



The Impact of Climate Change and Biodiversity Loss on Sustainable Food Security under Global Environmental Policies: -An Analytical Foresight Study for the Period 2010-2050-
أثير تغير المناخ و فقدان التنوع البيولوجي على الأمن الغذائي المستدام في ظل السياسات البيئية العالمية -دراسة تحليلية إستشرافية للفترة 2010-2050

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Abstract

This study aims to analyse the impact of climate change and biodiversity loss on sustainable food security, emphasizing the role of global environmental policies in addressing these challenges. It highlights issues such as rising temperatures, shifting precipitation patterns, and extreme weather events, as well as how biodiversity loss undermines agricultural productivity. The research underscores the importance of international agreements like the Paris Agreement and the Convention on Biological Diversity in promoting sustainable agriculture and protecting ecosystems. However, the success of these policies relies on national commitment and adequate funding for implementation.

Keywords

Sustainable Food Security;
Climate Change;
Biodiversity;
Global Environmental Policies

JEL Classification Codes : Q18 ; Q54 ; Q57 ; Q58

المصطلحات المفتاحية	المخلص
الأمن الغذائي المستدام؛ التغير المناخي؛ التنوع البيولوجي، السياسات البيئية العالمية	تهدف هذه الدراسة إلى تحليل أثر التغير المناخي وفقدان التنوع البيولوجي على الأمن الغذائي المستدام، مع التركيز على دور السياسات البيئية العالمية في التخفيف من هذه الآثار، تم استعراض التحديات التي تواجه النظم الغذائية العالمية بسبب التغيرات المناخية، مثل ارتفاع درجات الحرارة، التغير في أنماط هطول الأمطار، وزيادة تواتر الظواهر الجوية المتطرفة، كما تم تحليل تأثير فقدان التنوع البيولوجي على الإنتاج الزراعي، حيث يؤدي انقراض الأنواع وتدهور النظم البيئية إلى تقليل قدرة الطبيعة على دعم الزراعة، أظهرت الدراسة أن السياسات البيئية العالمية، مثل اتفاقية باريس للمناخ واتفاقية التنوع البيولوجي، تلعب دوراً محورياً في تعزيز الأمن الغذائي من خلال دعم الزراعة المستدامة وحماية الموارد الطبيعية ومع ذلك، فإن فعالية هذه السياسات تعتمد على مدى التزام الدول بتنفيذها وتوفير التمويل اللازم.

تصنيف JEL : Q58 ؛ Q57 ؛ Q54 ؛ Q18

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I.INTRODUCTION:

Climate change and biodiversity loss are major challenges to sustainable food security in the twenty-first century, and with increasing environmental and economic pressures, global food systems are becoming more vulnerable to climate variability and loss of natural resources. According to UN reports, more than 800 million people suffer from chronic hunger, and this crisis is expected to be exacerbated by climate change and biodiversity loss.

Climate change directly affects agricultural production through changing weather patterns, rising temperatures, and increasing frequency of extreme weather events such as droughts and floods. These changes lead to reduced crop productivity, threatening the availability of food and making it more difficult to access, especially in poor and developing areas. In addition, biodiversity loss reduces the ability of ecosystems to provide essential services that support agriculture, such as natural pollination and improved soil quality.

Against these challenges, global environmental policies play a pivotal role in mitigating the negative impacts of climate change and biodiversity loss on food security. These policies include international agreements such as the Paris Climate Agreement and the Convention on Biological Diversity, which aim to reduce greenhouse gas emissions and protect natural habitats. However, the effectiveness of these policies depends on the extent to which States commit to their implementation and provide the necessary funding to achieve their objectives.

From the above, the main problem of our research is as follows: **How does climate change and biodiversity loss affect sustainable food security, and what is the role of global environmental policies in mitigating these impacts?**

This problem branches into the following sub-questions:

Sub-questions

1. How did the concept of sustainable food security evolve and what are its dimensions?
2. What are the effects of climate change on agricultural production and livestock?
3. How does biodiversity loss affect global food systems?
1. What are effective global environmental policies to address climate change and biodiversity loss in order to ensure sustainable food security?

Importance of the study:

This study is of great importance in light of the increasing global challenges facing food security, especially with the worsening effects of climate change and biodiversity loss. The importance of the study lies in the following points:

1. Understand the key challenges facing global food systems, such as climate change and biodiversity loss, and their impact on food security.
2. Promote global awareness of the importance of preserving biodiversity and confronting climate change to ensure food sustainability.
3. Assess the effectiveness of current global environmental policies, such as the Paris Climate Agreement and the Convention on Biological Diversity, in promoting sustainable food security.
4. Provide practical recommendations to policymakers and international institutions to improve environmental policies and enhance food security.
5. Support international efforts to achieve the Sustainable Development Goals, especially the second goal (zero hunger) and the thirteenth goal (climate action)

Study Methodology:

The study relies on the descriptive and analytical approach to understand and analyse the impacts of climate change and biodiversity loss on food security, assess the effectiveness of various global environmental policies in enhancing food security, and use statistical data and global indicators (such as food security indicators, greenhouse gas emissions, biodiversity loss rates) to analyse trends and relationships.

Study Tools:

The study relies mainly on secondary data, such as UN reports (FAO, IPCC) and international databases (World Bank, WHO), which provide reliable and accurate information on the impact of climate change and biodiversity loss on food security. In addition, international agreements such as the Paris Climate Agreement and the Convention on Biological Diversity are analysed, In addition to books, scientific articles, doctoral theses and master's theses on the subject.

II.THEORETICAL FRAMEWORK AND PREVIOUS STUDIES:**THEORETICAL FRAMEWORK:****1- The concept of sustainable food security:**

2-

Sustainable food security is a vital concept that is gaining increasing importance in light of global challenges such as climate change, population growth, and biodiversity loss.

A- Definition of sustainable food security:

Sustainable food security is an evolving concept that reflects the ability to continuously provide adequate and nutritious food to all individuals, while ensuring the sustainability of ecosystems and natural resources for future generations. This concept goes beyond simply providing food to also include preserving the environment, achieving social and economic justice, and ensuring that food systems are able to adapt to future challenges such as climate change and population growth (Fao,2024).

B- Evolution of the concept of sustainable food security:

The concept of food security has evolved significantly over the decades, shifting from a focus on food availability only to a more holistic concept that includes sustainability and social justice. This development reflects growing global challenges such as climate change, population growth, and biodiversity loss.

B-1- Phase 1 (1970-1990): Focus on Food Availability

At this stage, the concept of food security was mainly focused on the availability of food, i.e. ensuring that there were sufficient quantities of food to meet the needs of the population. The main issue was to increase agricultural production to cope with rapid population growth. One of the objectives of this phase is to increase agricultural production and ensure the availability of food at affordable prices. However, this phase faced challenges such as over-reliance on global markets and neglect of social and environmental aspects (Boubkir,2022, p:420).

B-2- Phase II (1996): Adding new dimensions

In 1996, the Food and Agriculture Organization (FAO) introduced a new definition of food security that includes four main dimensions: availability, access, use, and stability.

- **Availability:** Ensuring sufficient amounts of food.
- **Access:** The ability of individuals to obtain food through financial or social resources.
- **Utilization:** Use food healthily through proper nutrition and clean water.
- **Stability:** Ensuring the continued availability and access of food even under unusual circumstances.

One of the objectives of this phase is to improve access to food for poor groups and promote food stability in the face of crises. However, there were challenges such as insufficient focus on environmental sustainability and neglect of social justice issues (Fao,2022).

B-3 Phase III (post-2008): Introducing the concepts of sustainability and equity

After the 2008 global food crisis, new concepts such as sustainability and social justice were introduced into the definition of food security. The focus has become on ensuring that food systems

are able to meet the needs of the present without compromising the ability of future generations to meet their needs. From the dimensions added at this stage:

- **Sustainability:** Conserving natural resources such as soil and water.
- **Equity:** Equitable distribution of food and resources among all social groups.

One of the objectives of this phase is to promote sustainable agriculture and ensure equitable distribution of food. However, this phase has faced challenges such as climate change, biodiversity loss and increased demand for food due to population growth (Fao,2024).

B-4-Present Phase: Integration with the SDGs:

Within the framework of the Sustainable Development Goals (SDGs) launched by the United Nations in 2015, sustainable food security has become an integral part of the second goal 'Zero Hunger', one of the objectives of this phase is to achieve food security for all individuals, improve nutrition and promote sustainable agriculture. However, this phase faces challenges such as adapting to climate change and strengthening international cooperation to achieve global food security (Fao,2024).

2-Climate Change:

The United Nations Framework Convention on Climate Change of 1992, in its first article, second paragraph, defined the term climate change as: "means a change in climate attributable directly or indirectly to human activity, which leads to a change in the composition of the global atmosphere, which, in addition to the natural variability of the climate, is observed over similar periods of time" (Litim,2022).

Climate change refers to the imbalances in the usual climatic conditions that characterize each region on Earth, which is reflected in the lifestyles and economies of countries. This phenomenon stimulates national and international efforts to mitigate its negative impacts, which include rising temperatures, changes in rainfall patterns, and rising sea levels. Climate change is closely linked to global warming caused by greenhouse gas emissions from human activities such as industry and agriculture (IPCC,2022).

3-Biodiversity:

Biodiversity is a term that refers to the diversity of life on Earth, including the diversity of species, genes, and ecosystems. This diversity includes plants, animals, microorganisms, and the interactions between them and the physical environment. Biodiversity provides basic services such as food, clean water, and protection from natural disasters, and is the foundation of human culture and history (United Nation,2022).

4- Biodiversity Loss:

The most unique feature of Earth is the existence of life, and the most extraordinary aspect of life is its diversity. Approximately 9 million species of plants, animals, protists, and fungi inhabit the Earth, alongside 7 billion humans. Two decades ago, at the first Earth Summit, the majority of the world's nations declared that human activities were dismantling Earth's ecosystems, leading to the loss of genes, species, and biological traits at an alarming rate. This raised critical questions about how the loss of biodiversity would affect ecosystem functioning and their ability to provide the goods and services necessary for societal prosperity (**Cardinale et al, 2012**). Biodiversity loss is a decrease in the number of living organisms, ecosystems, or natural habitats. This loss is caused by human activities such as deforestation, poaching, pollution, and climate change. Biodiversity loss leads to ecosystem degradation and species extinction, negatively impacting food security and human health (**IPBES,2024**).

5-Global Environmental Policies:

Global environmental policies are a set of international rules and conventions aimed at addressing transboundary environmental issues, such as climate change and biodiversity loss. These policies include agreements such as the Paris Climate Agreement and the Kyoto Protocol, which derive their legislation from principles agreed at international environmental conferences such as the 1972 Stockholm Conference and the 1992 Rio Conference (**UNFCCC,2024**).

PREVIOUS STUDIES:

- A study entitled: "**Assessing the Impact of Climate Change on Wheat Productivity in Egypt**", Sara Mahmoud, Magister Thesis, Alexandria University, Egypt, 2018, the study focused on analysing the impact of rising temperatures and changing rainfall patterns on wheat productivity in Egypt, using mathematical models. The study found that rising temperatures and irregular rainfall reduce wheat productivity in Egypt, urging adaptive measures like efficient irrigation and heat-resistant crops to ensure food security.

- A study entitled: "**Climate Change: The Causes, the Future Repercussions and the Adaptation Mechanisms**", Nadia Litim, Journal of Law Studies, Faculty of Law of the University of Badji Mokhtar-Annaba, Algeria,2022, The study presents climate change as one of the most critical global issues threatening human life and fundamental rights such as health, a safe environment, food security, and safety. To address this crisis, the international community has taken significant measures, including reducing greenhouse gas emissions, enhancing adaptation to climate change, and supporting developing countries with eco-friendly technologies to build low-carbon green economies, aiming to achieve sustainable development and protect the planet's future.

A study entitled "**Impacts of the global food system on terrestrial biodiversity from land use and climate change**", Boakes, E.H., Dalin, C., Etard, A. et al, Nature Communications, 15, 5750, 2024, showed that the global food system causes changes in land use and greenhouse gas emissions, threatening biodiversity. The researchers found that methane emissions account for about 70% of the greenhouse gases that affect biodiversity, with regions such as Central and South America being

more affected by species scarcity. The study presented simple actions that governments and companies can apply to improve decision-making and promote environmental sustainability, such as improving the efficiency of agricultural production and reducing food waste.

-A study entitled: ' **Biodiversity loss and its impact on humanity**', Cardinale, B., Duffy, J., Gonzalez, A. et al., Nature 486, 59–67 (2012). The study aimed to explore how the loss of biodiversity, driven by human activities, affected ecosystem functioning and their ability to provide the goods and services necessary for societal prosperity. In other words, it sought to understand the environmental and social consequences of declining biodiversity and how this impacted the stability of ecosystems and the services they provided to humanity.

II. METHOD AND PROCEDURES:

1- Impact of climate change on food security:

Climate change has an impact on the following points:

A- Global greenhouse gas emissions :(GHG (*) Emissions)

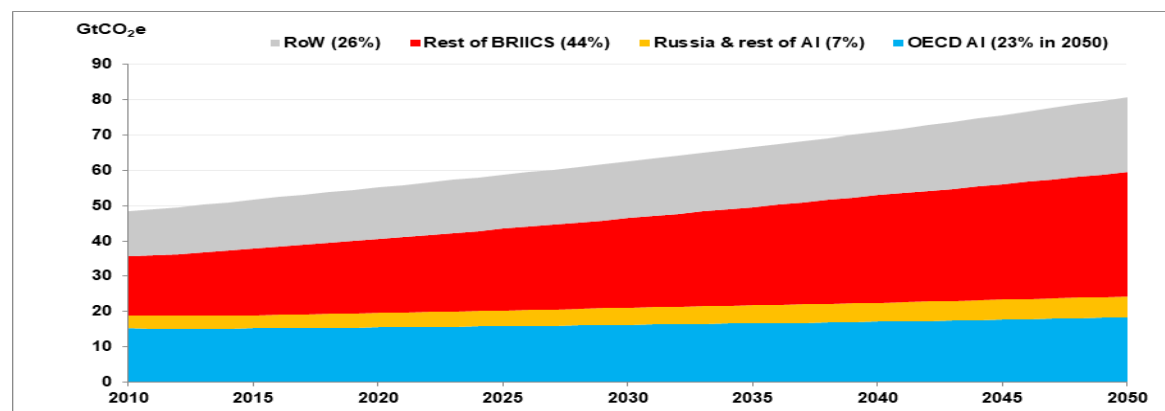
Historically, the major industrialized countries, namely the OECD countries, have been responsible for these emissions, but over time emerging economies have emerged that have contributed significantly to this as well, namely the BRICS countries in particular (**OCDE,2024**).

Many gases contribute to climate change, which is why the Kyoto Protocol** came to oblige the industrialized countries in particular to adhere to some of the goals set and the standards set.

Figure (01): Greenhouse gas emissions by region 2010-2050.

(*) (GHG: Green House Gas)

(**) Kyoto Protocol :(It is an international agreement linked to the United Nations Convention on Climate Change, adopted in Kyoto, Japan on 11/12/1997 and entered into force on 16/02/2005, its advantage is that it sets binding targets for 37 industrialized countries and the European Union to reduce greenhouse gas emissions.



Source: Prepared by the researcher based on: OCDE, data-explorer, 2024, <https://data-explorer.oecd.org>

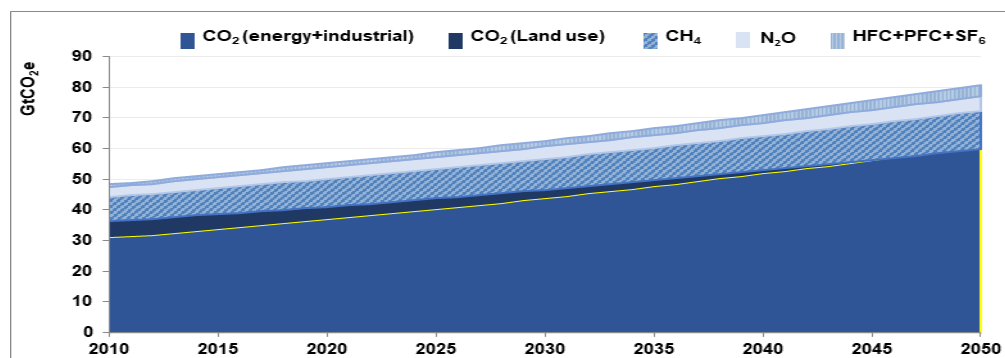
From the above figure, it is clear that greenhouse gas emissions will continue to increase, as by 2050 the rate of increase will reach nearly 50%, consisting primarily of the expected growth in the proportion of carbon dioxide emissions resulting from energy uses by up to 70%, and this is due to the global increase in energy demand of up to 80%. Emissions from transport are also doubling due to the significant increase in demand for cars in developing countries, as well as due to the economic growth of some emerging economies.

CO₂ emissions from land use have reached 4 to 8 gigatons of CO₂ per year. All these emissions are due to deforestation in order to expand agricultural land in order to increase yields due to increasing population growth and changing diets, as well as increasing urbanization.

B-Concentration of greenhouse gases (GHG) in the atmosphere :

Without more serious policies, greenhouse gas concentrations in the atmosphere are expected to reach about 658 parts per million equivalent of carbon dioxide (CO₂) by 2050, well above the desired concentration of 450 parts per million to maintain a temperature of 2° C (2°C) (OCDE,2024).

Figure (02): Greenhouse gas emissions by gases 2010-2050



Source: Prepared by the researcher based on: OCDE, data-explorer, 2024, <https://data-explorer.oecd.org>

The figure above shows the evolution of major greenhouse gas emissions (e.g. carbon dioxide from energy and industry, methane, nitrous oxide, and fluorinated gases) from 2010 to 2050. There was a rise in emissions until 2020 due to economic growth, it will be followed by a gradual decline until 2050 as a result of climate policies such as switching to clean energy and improving efficiency. Carbon dioxide from energy and industry is the largest contributor, followed by methane and nitrous oxide emissions, while the contribution of fluorinated gases is small but their impact is strong.

According to the currently available data, the average global temperature is expected to exceed this goal by 2050, and will rise by 3° by the end of this century (twenty-first century), and this will lead to changing patterns of precipitation, melting ice, causing sea level rise, and rising extreme weather events to unprecedented levels.

C-Impacts of climate change on the ecosystem:

Global climate change has had noticeable effects over the past decades, and given the expected increase in temperature, the International Commission (IPCC) predicts that there will be more impacts from climate change in the future, the most important of which are the main ones: (IPCC,2007).

- **Effects on temperature and precipitation:** The global temperature rose from 0.7° °C to 0.8° °C on average, as much of the Arctic was exposed to temperature rise of more than 2 degrees Celsius. Under this scenario, the global concentration of greenhouse gases is expected to reach approximately 685 ppm of CO₂ equivalent by the middle of this century, reaching more than 1,000. ppm of CO₂ by 2100, as a result of all this average temperature is expected to rise to high rates.
- **Impacts on water:** Water availability increases in humid tropics and high latitudes, with decreasing drought and increasing drought in mid-latitudes and low-arid semi-arid latitudes. In Europe, the risk of internal flash floods is expected to increase; in Africa by 2020, between 75 and 250 million people are expected to be exposed to increased water stress; and in Asia, freshwater availability is expected to decrease in Central, South and East Asia by 2050.
- **Impacts on ecosystems:** More than 30% of species will be at risk of extinction, and about 40% of the ecosystem will be severely damaged. In Europe, there will be reduced snow cover and winter tourism; increased erosion from storms and sea level rise; and ice retreat in mountainous areas.

Greenhouse gas (GHG) emissions continue to increase, with carbon dioxide (CO₂) emissions reaching a high of 30.5 gigatons in 2010, and it is expected that greenhouse gas emissions will increase by another 50% by 2050, with a growth of 70% of carbon dioxide (CO₂) emissions from energy use, due to an increase in global energy demand by 80%. Transport emissions are also increasing due to increased demand for cars in developing countries.

The concentration of greenhouse gases in the atmosphere is expected to reach approximately 658 parts per million by 2050, well above the 450-ppm level required for a chance to stabilize the climate at 2°C.

- **Impact on food:** Cereal production trends tend to decline in lower latitudes, although the productivity of some cereals tends to increase in some medium and high regions. In Europe, there

will be a decline in productive yields in the south, and in Africa, rainfed yields will fall by up to 50% in some regions by 2020; in most Arab countries, especially Egypt, climate variation and maximum temperatures have negatively affected the productivity of cereals, especially wheat, where Egyptian wheat varieties showed a decline in productivity(**Mahmoud,2018**).

- **Impacts on coasts:** There will be an increase in damage from floods and storms, and global coastal wetlands will lose about 30% of their area. In Europe, more frequent coastal flooding is expected, and in Asia, coastal areas will also be at risk due to increased flooding.
- **Impacts on health:** There will be an increase in the effects of malnutrition, diarrhea, cardiovascular and respiratory diseases, and the number of deaths from high heat, drought and flooding. In Asia, the mortality rate from flood- and drought-related diseases is expected to rise in some regions.

Overall, all regions are expected to suffer significant damage from climate change, but developing countries are likely to be the most affected by already difficult climatic conditions, the sectoral composition of their economies and their limited adaptation capacities. The costs of damage are expected to be much higher in Africa and Southeast Asia than in the OECD or Eastern European countries.

2-Impact of biodiversity loss on global food systems:

Although there is no single comprehensive measure to assess the state of biodiversity, the participating countries of the Convention on Biological Diversity have agreed to use 17 key indicators to measure progress towards the set targets, the most important of which are: (**CBD,2015**)

1. Forest area and species.
2. The percentage of protected areas.
3. Change in the status of endangered species.
4. Areas under sustainable management.
5. Invasive alien species.
6. Marine recharge indicators.
7. Data of species abundance.
8. Endangered species.
9. Forest areas.
10. Marine fish stocks (one of the few indicators available globally).

A- Impact of biodiversity loss on species abundance:

Species abundance refers to the populations of species, and two indicators are used to assess species abundance: average species abundance* (MSA) and the living planet index(LPI¹ **)

* (MSA): Mean Species Abundance: Species diversity is measured relative to healthy ecosystems and is determined by

Both indicators point to a decline in global species abundance, more precisely by an 11% decline in the average species abundance over the four decades since 1970.

According to the Living Planet Index, the period 1970 to 2007 saw a 30% decline for most of the global abundance of vertebrate species, and under a status quo scenario, species would continue to decline over the next four decades at the same or greater pace (Alkemade et al,2009).

The table below represents the distribution of the average abundance of species over the biomes, which are: polar/tundra, grassland/steppe, bushland and savanna, boreal forests, temperate-forests, tropical-forests, hot-deserts.

Table (01): Average percentage of species abundance in each biome, 2010-2050

	2000	2010	2020	2030	2050
Polar/Tundra	92,22685	90,77979	88,99394	88,53858	86,04237
Grassland/Steppe	62,8551	59,98602	56,83571	56,0291	54,26191
Scrubland/Savanna	61,26919	58,77173	54,28461	51,26573	47,50042
Boreal forests	80,66147	77,97979	76,1887	75,01311	72,35877
Temperate forests	39,89295	37,30663	34,64934	32,7733	30,32638
Tropical forests	67,19333	65,07928	61,44104	59,03182	55,89643
Hot desert	88,81663	87,20344	85,29006	84,45666	82,7722
Total MSA	69,83354	67,5246	64,64573	63,0325	60,43846

Source: Based on OECD Environmental Outlook Baseline; output from data, 2023

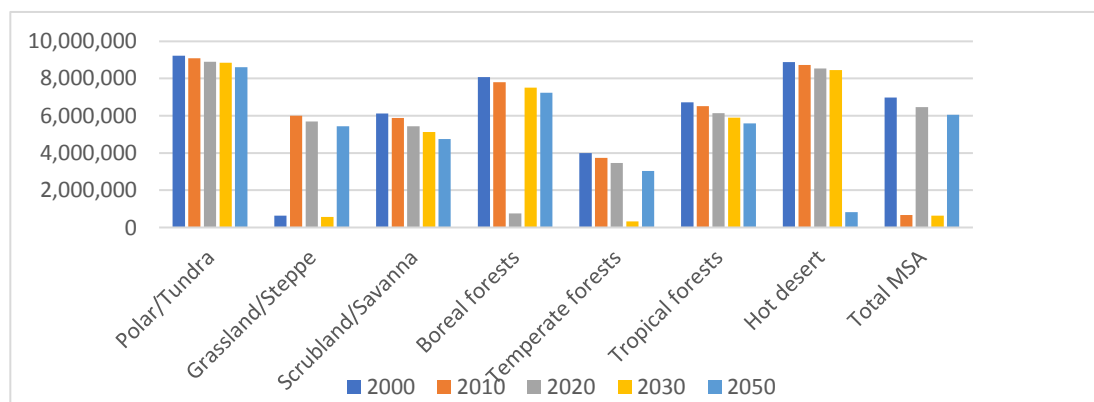
<http://dx.doi.org/10.1787/888932570905>

The table shows a continuous decline in average species abundance (MSA) across all bioregions, with abundance in temperate forests declining by -13% in 2000 to 2020, expected to reach -23% by 2050, and in jungle and savannah abundant decreased by -11% from 2000 to 2020, with a projected decline of -22% in 2050. The overall average species abundance declined by -7% from 2000 to 2020, and is expected to reach -13% in 2050. These trends show a clear decline in biodiversity so far, with this degradation expected to increase in the future if urgent action is not taken to address underlying causes such as climate change and habitat loss.

the intensity of human stress according to the relationship between the response between these pressures and the average abundance of species.

****(LPI):** Living Planet Index: It is based on indicators observed in about 8,000 populations in more than 2,500 vertebrate animal species (mammals, birds, reptiles, amphibians, fish), and is the overall result of changes in density size for each species.

Figure (03): Average species abundance per biome, 2010-2050.



Source: Prepared by the researcher based on: OECD Environmental Outlook Baseline; output from data,2023 (<http://dx.doi.org/10.1787/888932570905>)

The graph shows a gradual decline in average species abundance (MSA) over the years 2000 to 2050. It can be seen that the lines are tilted downwards, indicating a continued decline in species abundance across different biomes. The most affected areas, such as temperate forests, jungles, and savannahs, show a more pronounced decline compared to other regions such as the Arctic and the hot desert. This decline reflects the current and future environmental challenges facing biodiversity.

B- Impact of biodiversity loss on forest areas:

Forests that tend to be richer in biodiversity and provide many services to the ecosystem provide an ecosystem with an environment for animals, sequester carbon, regulate water and precipitation, etc. Therefore, it is an important indicator of global biodiversity (OCDE,2012).

However, forest areas are declining and species abundance is expected to decline dramatically to more than 40% between 2010 and 2050 if conditions remain the same. Overuse of natural or cultivated forests for timber production can harm biodiversity (Alkemade et al,2009).

Table (02): Percentage of forest area changes globally 2010-2050.

	Primary Forest OECD	Primary Forest BRIICS	Primary Forest RoW	Primary Forest World	Total Forest OECD	Total Forest BRIICS	Total Forest RoW	Total Forest World
2010	100	100	100	100	100	100	100	100
2020	95	97	91	96	98	99	92	97
2030	91	93	85	92	101	104	86	99
2040	88	91	82	89	103	107	88	102
2050	86	89	80	87	105	112	92	106

Source: Prepared by the researcher based on: OECD, OCDE Environmental Outlook to 2050, the consequences of inaction, 2012, <https://www.oecd.org>

- **RoW:** (Rest of the World)
(Includes all other countries not listed in the OECD or BRIICS).
- **Primary Forest:**(These are natural forests that are largely untouched by humans and retain their native ecological characteristics.)
- **Total Forest:**(Includes all types of forests, whether primary, planted or managed).
- **World:** (Represents the grand sum of all the regions mentioned).

By 2050, data indicate a decrease in primary forest area in all regions compared to 2010, reaching 86% in OECD, 89% in BRIICS, 80% in RoW, and 87% globally. In contrast, overall forests are experiencing a slight increase in the OECD and BRIICS regions, reaching 105% and 112%, respectively, while recovering in the RoW region to 92% after declining in previous years. Globally, total forests rise to 106%. These figures reflect the continued loss of primary forests important for biodiversity, while the increase in total forests indicates reforestation or expansion that may not fully compensate for the loss of primary forests.

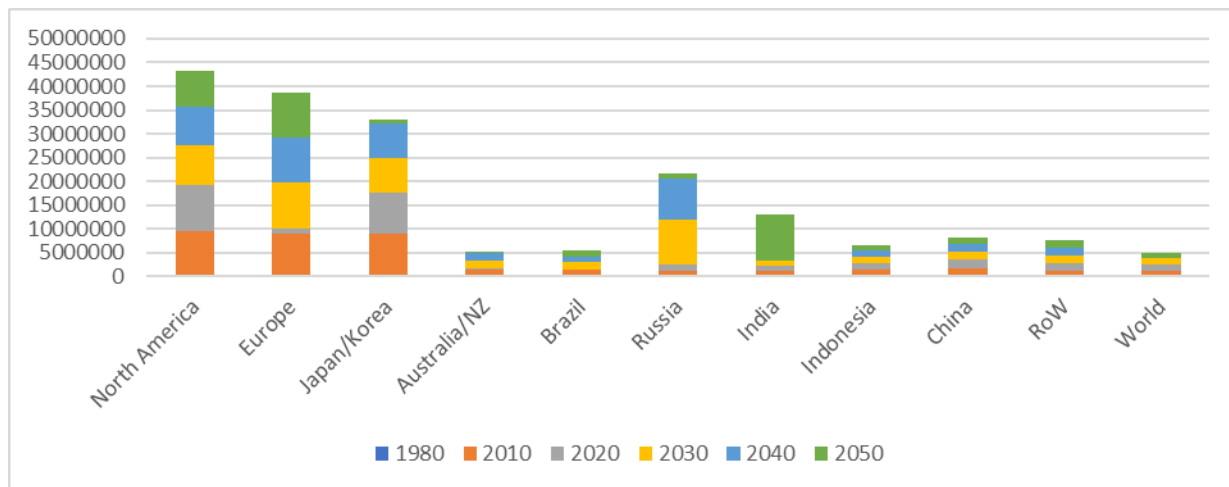
C-Impact of biodiversity loss on marine fish stocks:

The proportion of overexploited fish stocks has increased over the past decades, and today more than 30% of marine fish stocks are over-depleted, about 50% are fully exploited, and 20% have the potential to increase their fish wealth.

D-Impact of biodiversity loss on change in global food crop area:

This pressure of impacts on biodiversity formed by land overwork relates to agricultural production and the lack of slow recovery time, leading to biodiversity loss.

Figure (04): Percentage change in the area of global food crops 2010-2050.



Source: Prepared by the researcher based on: OECD, OCDE Environmental Outlook to 2050, the consequences of inaction, 2012, <https://www.oecd.org>

The area of land used to produce agricultural crops worldwide is expected to expand between 2010 and 2030 by about one million km², and most of this increase will be concentrated in the rest of the world, especially sub-Saharan Africa, and decrease in North America, South Asia and some BRICS countries. (Fao,2010)

E-Impact of biodiversity loss on change in global grazing area:

Changing consumption habits are clearly affecting the change in grazing areas across the world, and the following is an illustration of the trajectory of change over four decades. There will be an expansion in the areas designated for the production of grazing and fodder between 1980 and 2010, especially in the BRICS countries, by 2.5 million km², and this expansion will continue until 2030 by 1 million km², after which it is expected that the total area of the world for grazing will decrease, while in Russia and China, the beginning of the decline will be from a year 2010.

3-The role of global environmental policies in confronting climate change and biodiversity loss with the aim of enhancing food security:

Global environmental policies play a pivotal role in addressing climate change and biodiversity loss by promoting sustainable agriculture, protecting biodiversity, and ensuring the stability of food production.

A- International Climate and Biodiversity Conventions:

In light of global environmental challenges, international agreements such as the Paris Climate Agreement and the Convention on Biological Diversity are key tools to address climate change and biodiversity loss. These agreements aim to promote global cooperation to achieve common goals, such as reducing temperature rise, protecting ecosystems, and supporting developing countries. In this context, we will review the main elements of these conventions, including their objectives and implementation mechanisms, and how they integrate to achieve sustainable development.

A-1-Paris Climate Agreement (2015):

The Paris Climate Agreement, which was adopted on December 12, 2015 during the 21st Conference of the Parties (COP21) in Paris, is considered one of the most important international agreements in the field of combating climate change, the agreement includes 196 member states, including major countries such as the United States, China and the European Union, the agreement aims to enhance the global response to the threat of climate change by reducing greenhouse gas emissions and supporting efforts to adapt to its effects, and this agreement aims to **(United Nation,2015):**

-Limiting global temperature rise: The agreement aims to keep global temperature rise "well below 2°C" above pre-industrial levels, while seeking to limit the increase to 1.5°C. This goal is crucial to reduce the risk of extreme climate change such as drought, floods and sea-level rise.

-Achieving net zero emissions: The Convention seeks to achieve a balance between greenhouse gas emissions and absorption processes by the second half of the twenty-first century.

At the Conference of the Parties (COP26) in Glasgow in 2021, some commitments were strengthened, including a pledge to reduce methane emissions by 30% by 2030, and at COP27 in Sharm El Sheikh in 2022, a special loss and damage fund was established to support developing

countries affected by climate change. In addition, FAO is integrating efforts to address climate change with the protection of biodiversity, as a global biodiversity framework was adopted at COP15. Montreal Biodiversity in 2022, which aims to protect 30% of land and oceans by 2030. Overall, despite the progress made, achieving the goals of the Paris Agreement requires a significant strengthening of global ambitions and actions (**United Nation,2023**).

A-2- Convention on Biological Diversity (CBD):

Adopted during the Earth Summit in Rio de Janeiro in 1992, and entered into force in December 1993, the Convention aims to promote the conservation of biological diversity, the sustainable use of its components, and the fair and equitable sharing of benefits arising from the utilization of genetic resources. The Convention is one of the most important international agreements in the field of environmental protection, as it addresses issues such as species loss, ecosystem degradation, and challenges associated with climate change, the agreement includes **196 countries**, including all UN member states except the United States, which have signed but not ratified the Convention. This makes the Convention one of the most comprehensive in terms of membership, reflecting the global consensus on the importance of biodiversity conservation. (**SCBD,2023**)

A-2-1- Aichi Biodiversity Targets (2011-2020):

After years of implementing the Convention on Biological Diversity, countries faced difficulties in measuring progress, clearly defining the required actions and effectively coordinating global efforts, so there was a need for a clear and specific action plan, so the Aichi Biodiversity Targets came to meet this need, which is a set of international targets that were adopted in 2010 during the tenth Conference of the Parties (COP 10). of the Convention on Biological Diversity (CBD) in Nagoya City, Aichi Prefecture, Japan. It is named after the region where the conference was held (Aichi). These goals are designed to be a global roadmap to protect biodiversity and promote the sustainable use of natural resources during the period from 2011 to 2020, during which 20 targets were adopted to stop biodiversity loss, these goals included protecting 17% of terrestrial areas and 10% of marine areas, as well as promoting the sustainable use of natural resources. (**SCBD,2024**)

A-2-2-Kunming-Montreal Global Biodiversity Framework (2022):

During COP15 in Montreal, Canada, a new Global Biodiversity Framework for Action 2022 to 2030 was adopted, which aims to protect 30% of land and oceans by 2030, in addition to promoting ecological restoration, reducing species extinction rates, and increasing funding for biodiversity. This framework is a major step towards strengthening efforts Universal nature conservation (**KMGB,2022**).

A-2-3- Nagoya Protocol (2010):

The Nagoya Protocol was adopted during COP10 and aims to ensure the fair and equitable sharing of benefits arising from the utilization of genetic resources. It has been ratified by more than 130 countries, promoting equity in the use of genetic resources, especially for developing countries with rich biological resources. (**CBD,2010**)

A-2-4-Supporting Developing Countries:

Funding mechanisms such as the Global Environment Facility (GEF) have been established to support biodiversity conservation projects in developing countries. These efforts help strengthen local capacities and provide resources to implement nature conservation projects. **(UNFCCC,2023)**

A-2-5- Integration with Climate Change:

Cooperation between the Convention on Biological Diversity and the United Nations Framework Convention on Climate Change (UNFCCC) has been strengthened to address interrelated issues such as deforestation and ecosystem degradation. This integration is essential to achieving the Sustainable Development Goals.

B-Mechanisms for implementing global environmental policies to address climate change and biodiversity loss:

B-1- Strengthening international cooperation:

International organizations, such as the World Bank and the United Nations Environment Programme (UNEP), are funding projects that promote food security through environmental conservation. For example, the World Bank supports projects in Niger aimed at improving land management and increasing irrigation efficiency, benefiting more than 500,000 farmers **(Word Bank,2023)**. to enhance cooperation between countries to exchange sustainable agricultural experiences and technologies, thus contributing to the achievement of sustainable development goals related to the eradication of hunger and environmental protection.

B-2- Local Capacity Building:

Environmental policies encourage building farmers' capacity through training programs on sustainable agricultural practices, 60% of farmers in developing countries still rely on unsustainable traditional practices, underscoring the importance of these programs **(Fao,2023)**, for example training programs have been implemented in Kenya to teach farmers organic farming techniques and soil management, which has led to a 30% increase in crop productivity in some areas **(UNEP,2023)**. Governments and NGOs are also working to provide technical and financial support to enable farmers to adopt more sustainable practices.

B-3-Development of environmentally friendly technologies:

Environmental policies support the development of new technologies, such as smart irrigation systems and soil moisture sensors, which contribute to improving the efficiency of water resource use and reducing emissions. For example, smart irrigation systems have been implemented in India, saving 20% of the water used in agriculture **(Word Bank, 2024)**, in addition to that the use of

renewable energy in agricultural operations, such as solar energy to power irrigation pumps, is encouraged, reducing dependence on fossil fuels and reducing carbon emissions **(UNEP,2023)**.

B-4- Promoting scientific research and innovation:

Scientific research plays a pivotal role in developing innovative solutions to environmental and agricultural challenges. International organizations and governments support research centers to develop climate-resilient crop varieties and advanced agricultural techniques. For example, drought-tolerant varieties of wheat and rice have been developed in the Philippines, helping to increase productivity by 15% in climate-change-affected areas. **(Fao,2024)**

B-5- Strengthening public-private partnerships:

International environmental policies encourage partnerships between governments and the private sector to finance and implement sustainable projects. For example, FAO, in collaboration with the United Nations Environment Programme (UNEP), launched a climate-smart agriculture project in several African countries, including Kenya, which improved water use efficiency by up to 30% and increased agricultural productivity by 20%. In the targeted areas **(Fao,2022)**, in addition to these efforts led to a 15% increase in food availability in local communities **(Fao,2022)**, these initiatives also helped reduce biodiversity loss by protecting native plant species. By replanting local plant species that were threatened with extinction, using agricultural practices that conserve soil and reduce land degradation, identifying areas to protect native plants and prevent the destruction of their natural habitats, training farmers on the importance of preserving biodiversity and how to use resources sustainably **(UNEP,2021)**.

III.STUDY RESULTS (ANALYSIS AND DISCUSSION):

This study concluded a set of results as follows:

-Climate change directly affects agricultural production by reducing crop productivity and making it more difficult to access water resources. According to the United Nations, more than 800 million people suffer from chronic hunger, and this crisis is expected to be exacerbated by climate change.

-Biodiversity loss reduces the ability of ecosystems to provide essential services such as natural pollination and soil quality improvement, negatively impacting food production.

-The study showed that global environmental policies, such as the Paris Climate Agreement and the Convention on Biological Diversity, play a pivotal role in enhancing food security by supporting sustainable agriculture and protecting natural resources. However, the effectiveness of these policies depends on the extent to which States commit to implementing them and providing the necessary funding.

-Despite the progress made, achieving the Paris Agreement targets to reduce emissions by 45% by 2030 and reach net zero by 2050 requires a significant enhancement in global ambitions and actions, especially in light of the challenges of underfunding to support developing countries and clean technology transfer, and the expectation of global warming of more than 1.5°C by 2050, which threatens to increase climate disasters and biodiversity loss.

-Despite the significant achievements of the Convention on Biological Diversity, significant challenges remain to be faced, biodiversity loss continues at high rates, with the degradation of ecosystems such as forests and oceans. In addition, there is a lack of funding to achieve the goals of the Global Biodiversity Framework, and the effective implementation of national commitments remains a major challenge for many States.

-Global environmental policies contribute to improving food security and protecting biodiversity by relying on mechanisms to enhance international cooperation such as World Bank projects in Niger, building local capacity such as training programs in Kenya that increased productivity by 30%, developing environmentally friendly technologies such as smart irrigation systems in India that saved 20% of water, and promoting scientific research such as developing Drought-resistant crop varieties in the Philippines that increased productivity by 15%, and public-private partnerships such as smart agriculture projects in Kenya increased productivity by 20% and food was available by 15%.

CONCLUSION:

Climate change and biodiversity loss threaten global food security by reducing crop productivity and degrading ecosystems. Global environmental policies, such as the Paris Agreement and the Convention on Biological Diversity, play a crucial role in promoting sustainable agriculture and protecting natural resources, but their success depends on the commitment of countries and the provision of adequate funding. Despite progress, significant challenges remain, including lack of funding, difficulty in transferring clean technology, and continued loss of biodiversity at high rates. Solutions are based on enhancing international cooperation, building local capacities, developing environmentally friendly technology, and promoting scientific research and public-private partnerships to achieve sustainability goals.

Recommendations :

1. Strengthen countries' commitment to implement the Paris Agreement and raise their national ambitions to reduce emissions by 45% by 2050, while providing the necessary financing to support developing countries in adapting to climate change, such as projects to improve land management and irrigation.
2. Increase funding for biodiversity targets to reach 30% protection of land and oceans by 2030, and restore degraded ecosystems.
3. Strengthen international cooperation and build local capacity through the expansion of inter-state projects, and the implementation of training programs for farmers on sustainable agricultural practices.

4. The development of environmentally friendly technologies by promoting the use of smart irrigation systems should be promoted, and the use of renewable energy in agriculture, such as solar energy to power irrigation pumps.
5. Promote scientific research and innovation by supporting research centers to develop climate-resilient crop varieties, and funding research to improve soil quality and water use efficiency.
6. Promote public-private partnerships by encouraging partnerships to finance sustainable projects, such as smart agriculture, and supporting biodiversity protection initiatives such as replanting threatened plant species.
7. Increase global awareness about the impact of climate change and biodiversity loss on food security, and encourage community participation in preserving the environment and adopting sustainable agricultural practices.

Prospects for future research:

1. Study the impact of climate change on agricultural crops
2. Analysis of the role of modern technology in sustainable agriculture
3. Assessing the effectiveness of current environmental policies
4. Study the impact of biodiversity loss on local food systems

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