papers, studies, and articles) in the fields of population and development, labor force and migration, climate change and environment, and hygiene and infection diseases, published by global publishing agencies, international scientific journals, organizations, and conferences.

Contact information:
Email: kehassan@gmail.com
Tel: (+2) 01225689100

Books by the author

- ***"AGE- STRUCTURE TRANSITION IN THE ARAB REGION "***. Published by LAP LAMBERT Academic Publishing GmbH & Co., Germany, (ISBN 978-3-659-90281-9), June, 2016. Online link: https://www.morebooks.de/store/gb/book/the-age%E2%80%90structural-transitions-in-the-arab-region/isbn/978-3-659-90281-9

- ***"STUDIES IN LABOR MIGRATION: MIDDLE EAST AND NORTH AFRICA*** ". Published by LAP LAMBERT Academic Publishing GmbH & Co., Germany, (ISBN 978-3-8465-4487-7), 2011. Online link: Studies in Labor Migration: Middle East and North Africa: Hassan, Khaled: 9783846544877: Amazon.com: Books

- ***"STRUCTURE AND DIMENSIONS OF THE EGYPTIAN LABOR FORCE***". Published by LAP LAMBERT Academic Publishing GmbH & Co., Germany, (ISBN 978-3-8465-2087-1), 2011. Online link: Structure and Dimensions of the Egyptian Labor Force: Hassan, Khaled: 9783846520871: Amazon.com: Books

- ***"CLIMATE CHANGE AND THE GLOBAL SUSTAINABLE DEVELOPMENT GOALS".*** Published by Jezert Al-Ward Publishing, Cairo, Egypt. (ISBN 978-977-834-447-4), June 2021. (In Arabic).

About the book:

The aim of the present book is to study the impact of climate change on achieving some of the global Sustainable Development Goals 2015-2030 (SDGs).

The first chapter of the book provides an explanation of the nature of climate change, its causes, and its significant manifestations observed in the past few decades, in Egypt, the African continent, developing countries, developed countries, and their future expectations. A review of the most significant socio-economic impacts of climate change on water, food production, land resources, infrastructure, and the environment will be presented. In addition, an explanation of the interrelation between SDGs and climate change, and how climate change hinders the achievement of these goals by the end of 2030 will be provided.

More specifically, the book provides a discussion of the impact of climate change on achieving the goals of eradicating hunger and extreme poverty, access to quality education, health and well-being, women's empowerment, and gender equality in the following four chapters.

In view of the growing impact of climate change on increasing the phenomenon of migration, asylum, and displacement worldwide in the next few decades, chapter six provides a detailed debate on the issue. While the final chapter presents a review of the most important foundations of building policies and programs aiming to mitigate and adapt to the impact of climate change.

Author

Prof. Khaled El-Sayed Hassan