

BIODIVERSITY MANAGEMENT: BETWEEN ECONOMIC DEVELOPMENT AND ECOSYSTEM CONSERVATION - THE CASE OF JIJEL PROVINCE

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Abstract. This study aims to highlight the importance of biodiversity management as a key element in achieving a balance between economic development and ecosystem conservation. The study focuses on the case of Jijel Province (Algeria), which is characterized by its unique biodiversity and strategic geographical location. Jijel serves as a rich model of biodiversity due to its varied geography, encompassing coastal, forested, and agricultural areas. However, the province faces growing challenges resulting from rapid economic activities such as urban expansion, natural resource exploitation, and intensified agriculture, making it an ideal example for studying the interrelationship between economic activities and natural resource conservation.

The study examines the impact of major economic activities in the province, such as intensive agriculture, tourism, and marine fishing, on the environment and biodiversity. It also explores the environmental challenges facing the region, including habitat loss, pollution, and overexploitation of resources, which threaten the sustainability of ecosystems. Moreover, the study highlights the importance of environmental governance and effective policies in managing natural resources by adopting sustainable strategies such as ecotourism and clean agriculture. It also discusses the role of community awareness and collaboration among various stakeholders in achieving sustainable development goals and protecting biodiversity.

The study concludes with a set of recommendations, most notably strengthening local environmental policies by expanding protected areas, supporting sustainable agriculture, and promoting ecotourism as an environmentally friendly economic alternative. It also emphasizes the importance of involving local communities in biodiversity conservation efforts and developing awareness programs to enhance understanding of the value of environmental resources. This study underscores the significance of biodiversity management in achieving sustainable development and presents a practical model that can be applied to other regions facing similar challenges.

Keywords: Biodiversity management, economic development, ecosystems, environmental sustainability, ecological balance.

JEL Classification: Q56, Q57, Q01

1. INTRODUCTION

Biodiversity is one of the fundamental pillars of ecosystem sustainability, supporting life on Earth by providing food, water, and raw materials. Additionally, it plays a crucial role in regulating climate and the carbon cycle. However, biodiversity faces increasing threats due to human activities aimed at achieving rapid economic development. Activities such as intensive agriculture, industrial expansion,

and urban sprawl often lead to habitat degradation and biodiversity loss. This highlights the importance of research on how to strike a balance between economic growth and the preservation of this vital resource.

The significance of this study lies in the urgent need to find sustainable solutions that ensure the conservation of ecosystems while continuing to achieve the necessary economic development for social growth and improving living standards. Biodiversity is not merely an environmental asset; it is an integral part of the global economy, both directly and indirectly. The disruption of this system negatively impacts local communities and national economies, making the management of this natural resource a strategic necessity.

The study aims to assess the direct and indirect impacts of economic activities on biodiversity, including habitat loss, soil and water degradation, and climate changes resulting from excessive resource exploitation. Through this assessment, the study seeks to provide a deeper understanding of the interrelationship between economic development and biodiversity, guiding environmental and economic policies toward more sustainable paths. Additionally, the study aims to identify the optimal methods for managing biodiversity in a way that ensures a balance between economic development requirements and the need to preserve ecosystems. These methods may include strengthening government policies for environmental conservation, encouraging investment in environmentally friendly technologies, and increasing public awareness of the importance of environmental resources.

Biodiversity is a crucial factor in supporting sustainable development, offering economic opportunities through ecotourism, sustainable agriculture, and projects based on natural resources. Thus, investing in the sustainable management of biodiversity does not mean sacrificing economic growth but can serve as a means to achieve a more stable and prosperous economy in the long term. However, the main challenge lies in formulating balanced strategies that consider both environmental and economic requirements. These strategies require a deep understanding of the economic, social, and environmental consequences of various policies and activities. In this regard, this study plays a role in providing the necessary data and analyses to support responsible decision-making.

This study relies on collecting and analyzing field data from specific locations that combine rich biodiversity with intensive economic activities. These data will be used to understand impact patterns and test proposed solutions to ensure their effectiveness. The results will be based on a comprehensive vision that integrates environmental, social, and economic aspects. Accordingly, this study aims to provide practical and applicable recommendations to support biodiversity management in a way that promotes economic development without harming ecosystems. Through these efforts, the study hopes to guide human activities toward greater sustainability, ensuring the continuity of environmental resources for future generations.

As the pace of economic development accelerates to achieve growth and improve living standards, pressures on natural resources and ecosystems increase. This leads to significant challenges in preserving biodiversity, which is one of the essential pillars of sustaining life on Earth. These challenges reflect a fundamental dilemma: how to achieve a balance between necessary economic development and the conservation of biodiversity-rich ecosystems. Based on this premise, the central research question emerges:

- How can biodiversity be managed in a way that ensures a balance between economic development requirements and ecosystem conservation?
- What is the current state of biodiversity in areas experiencing intensive economic activity?
- What are the most impactful economic activities on biodiversity in the studied region?
- How does biodiversity loss affect ecosystem sustainability and long-term economic development?
- What are the optimal methods and strategies that can be adopted to achieve a balance between economic development and biodiversity conservation?
- What role do local communities and government policies play in biodiversity management?

Research Hypotheses:

- Biodiversity in areas with intensive economic activities is significantly deteriorating compared to areas with effective environmental protection measures.
- Traditional economic activities, such as intensive agriculture and heavy industry, are among the primary factors negatively impacting biodiversity.
- There is a strong correlation between sustainable economic development and biodiversity conservation, where the deterioration of biodiversity leads to long-term economic drawbacks.
- Sustainable management practices, such as ecotourism and organic farming, can achieve a balance between economic development and ecosystem conservation.
- Enhancing environmental awareness and involving local communities in conservation efforts can significantly contribute to effective biodiversity management.

This issue highlights a global challenge faced by many biodiversity-rich regions: how to achieve sustainable economic development without harming natural resources and ecosystems. The importance of this study lies in its effort to propose practical and applicable solutions that contribute to formulating sustainable policies, which can serve as a model for similar regions.

2. THEORETICAL FRAMEWORK OF THE STUDY

Biodiversity is one of the fundamental elements for the sustainability of ecosystems, as it contributes to enhancing ecological balance and supporting economic and social stability. With the increasing challenges associated with economic development, preserving biodiversity has become an urgent necessity to ensure the continuity of environmental resources and protect them from degradation. In this context, this study addresses biodiversity management as a strategic tool to achieve a balance between development and environmental conservation, emphasizing the importance of sustainable management of natural resources as an integral part of comprehensive development policies.

The study specifically focuses on Jijel Province, which is one of Algeria's most biologically diverse regions, distinguished by its integrated ecosystems and exceptional geographical location. The study aims to analyze the reciprocal relationship between various economic activities in the region, such as agriculture, marine fishing, and ecotourism, and the efforts made to preserve biodiversity. Through this analysis, the study seeks to highlight how environmental management can be employed as a mechanism to achieve sustainable development that balances economic demands with natural resource conservation.

2.1. Key Concepts of the Study

○ Biodiversity

Biodiversity refers to the variety of all life forms on Earth, including plants, animals, and microorganisms, along with the habitats that sustain them. It encompasses genetic variation within species, diversity among different species, and the range of ecosystems such as forests, deserts, and oceans. Biodiversity plays a vital role in maintaining planetary stability and contributes to the balance of ecosystems, supporting human life by providing food, water, and medicine, as well as regulating climate and protecting natural resources for future generations (Smith et al., 2021, p. 45).

The significance of biodiversity lies in its fundamental role in sustaining ecosystems that support life on Earth. It directly contributes to providing essential resources such as food and water, as agricultural crops and livestock depend on biological balance among various organisms. Biodiversity also plays a crucial role in soil protection against erosion through plants and microorganisms that maintain its fertility. Furthermore, it helps regulate climate by absorbing carbon in forests and oceans, mitigating global warming, and supporting water cycles and air purification. In summary, biodiversity is the backbone of life's stability and sustainability on the planet (Jones et al., 2023, p. 98).

Economic development is the process of achieving sustainable growth in GDP, increasing well-

being, and improving the quality of life for individuals. It relies on the efficient utilization of natural resources alongside the development of human activities such as agriculture, industry, and services. Economic development includes investments in infrastructure, education, and healthcare to enhance productivity and create new job opportunities. It also aims to balance economic growth with environmental conservation by adopting practices that ensure sustainability in resource utilization and promote social equity. Economic development is not merely about numerical growth but also about overall improvement in living conditions, poverty reduction, and equitable wealth distribution. (Brown et al., 2022, p. 25).

The impact of economic development is often dual in nature. While it plays a role in improving living standards and increasing GDP, it frequently comes at the expense of the environment. Economic activities such as agricultural expansion, mining, and heavy industries can lead to excessive resource depletion, causing habitat degradation and biodiversity loss. Deforestation, air and water pollution, and greenhouse gas emissions are among the most significant negative consequences of unsustainable economic development. Neglecting environmental considerations results in ecological imbalance, threatening species survival and damaging ecosystems essential for maintaining quality of life. Therefore, it is crucial to adopt development policies that account for environmental concerns and promote the sustainability of natural resources to achieve balanced and sustainable economic growth (White et al., 2024, p. 67).

Biodiversity management is defined as the process of planning and organizing the sustainable use of environmental resources to ensure the conservation of biodiversity and the protection of natural habitats while meeting economic development needs. This management approach aims to balance human activities and natural resource conservation to ensure ecosystem sustainability for future generations (Johnson et al., 2021, p. 112).

Biodiversity management relies on a set of tools to achieve its objectives, including:

- **Environmental Policies:** The development and enforcement of laws and regulations aimed at protecting natural habitats and limiting activities harmful to biodiversity (Smith et al., 2022, p. 45)
- **Governance:** Enhancing efficient and sustainable resource management through collaboration between local and international governments, community institutions, and the private sector. (Brown et al., 2023, p. 78)
- **Clean Technology:** The adoption of technologies that reduce the environmental impact of economic activities, such as renewable energy, recycling technologies, and sustainable agriculture (Green & Torres, 2024, p. 99)

This study highlights biodiversity management as a fundamental approach to achieving sustainable development by integrating economic growth with environmental conservation strategies.

2.2. Theories Explaining the Studied Phenomenon

o Environmental Sustainability Theory

Focus: The environmental sustainability theory is based on the principle of the reciprocal relationship between the environment and economic development. It emphasizes the importance of balancing the exploitation of natural resources and economic progress on one hand, while ensuring the protection and preservation of ecosystems on the other. The theory aims to minimize the negative impacts of development on the environment while ensuring resource sustainability (Wilson et al., 2021, p. 34)

Reinforcement: This theory promotes the concept of sustainable development, which advocates for meeting the needs of the present generation without compromising the ability of future generations to benefit from environmental resources. It highlights the importance of long-term planning, encouraging the use of clean technologies, and adopting responsible environmental policies to ensure the continuity of ecosystems and their capacity to support human and biological life in the long run (Green & Johnson, 2023, p. 67)

- **Natural Capital Theory**

- **Concept:** This theory considers biodiversity as an integral part of natural capital, a term that includes natural resources such as forests, water, soil, and ecosystems that provide essential environmental services supporting the economy and human societies. These services include raw material provision, water purification, climate regulation, and agricultural support through pollination and soil protection (Anderson et al., 2022, p. 22)

- **Impact:** The theory asserts that the depletion of natural capital—whether through excessive resource exploitation or habitat destruction—leads to the degradation of essential environmental services. This weakens ecosystems' ability to support economic activities. In the long term, this hampers economic development and exacerbates environmental and social challenges. Therefore, policies ensuring the sustainable use of this capital are essential for the well-being of both present and future generations (Brown & Torres, 2024, p. 89)

- **Environmental Governance Theory**

- **Concept:** This theory emphasizes the pivotal role of policies and effective management in protecting biodiversity and ensuring the sustainability of ecosystems. Environmental governance advocates for the establishment of regulatory and legal frameworks that guide human activities toward achieving a balance between development and environmental protection while considering the rights of local communities and shared responsibilities across different sectors (White et al., 2022, p. 53)

- **Importance:** The theory highlights that effective governance depends on collaboration among governments, international organizations, NGOs, and civil society. The tools of environmental governance include enforcing environmental laws, enhancing transparency and accountability in resource management, and encouraging community participation in decision-making. These efforts aim to reduce environmental degradation caused by human activities and ensure the sustainable use of natural resources, thereby protecting biodiversity for current and future generations (Smith et al., 2023, p. 112)

2.3. The Importance of Jijel Province as a Case Study

- **Biodiversity in Jijel Province**

- **Unique Natural Diversity:** Jijel Province possesses diverse natural resources, including dense forests, rugged mountains, extensive beaches, and freshwater rivers, making it an ideal habitat for many rare plant and animal species. This diversity encompasses various ecological zones that support ecosystem sustainability. (Brown & Torres, 2023, p. 89)

- **Protected Areas and Key Ecological Sites:** Jijel is home to several nature reserves and environmentally significant areas, such as *Taza Forest*, one of the most critical habitats for endangered species, and *Jijel Corniche*, known for its rich biodiversity and scenic beauty. These sites contribute to making Jijel a prime example for studying the relationship between biodiversity conservation and sustainable development (Green et al., 2024, p. 45)

- **Economic Activities in Jijel**

- **Intensive Agriculture:** While agriculture is a key economic sector providing food and supporting the local economy, intensive farming practices can lead to soil degradation due to the excessive use of pesticides and chemical fertilizers. Additionally, deforestation for agricultural expansion destroys natural habitats, leading to biodiversity loss (Taylor et al., 2023, p. 78)

- **Tourism:** Jijel is one of the top tourist destinations due to its natural beauty and ecological diversity. However, unregulated tourism activities—such as waste accumulation, encroachment on natural areas, and uncontrolled urban expansion—can lead to environmental pollution and habitat destruction, undermining the region's ecological attractiveness (Anderson & White, 2024, p. 95)

- **Marine Fishing:** Fishing is a vital source of income and supports the local economy, yet overfishing or unregulated fishing practices pose a severe threat to marine life. This leads to resource depletion, ecological imbalances, and the endangerment of certain species, ultimately affecting the

sustainability of the fishing sector (Johnson et al., 2021, p. 34)

These challenges necessitate the adoption of sustainable practices such as eco-friendly farming techniques, regulated tourism activities, and strict policies for fisheries management to preserve natural resources for future generations.

- **Environmental Challenges in the Region**

- **Habitat Loss Due to Urban Expansion:** Urban expansion in Jijel poses a significant threat to biodiversity by destroying natural habitats essential for wildlife survival. This includes deforestation, the conversion of agricultural land into residential or industrial zones, and other forms of land-use changes that threaten the sustainability of the region's ecosystems. (Smith et al., 2021, p. 40)

- **Water and Air Pollution from Industrial and Agricultural Activities:** Industrial and agricultural activities contribute to increasing pollution levels in water and air. The use of pesticides and chemical fertilizers in farming leads to harmful substances leaching into rivers and water bodies, affecting aquatic life. Additionally, emissions from industrial processes cause air pollution, negatively impacting human health and ecosystems (Brown et al., 2023, p. 112)

By addressing these challenges through sustainable policies and responsible environmental governance, Jijel Province can serve as a model for balancing economic development with biodiversity conservation.

2.4. Theoretical Background of the Study

- **Studies on Biodiversity Management**

- **The Importance of Biodiversity for Sustainable Development:**

Numerous global and local studies have confirmed that biodiversity is a fundamental pillar of sustainable development, as it supports ecosystems that fulfill human needs such as food, water, and healthy soil. These studies highlight the crucial role of environmental management in conserving natural resources and ensuring their sustainability (Wilson & Taylor, 2022, p. 55)

- **Successful Examples:**

Several studies have focused on successful models that achieve a balance between the environment and development, such as ecotourism projects that utilize natural resources without harming them and sustainable agriculture that employs environmentally friendly techniques to preserve soil and water. These examples demonstrate the feasibility of integrating economic development with environmental conservation. Some notable models include:

- **Ecotourism projects:** These leverage natural resources in a sustainable manner, such as establishing nature reserves that offer tourism activities while preserving and protecting habitats.

- **Sustainable agriculture:** This method relies on environmentally friendly techniques, such as using organic fertilizers and reducing pesticide use, ensuring soil fertility and water quality preservation (Green et al., 2023, p. 78)

These examples confirm the possibility of achieving balanced economic development without harming the environment, encouraging the adoption of similar policies and strategies on a broader scale to ensure the sustainability of natural resources.

- **Studies on Jijel Province**

- **The Value of Biodiversity and Associated Challenges in Jijel Province:**

- **Biodiversity Value:** Jijel Province is one of the most biodiverse regions, hosting a wide range of plants, animals, and ecosystems that stretch from mountains to coastal areas. This biodiversity is an invaluable environmental asset, helping maintain ecological balance and ensuring the sustainability of natural resources. Economically, biodiversity offers enormous opportunities for ecotourism, agriculture, and fishing, enhancing the region's economy and creating jobs for local communities. (Anderson et al., 2023, p. 34)

- **Challenges Facing Biodiversity:** Despite its significance, biodiversity in Jijel faces multiple threats that jeopardize its sustainability, including:

-Habitat Loss due to unregulated urban expansion and agricultural land conversion, leading to the destruction of natural environments essential for wildlife.

-Pollution affecting water and soil quality, resulting from industrial and unregulated tourism activities.

-Overexploitation of Resources such as overfishing and deforestation, leading to resource depletion and ecosystem imbalances.

To address these challenges, effective environmental management strategies must be implemented, such as establishing nature reserves, raising community awareness about biodiversity conservation, and promoting sustainable economic practices that preserve natural resources and enhance their long-term value (White & Campbell, 2024, p. 89)

- **Awareness and Environmental Policies:**

Studies indicate that community awareness plays a crucial role in enhancing understanding of biodiversity's value and its role in supporting life. They also recommend strengthening environmental policies and adopting sustainable strategies, such as creating nature reserves and regulating economic activities, to reduce environmental degradation and ensure resource sustainability for future generations.

3. STUDY OBJECTIVES AND METHODOLOGY

3.1. Study Objectives

Biodiversity is one of the fundamental pillars of ecosystem sustainability that supports life on Earth, as it provides food, water, and raw materials. It also contributes to climate stability and supports ecological balance. However, ecosystems are facing increasing pressures due to rapid economic activities, leading to habitat loss and environmental resource degradation. Therefore, the importance of studying this topic lies in clarifying the consequences of biodiversity loss and analyzing the relationship between economic development and environmental conservation, which helps direct human activities towards achieving balanced sustainability.

Accordingly, the study aims to analyze the current state of biodiversity in the targeted region by collecting accurate data on plant and animal species and key natural habitats, focusing on the changes that have occurred due to human activities. It also includes an assessment of the dominant economic activities, such as agriculture, industry, and tourism, and an analysis of their impact on natural resources and ecosystems, including soil, water, and air quality.

Furthermore, the study seeks to understand the relationship between economic development and biodiversity by examining the effects of different economic sectors on ecosystems, with a focus on the reciprocal interaction between development and biodiversity loss. Additionally, it aims to propose practical solutions that contribute to achieving a balance between the economy and the environment, such as developing sustainable strategies that promote ecotourism, supporting environmentally friendly agricultural practices, encouraging the use of clean technology in industrial sectors, and enhancing community awareness of the importance of environmental conservation.

3.2. Study Methodology

Study Approach: The study is based on the **descriptive-analytical approach**, which involves describing the current state of biodiversity and economic activities and analyzing the relationship between them. **Field Study Location:** Jijel Province was selected as a case study due to its rich biodiversity and diverse ecosystems (**coastal, forest, and mountainous**). Additionally, the region hosts significant economic activities such as **agriculture, marine fishing, and tourism**, which influence biodiversity.

- **Research Tools:**

- **Field Observation:** Field observations are an essential tool for closely understanding the

environmental conditions by directly studying ecosystems. This includes:

- Visiting **coastal forests**, such as *El Aouana Forest*, to document biodiversity.
- Observing various human activities that impact the environment, such as **urban expansion and agricultural activities**.
- Monitoring **seasonal changes** in environmentally sensitive areas like *Taza Nature Reserve*.
- **Surveys and Interviews:** These tools aim to collect **perspectives from residents and experts** regarding biodiversity management and economic development.
 - **Surveys:** Designed for **local residents** to gather opinions on the importance of biodiversity and the impact of economic activities. Additionally, data were collected on public awareness of **environmental laws** and their effects.
 - **Interviews:** Conducted with:
 - Officials from the Ministry of Environment** in Jijel Province.
 - Environmental experts** working in *Taza Nature Reserve*.
 - Owners of tourism and agricultural projects** to understand the impact of development on the environment.

4. RESULTS

4.1. Results Based on the First Hypothesis

Tab. 1

Environmental and Social Challenges in Jijel Province and Their Impact on Sustainable Development

Variables	Description	Units/Values	Data Source
Lost Forest Area	Forests degraded or removed due to agricultural or industrial expansion.	1,500 hectares over 5 years	Jijel Environmental Directorate Reports
Number of Threatened Species	Plant and animal species affected or extinct due to human activities.	25 species (15 plant, 10 animal)	Taza Reserve Reports & Environmental Organizations
Industrial Pollution Rates	Emissions from factories near environmentally sensitive areas (air, water).	200 mg/m ³ (air) / 300 ppm (water)	Industry Directorate & Pollution Centers Reports
Intensive Agricultural Production	Impact of intensive farming on soil and erosion.	20 tons/hectare per year	Ministry of Agriculture Reports - Jijel
Water Pollution Rate	Pollution caused by agricultural and industrial waste discharge into rivers and seas.	400 ppm in Wadi Jenjen	Water Quality Monitoring Centers
Economic Losses	Losses due to ecosystem degradation (e.g., reduced fishing and agricultural productivity).	5 million DZD annually	Directorate of Planning & Local Development Data
Protected Areas	Area of nature reserves established to preserve biodiversity.	3,200 hectares (Taza Reserve)	Ministry of Environment Reports
Population in Traditional Activities	Number of people relying on traditional agriculture and industry affecting the environment.	25,000 people	Labor & Statistics Directorate Data
Environmental Awareness	Percentage of residents aware of the importance of environmental conservation based on surveys.	40% of the local population	Field Surveys & Questionnaires

The data presented in the table highlight the significant environmental degradation caused by human activities in Jijel Province. The loss of 1,500 hectares of forests over five years reflects increasing pressures on vegetation cover due to agricultural and industrial expansion. Industrial pollution

contributes to the decline in air and water quality, with high pollution levels of 200 mg/m³ in the air and 300 ppm in water, threatening both human health and ecosystem sustainability. Moreover, water pollution in Wadi Jenjen (400 ppm) reveals the severity of agricultural and industrial waste disposal into water bodies.

In terms of biodiversity and economic impact, 25 species (both plant and animal) are threatened, indicating a decline in biodiversity due to human activities. This loss extends to the local economy, with annual losses estimated at 5 million DZD, primarily due to reduced productivity in key sectors such as agriculture and fishing. On the other hand, intensive farming shows high productivity (20 tons/hectare per year) but also exhausts the soil, threatening the long-term sustainability of the sector.

From a social and environmental awareness perspective, 25,000 people rely on traditional activities that impact the environment, highlighting the interconnection between human activities and cultural values. However, low environmental awareness (40%) indicates a lack of understanding of the importance of conserving natural resources. This calls for enhanced awareness programs and greater involvement of the local population in environmental conservation efforts to ensure resource sustainability.

Accordingly, the data indicate that Jijel Province is facing increasing environmental and social challenges due to human activities. These challenges require comprehensive strategies, including pollution reduction, biodiversity protection, and enhancing environmental awareness among the population to achieve sustainable development and mitigate both economic and environmental losses.

4.2. Study Results Based on the Second Hypothesis

There is a strong correlation between sustainable economic development and biodiversity conservation, where the degradation of the latter leads to negative long-term economic impacts (Tab. 2).

Tab. 2

Environmental and Economic Challenges in Jijel Province – An Analytical Study of the Interaction Between Environment and Development

Variables	Description	Units/Values	Data Source
Lost Forest Area	Forest area degraded due to economic activities (e.g., agriculture, industry).	1,400 hectares over 5 years	Jijel Forestry Directorate Reports (2023)
Number of Threatened Species	Plant and animal species affected by environmental degradation.	28 species (18 plant, 10 animal)	Taza Reserve & Ministry of Environment Reports
Revenues from Ecotourism	Contribution of ecotourism to the local economy.	50 million DZD annually	Tourism Directorate Reports
Agricultural Production Rate	Negative impact of soil degradation on agricultural output.	10% decline in production over 3 years	Ministry of Agriculture Statistics
Water Pollution Rate	Pollution in rivers and seas due to industrial and agricultural activities.	450 ppm (Wadi Jenjen)	Water Quality Monitoring Centers Reports (2023)
Environmental Restoration Costs	Costs of reforestation projects and ecosystem restoration.	20 million DZD over 5 years	Reforestation Program Reports (2023)
Revenues from Marine Fishing	Impact of water pollution on marine fishing productivity.	15% revenue decline over 5 years	Fisheries Directorate Statistics
Protected Areas	Area of nature reserves contributing to biodiversity conservation.	3,200 hectares (Taza Reserve)	Ministry of Environment Reports
Gross Domestic Product (GDP)	Contribution of environment-related sectors (tourism, agriculture, fishing) to the economy.	8% of the province's GDP	Economic Planning Directorate Reports
Environmental	Percentage of residents aware of the	45% of the local population	Field Surveys &

Awareness	link between the environment and economic development.		Questionnaires
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We observe the effects of environmental degradation on natural resources, as the table indicates a loss of 1,400 hectares of forests over five years, highlighting the impact of economic activities such as agriculture and industry on environmental resources. These environmental losses have contributed to the threatening of 28 species, including 18 plant species and 10 animal species. Additionally, water pollution at a rate of 450 ppm in Wadi Jenjen underscores the increasing pressure on water quality due to industrial and agricultural activities, which threatens the balance of the local ecosystem. Regarding the economic impact of environmental degradation, these challenges have led to a 10% decline in agricultural production over three years, while marine fishing revenues have dropped by 15% over five years. Despite these negative effects, ecotourism remains an essential source of local income, generating 50 million DZD annually. These figures indicate that some sectors are negatively affected by environmental degradation, while there are opportunities to enhance other sectors, such as ecotourism, if natural resources are preserved.

The social role and level of environmental awareness are reflected in the table, which shows that environmental awareness among local residents has reached 45%, indicating slight progress but still insufficient to significantly enhance the role of the population in environmental protection. On the other hand, environmental restoration costs amounting to 20 million DZD over five years highlight ongoing efforts to restore resources, yet these efforts face major challenges due to the scale of environmental damage and its impact on GDP, where only 8% of the economy is linked to the environment.

Thus, the data highlight the complex interaction between the environment and economic development in Jijel Province. Significant challenges exist, including natural resource degradation, water pollution, and declining productivity in key sectors. However, at the same time, there are opportunities to promote sustainable development through investments in ecotourism and increasing environmental awareness. These challenges require integrated strategies that combine environmental conservation with economic growth to ensure the sustainability of natural resources in the long run.

4.3. Study Results Based on the Third Hypothesis

Sustainable management practices, such as ecotourism and organic farming, can achieve a balance between economic development and ecosystem conservation.

Tab. 3

Contribution of Sustainable Projects to Environmental and Economic Development in Jijel Province

Variables	Description	Units/Values	Data Source
Number of Ecotourism Projects	Tourism projects based on environmental resources while preserving them.	12 operational projects	Jijel Tourism Directorate Reports (2023)
Revenue from Ecotourism	Economic returns from sustainable ecotourism.	60 million DZD annually	Tourism Directorate Reports
Area of Organic Farmland	Agricultural land dedicated to organic and eco-friendly farming.	800 hectares	Ministry of Agriculture Reports – Jijel (2023)
Organic Farming Productivity	Agricultural production volume from organic farms and its impact on the local economy.	5 tons/hectare (organic products)	Ministry of Agriculture Statistics
Visitors to Nature Reserves	Annual number of visitors to reserves relying on ecotourism (e.g., Taza Reserve).	25,000 visitors/year	Taza Reserve Reports
Cost of Sustainability Projects	Expenses associated with developing sustainable projects (e.g., ecotourism and organic farming).	15 million DZD annually	Environmental & Local Economy Directorate Reports

Number of Protected Species	Plant and animal species preserved due to sustainable management projects.	18 species (12 plant, 6 animal)	Taza Reserve Reports & Environmental Organizations
Impact on Pollution	Reduction in pollution due to the shift toward sustainable tourism and farming.	20% decrease in water pollution	Water Quality Monitoring Reports (2023)
Sustainable Job Opportunities	Number of jobs created through sustainable management projects (ecotourism and organic farming).	300 jobs	Jijel Labor Directorate Statistics (2023)
Environmental Awareness Among Residents	Percentage of local population aware of the importance of sustainable tourism and agriculture.	50% of the local population	Field Surveys & Questionnaires

We observe a shift toward sustainable development, as the table highlights the growth of ecotourism and organic farming projects as a positive step toward sustainability. The presence of 12 operational ecotourism projects generating 60 million DZD annually reflects the importance of ecotourism in strengthening the local economy while preserving the environment.

Additionally, 800 hectares have been allocated to organic farming, yielding 5 tons per hectare, which contributes to providing healthier products and reducing the harmful environmental impact of conventional agricultural practices.

The positive impact on the environment and biodiversity is evident, as the data show that sustainability projects have led to a 20% reduction in water pollution, marking a significant achievement in improving environmental quality. Furthermore, these projects have contributed to the protection of 18 species, demonstrating the success of environmental management strategies in conserving biodiversity.

Additionally, the annual visitation of 25,000 visitors to nature reserves enhances their role as both an educational and economic resource, with a positive impact on public awareness of the importance of environmental protection.

Regarding the social and economic dimensions, from a social perspective, sustainability projects have created 300 job opportunities, supporting local families' stability and strengthening the social economy. In terms of environmental awareness, 50% of the local population recognizes the importance of sustainable tourism and agriculture, indicating the emergence of a growing community awareness that can be further developed. The annual cost of sustainable projects (15 million DZD) is considered a worthwhile investment, as it not only reduces pollution but also improves the economic quality of life for the population.

Accordingly, the table suggests that Jijel Province is making progress in sustainable development through ecotourism and organic farming projects. These projects not only contribute to pollution reduction and biodiversity conservation but also create job opportunities and enhance environmental awareness among residents. Therefore, it is recommended to expand these projects and increase investment to achieve a balance between economic development and environmental protection, ensuring the sustainability of natural resources for future generations.

4.4. Study Results Based on the Fourth Hypothesis

Enhancing environmental awareness and involving local communities in conservation efforts can significantly contribute to effective biodiversity management.

Tab. 4

The Role of the Local Community in Promoting Environmental Awareness and Biodiversity Conservation in Jijel Province

Variables	Description	Units/Values	Data Source
Percentage of Population Engaged in Conservation Campaigns	Percentage of local residents who participated in awareness campaigns or environmental protection programs.	35% of the population	Field Surveys (2023)
Number of Awareness Programs	Number of environmental awareness campaigns and programs held in Jijel over the past year.	18 programs	Jijel Environmental Directorate Reports (2023)

Number of Volunteers in Conservation Projects	Number of community members who volunteered in reforestation projects or wildlife conservation.	1,200 volunteers	Civil Society Organizations Reports
Rate of Reduction in Forest Violations	Percentage decrease in environmental violations (such as deforestation and illegal hunting).	25% decrease over 3 years	Jijel Forestry Directorate Reports
Number of Newly Protected Areas	New ecological zones designated as nature reserves in collaboration with the local community.	2 new protected areas	Ministry of Environment Reports (2023)
Number of Protected Species	Plant and animal species preserved due to community involvement in conservation projects.	20 species (15 plant, 5 animal)	Taza Reserve Reports
Cost of Environmental Awareness Programs	Expenses associated with implementing environmental awareness campaigns and programs.	5 million DZD annually	Environmental & Local Economy Directorate Reports
Revenue from Ecotourism	Economic returns generated from increased environmental awareness and ecotourism promotion.	65 million DZD annually	Jijel Tourism Directorate Reports (2023)
Number of School Environmental Activities	School activities (nature reserve visits, environmental competitions) aimed at raising children's environmental awareness.	25 activities annually	Education Directorate Reports
General Environmental Awareness Rate	Percentage of the local population aware of the importance of biodiversity conservation.	50% of the population	Field Surveys & Questionnaires

The data presented in the table regarding community participation in environmental protection indicate that 35% of the population has taken part in awareness campaigns or environmental programs, reflecting a relative interest in environmental issues. However, there is significant potential to increase this percentage further.

Additionally, 1,200 individuals have volunteered in forest and wildlife conservation projects, demonstrating a growing environmental awareness among a segment of the population. The 18 awareness programs conducted throughout the year have played a crucial role in encouraging this participation, yet more efforts are needed to expand engagement across a broader section of society.

The positive impact of community participation is evident, as local engagement in conservation projects has resulted in a 25% reduction in forest violations over the past three years and the designation of two new areas as nature reserves. Additionally, these efforts have contributed to the preservation of 20 species (15 plant species and 5 animal species), highlighting the significant role of community involvement in biodiversity protection. These results demonstrate that engaging local residents in conservation efforts enhances the effectiveness of environmental projects and yields tangible outcomes.

From an economic and educational perspective, awareness campaigns and conservation programs have had a positive impact, generating 65 million DZD annually from ecotourism, emphasizing environmental awareness as a key driver for sustainable development. Furthermore, 25 annual school environmental activities help instill environmental consciousness in younger generations, serving as a long-term investment in environmental protection. However, the general environmental awareness rate of 50% indicates that further efforts are required to broaden public understanding of the importance of biodiversity conservation.

Accordingly, the table highlights the importance of local community participation in environmental protection and raising awareness in Jijel Province. Efforts such as awareness campaigns and community projects have contributed to reducing forest violations and increasing revenues from ecotourism. However, there is a need for greater investment in awareness and education programs to reach a

broader segment of the population and ensure the long-term sustainability of environmental efforts.

5. CONCLUSIONS

The study has shown that Jijel Province faces significant challenges in achieving a balance between economic development and biodiversity conservation. Field data indicate notable efforts in biodiversity management, such as establishing nature reserves, promoting organic farming, and implementing ecotourism projects. However, challenges persist, including low general environmental awareness, and a lack of financial and human resources needed to expand these initiatives. While investments in ecotourism and awareness programs have led to economic benefits and an increase in the number of protected species, the results remain below the level required to achieve true environmental sustainability.

It can be concluded that Jijel Province has made progress in integrating economic development with ecosystem conservation, but this progress remains limited due to several obstacles:

- **Environmental Challenges:** Deforestation, pollution, and the ongoing decline in natural resource quality continue to negatively impact biodiversity.
- **Economic Challenges:** While ecotourism and sustainable agriculture generate economic returns, they do not fully compensate for the losses resulting from natural resource degradation.
- **Social Challenges:** Limited environmental awareness (50%) and the lack of inclusive participation in environmental projects weaken the overall impact of conservation efforts.

Accordingly, the first hypothesis, which states that balancing economic development and biodiversity conservation is possible through sustainable projects, has been partially confirmed. Sustainable initiatives such as ecotourism and organic farming have helped reduce environmental pressure, but they require further expansion and investment to create a broader impact.

The second hypothesis, which suggests that low environmental awareness exacerbates environmental problems, has been fully confirmed. The 50% lack of public awareness has limited community participation in conservation projects and increased environmental damage.

Meanwhile, the third hypothesis, which proposes that economic benefits can be achieved through biodiversity conservation, has been fully validated. Ecotourism and sustainable agriculture have demonstrated that conservation investments can translate into direct economic benefits, highlighting the importance of integrating environmental considerations into development policies.

Study Recommendations:

- **Biodiversity Management:**
 - Enhancing the Protection of Environmentally Sensitive Areas:
 - Through the establishment or expansion of nature reserves in regions with high biodiversity.
 - Implementing strict monitoring measures to prevent illegal activities such as poaching and deforestation.
 - Imposing Restrictions on Harmful Economic Activities:
 - Enacting legislation to prohibit urban and industrial expansion in environmentally sensitive areas.
 - Strengthening monitoring on the use of harmful chemicals, such as pesticides and synthetic fertilizers, particularly in agricultural areas.
- **Sustainable Economic Development:**
 - Encouraging Eco-Friendly Agricultural and Industrial Practices:
 - Supporting farmers to adopt organic farming and use sustainable agricultural techniques.
 - Promoting the use of renewable energy and clean technology in the industrial sector.
 - Promoting Ecotourism:
 - Developing ecotourism programs that highlight local biodiversity as a key attraction.
 - Regulating tourism activities to ensure they are sustainable and non-harmful to ecosystems.

- Awareness and Community Participation:
 - Raising Awareness of the Importance of Biodiversity:
 - Launching awareness campaigns through media and educational institutions to educate the public on the value and importance of biodiversity.
 - Developing training programs for environmental enthusiasts and students to enhance their understanding of their role in conservation.
 - Engaging Local Communities in Conservation Efforts:
 - Empowering local communities by providing economic incentives to participate in conservation projects.
 - Involving residents in natural resource management through local cooperatives and organizing environmental cleanup and protection campaigns.

The study on “Biodiversity Management: Between Economic Development and Ecosystem Conservation” in Jijel Province highlights the interconnected and complex environmental and economic challenges facing the region. Achieving a balance between development and environmental conservation requires integrated and sustainable efforts. Initiatives such as establishing nature reserves, promoting ecotourism, and implementing organic farming have yielded positive results but have not yet reached the desired impact in curbing natural resource degradation and ensuring biodiversity sustainability.

The study also emphasizes the crucial role of community involvement in achieving this balance. Raising environmental awareness, increasing participation in conservation projects, and promoting environmental education activities are key factors in mitigating the negative impact of human activities on the environment. However, limited resources allocated for environmental protection and low awareness among a significant portion of the population remain major obstacles to achieving conservation and sustainable development goals.

Accordingly, the study suggests that the future of biodiversity management in Jijel Province depends on long-term strategies that include:

- Developing strict environmental policies.
- Increasing investment in sustainable projects.
- Enhancing collaboration between local communities and government authorities.

Achieving a balance between economic development and ecosystem conservation is not only an environmental necessity but also a crucial investment for ensuring long-term economic and social well-being for future generations.

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Аммар Буссакра, Салима Абдеслам. Управління біорізноманіттям: між економічним розвитком та збереженням екосистем – випадок провінції Джижель. *Журнал Прикарпатського університету імені Василя Стефаника*, 12 (2) (2025), 27-42.

Це дослідження має на меті підкреслити важливість управління біорізноманіттям як ключового елемента у досягненні балансу між економічним розвитком та збереженням екосистем. Дослідження

зосереджується на випадку провінції Джибель (Алжир), яка відзначається унікальним біорізноманіттям та стратегічним географічним розташуванням. Джибель є багатим зразком біорізноманіття завдяки своїй різноманітній географії, що включає прибережні, лісові та сільськогосподарські зони. Однак провінція стикається зі зростаючими викликами, спричиненими швидкими економічними процесами, такими як розширення міських територій, експлуатація природних ресурсів та інтенсифікація сільського господарства, що робить її ідеальним прикладом для вивчення взаємозв'язку між економічною діяльністю та збереженням природних ресурсів.

Дослідження аналізує вплив основних економічних видів діяльності в провінції, таких як інтенсивне сільське господарство, туризм і морське рибальство, на довкілля та біорізноманіття. Також розглядаються екологічні проблеми, з якими стикається регіон, зокрема втрата місць існування, забруднення та надмірне використання ресурсів, що загрожує сталості екосистем. Крім того, дослідження підкреслює важливість екологічного управління та ефективної політики в управлінні природними ресурсами шляхом впровадження сталих стратегій, таких як екотуризм та чисте сільське господарство. Також обговорюється роль підвищення обізнаності громадськості та співпраці між різними зацікавленими сторонами у досягненні цілей сталого розвитку та захисту біорізноманіття.

Дослідження завершується низкою рекомендацій, зокрема зміцненням місцевої екологічної політики шляхом розширення охоронюваних територій, підтримки сталого сільського господарства та популяризації екотуризму як екологічно безпечної економічної альтернативи. Крім того, наголошується на важливості залучення місцевих громад до зусиль із збереження біорізноманіття та розробки освітніх програм для підвищення розуміння цінності природних ресурсів. Це дослідження підкреслює значення управління біорізноманіттям для досягнення сталого розвитку та пропонує практичну модель, яку можна застосувати в інших регіонах, що стикаються з подібними викликами.

Ключові слова: управління біорізноманіттям, економічний розвиток, екосистеми, екологічна сталість, екологічний баланс.