Journal of Administrative and Financial Sciences

Volume: 09 / N°: 02 (2025), P: 138-158

The Changing Ecological Footprint in Algeria from 2000 to 2024: Balancing Human Pressure and Resource Sustainability

Farid SEGHOUR [1] *, Naima Anfal SAIDANI [2] , Walid LAIB [3]

[1] University of Bordj Bou Arreridj (Algeria), LEZINRU research laboratory, farid.seghour@univ-bba.dz

[2] University of Bordj Bou Arreridj (Algeria), LERDR research laboratory, naimaanfal.saidani@univ-bba.dz

[3] University of Bordj Bou Arreridj (Algeria), LEZINRU research laboratory, walid.laib@univ-bba.dz

Received: 10/11/2025 ***Accepted: 05/12/2025*** ***Published: 27/12/2025***

Abstract:

This study aims to assess the evolution of Algeria's ecological footprint from 2000 to 2024 by examining its key components—carbon, agriculture, grazing land, fishing grounds, and forest—and comparing them with the current biocapacity. The research utilizes a descriptive-analytical methodology, drawing on data from the Global Footprint Network, the National Office of Statistics, the Food and Agriculture Organization (FAO), and the World Bank. The results show that Algeria's ecological deficit is getting worse, which means that the country's consumption is higher than what its ecosystems can naturally replace. The carbon and agricultural footprints are the most harmful to the ecosystem. Algeria's biocapacity has also dropped, especially in forests, grazing lands, and fisheries. At the same time, the country needs more food and natural resources, and some of this need is met by imports. The study says that the government needs to improve how it manages the environment and make policies for sustainable management in order to find a balance between economic growth and protecting natural resources.

Keywords: Ecological footprint; Biocapacity; Environmental deficit; Sustainable development.

JEL Classification : Q01; Q56; Q57.

* ***Corresponding author.***

Introduction

In the last few decades, the environmental effects of development have been a big part of global economic policy. This is because countries have realized that the old way of growing, which relied on using up natural resources, is no longer good for the environment. Because of climate change, the loss of biodiversity, and the depletion of important resources, we need to rethink how we develop so that economic growth and the protection of ecosystems that are the basis of life and production are in harmony.

Sustainable development has evolved from a basic environmental concept into an essential component of public policy formulation and economic planning. In this case, the ecological footprint is a useful way to measure the real effects of economic activities on the environment by comparing how much people need resources to how much the world can regenerate and take them in. This method assigns a numerical value to the pressure that societies exert on nature, making it an essential tool for determining the compatibility of economic growth objectives with environmental sustainability limitations.

Algeria is currently facing a big problem: it needs to switch to a more sustainable economic model that takes into account both environmental and developmental goals. This change requires policies for production and consumption that focus on using resources wisely and keeping natural wealth for future generations.

1- The Conceptual Framework of the Ecological Footprint and Its Connection to Sustainable Development

1-1 Historical Origins of the Concept

The idea of environmental limits to economic growth began to emerge in the sixties of the 20th century, when the Club of Rome (1972) warned that if economic and population growth were not controlled, it could lead to the excessive consumption of natural resources. The report emphasized the serious danger of exceeding the planet's ability to sustain life. The concept of "carrying capacity" refers to the maximum number of living organisms that an ecosystem can support without deteriorating. (Donella H. Meadows, 1972)

In his 1992 article "Ecological Footprints and Appropriated Carrying Capacity: What Urban Economics Leaves Out," published in Environment and Urbanization, Canadian researcher William Rees of the University of British Columbia first used the term "ecological footprint." Rees shifted the examination of development from the economic to the ecological dimension, asserting that "urban areas occupy a much larger ecological space than the land they physically cover." Cities rely on extensive external regions to fulfill their requirements for food, energy, and materials, as well as to manage their waste.

Mathis Wackernagel, with Rees's help, made the first quantitative tool to estimate ecological footprints for his doctoral dissertation, "Ecological Footprint and Appropriated Carrying Capacity: A Tool for Planning Toward Sustainability" (Mathis, 1994, pp. 66–70, 96–113, 117–120.). Their 1996 book, Our Ecological Footprint: Reducing Human Impact on the Earth, showed that humanity as a whole is operating beyond the planet's ecological limits and called for rethinking production and consumption patterns to secure a sustainable future.

Mathis Wackernagel and Susan Burns started the Global Footprint Network (GFN) in 2003 (Our History, 2025), which made the idea official. Since then, the group has been making yearly reports on the biocapacity and ecological footprint of countries. The ecological footprint is now a key way for big international groups like the World Bank (WB), the Organization for Economic Co-operation and Development (OECD), and the United Nations Environment Programme (UNEP) to see how well they are doing on the environmental parts of the Sustainable Development Goals (SDGs)

1-2 Definition of the Ecological Footprint

Mathis Wackernagel says that the ecological footprint is "the total area of biologically productive land and water needed to continuously provide the resources and services consumed by a given population and to absorb the waste it generates, using prevailing technology." (Mathis, 1994, p. 68).

William Rees also defines it as "the amount of productive land and aquatic ecosystems needed to produce the resources and materials consumed by a society and to assimilate its wastes, given its standard of living." This means it can be used to figure out how a community affects natural resources and how long its way of life can last. (Bouajila Aldarsi, 2023, p. 1)

The Global Footprint Network says that it is a way to measure how much people are using the planet's ecosystems, especially the Earth's biocapacity. It measures the biologically productive area needed to replace the resources and services that people use, using standardized accounting methods that figure out how much biological area is needed to meet human needs. (Global Footprint Network, 2025)

Human demand on nature competes for the planet's limited biocapacity, which includes productive land and water areas that provide food, fibers, and timber; support infrastructure; enable energy production (hydropower, biomass); and absorb or neutralize wastes like carbon dioxide emissions from burning fossil fuels and making cement. (Global Footprint Network, 2025)

1-3 The Ecological Footprint and Biocapacity

From an ecological perspective, Earth has a finite amount of biological production or regeneration that supports all life. This is called biocapacity. (Lin, Wackernage, Horsburgh, & Tyler, 2023, p. 20)

For example, there were about 11.9 billion hectares of land and water on Earth that could support life in 2023. If you divide this by the 8 billion people in the world, you get 1.5 global hectares per person. This is the amount of biocapacity that each person has. But this area must also be able to support wildlife species that are competing for the same biological resources (Global Footprint Network, 2025). The amount of biocapacity per person in the world has gone down since 2016, when it was 1.6 global hectares. This is because the number of people has gone up from 7.4 billion to 8 billion and the amount of land and water that can be used for farming has gone down from 12.2 billion hectares to 11.9 billion hectares)Bouajila Aldarsi(1 صفحة، 2023 ،.

1-4 The Link Between the Ecological Footprint and Long-Term Growth

The ecological footprint is a major way to measure how sustainable the environment is. It looks at the biologically productive area needed to meet human needs and deal with the waste that comes from them, especially carbon dioxide emissions.(Sarwar et al., 2024)It helps determine if a country's patterns of production and consumption are within or outside the ecological limits of the Earth.

Sustainable development, conversely, aims to equilibrate its three fundamental dimensions—economic, social, and environmental—by fulfilling current requirements without undermining the capacity of future generations to satisfy their own. So, the ecological footprint is a useful way to see how effectively countries follow the rules of sustainability, because it connects human health to environmental limits (global footprint network data, 2025)

Research shows that there is a positive link between the Human Development Index (HDI) and the per capita ecological footprint. As human development progresses, resource use and environmental problems increase. This connection shows how hard it is to achieve sustainable development. Most high-HDI countries have ecological footprints that are bigger than the Earth's biocapacity, while low-HDI countries have smaller footprints but still have poor social and economic welfare (global footprint network data, 2025)

(Sarwar et al., 2024) caution that exceeding the planet's ecological limits jeopardizes ecosystem stability and socioeconomic resilience. The main goal of sustainable development is to make people's lives better while staying within the Earth's biocapacity. This aligns with (United Nations Development Programme (UNDP), 2024)notion of the "Safe Operating

Space for Humanity," which underscores the necessity for human activities to remain within planetary boundaries to prevent irreversible damage.

Because of this link, countries should make policies that support renewable energy, use the principles of a circular economy to make better use of resources, and include ecological footprint indicators in their national development plans to keep track of their environmental and social performance while working toward the 17 Sustainable Development Goals (SDGs). (United Nations Development Programme (UNDP), 2024)

3- The parts of the ecological footprint and Its Measurement Methodology

The ecological footprint (EF) is a standard method for measuring how sustainable the use of natural resources on Earth is. It demonstrates how much biologically productive land and water are required to provide the resources humans use and to dispose of the trash they generate, particularly carbon dioxide emissions, depending on current technology. (Global Footprint Network, 2025)

An ecological deficit is when a culture uses too many natural resources. To find out if this is the case, you can compare an ecological footprint to the biocapacity that is available.(Farouq & Sulong, 2025)

3-1 Parts of the Ecological Footprint

There are many smaller parts that make up the ecological footprint. These parts show how people use nature in different ways. There are six main groups in the Global Footprint Network (GFN), and each one is linked to a specific resource area.(Marshadi et al., 2025)

- **Carbon Footprint:** This is how much forest land is needed to absorb the carbon dioxide that comes from driving, using energy at home, doing business, and burning fossil fuels. The same amount of forest land is created from emissions based on the rates of carbon sequestration.
- **Cropland Footprint:** Shows how much farmland is needed to grow food, feed, and raw plant resources that people or countries use.(Farouq & Sulong, 2025)
- **Grazing Land Footprint:** Refers to the area of land that is biologically productive enough to grow meat, milk, wool, and other animal products. It depends on how much land is used for productive pastures and grain to feed animals (Global Footprint Network, 2025)

- **Forest Products Footprint**: This shows how much land is needed to get wood, paper, and fuelwood, which shows how much people are putting strain on forest ecosystems.
- **Fishing Grounds Footprint**: According to their average biological productivity, it measures the productive marine and freshwater areas needed to supply fish and seafood consumption in worldwide hectares
- **Built-up Land Footprint:** This includes the land used for infrastructure, housing, and transportation networks, which is a part of the planet's total biocapacity set aside for human settlements. (Global Footprint Network, 2025) Some studies include the carbon footprint in the forest category, which means that biocapacity is made up of five main parts: cropland, grazing land, forest land, fishing grounds, and built-up land. Carbon is seen as a separate ecological pressure because it is important to the whole world.(Abbas et al., 2025)

To find the total ecological footprint, add up all the sub-footprints (in global hectares, gha) and then divide that by the number of people to get the per capita footprint. This figure is compared to the available biocapacity to see if a country has an ecological deficit or a surplus. (worldpopulationreview, 2025)

3-2 Methodology for Measuring the Ecological Footprint

The Global Footprint Network's National Footprint Accounts (NFA) publication gives the accounting framework that is used to figure out the ecological footprint. The process consists of the following steps:(Albu & Juneja, 2023) (Global Footprint Network, 2025)

- **Data Collection:** We get the basic data from trustworthy international sources like the Food and Agriculture Organization (FAO), the International Energy Agency (IEA), and the UN Comtrade databases. The databases have information on CO2 emissions, energy use, carbon emissions, agricultural production, livestock and fisheries output, and CO2 emissions.
- **Transforming Physical Flows into Biologically Productive Regions**: You can compare different types of land by using yield and equivalency variables. The amounts of production and consumption are then turned into biologically productive areas (in global hectares, gha).
- **Finding the Total Footprint**: The total national footprint is found by adding up all six parts. To find the per capita ecological footprint, divide this number by the total number of people. To find biocapacity, you multiply the yield and equivalence factors for each land-use category by the amount of land that is available. This makes it easy to see if there is an

ecological surplus or deficit by comparing biocapacity to the ecological footprint.

- **Including international trade:** To account for trade flows, imported ecological footprints are added while exported footprints are subtracted, yielding a measure of national consumption footprint rather than production footprint.
- **Verification and Sensitivity Analysis:** Sensitivity tests are done to make sure the results are strong, and all data sources and conversion coefficients are written down to keep things clear and scientifically sound. (Farouq & Sulong, 2025)

Table number (1): Indicators for Measuring the Ecological Footprint

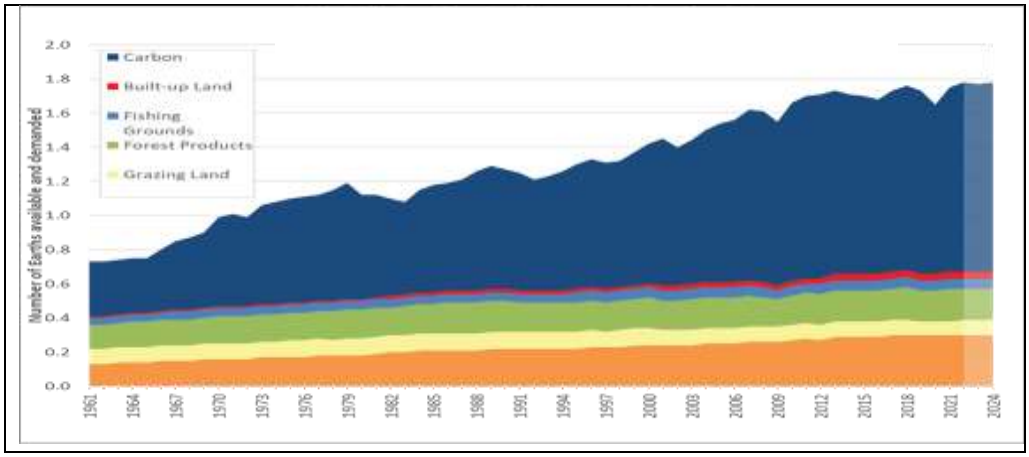
Component	Indicator Used	Data Source	Unit of Measurement	Indicator Used
Carbon footprint	Annual CO_2 emissions	IEA, UNFCCC	tons CO_2 / gl	Annual CO_2 emissions
Cropland footprint	Grain, vegetable, and biofuel production	FAOSTAT	tons / gha	Grain, vegetable, and biofuel production
Grazing footprint	Meat, milk, and wool production	FAO	tons / gha	Meat, milk, and wool production
Forest footprint	Timber and paper production	FAO Forestry	m^3 / gha	Timber and paper production
Fishing footprint	Fish and aquatic resource production	FAO-FISHSTAT	tons / gha	Fish and aquatic resource production
Built-up land	Urbanized and developed areas	Remote sensing data	Gha	Urbanized and developed areas

Source: Prepared by the authors.

Data from throughout the world show that the ecological footprint has been steadily and steadily rising since the early 1960s. The graph that depicts the global ecological footprint by its parts makes it evident that the carbon part is the biggest reason for this growth. This is because greenhouse gas emissions from burning fossil fuels and industrial activities are going up.

Over time, carbon has come to make up the biggest part of the total ecological footprint. Other parts, like built-up land, grazing areas, fishing grounds, and forest products, have either stayed the same or only gone up a little. The global economy still depends on non-renewable energy sources, which has made the global ecological deficit worse because people need more resources than the world can provide.

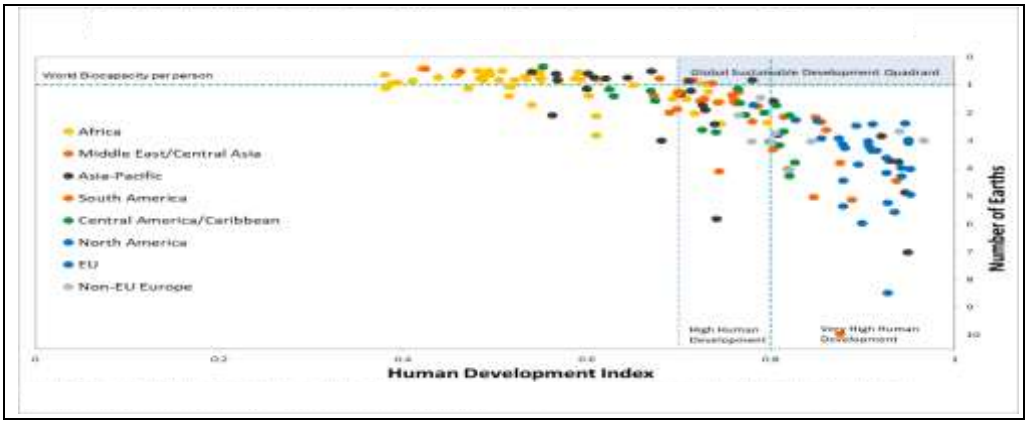
Figure 1. World Ecological footprint by Component



Source: (global footprint network data, 2025)

This uneven trend shows a direct link between economic growth and more stress on ecological systems. People have been using more resources each year than the Earth can replace in the same amount of time since the 1980s, which means that people are using more resources than the Earth can replace in the same amount of time.

Figure 2. Ecological Footprint and HDI by countries



Source: (global footprint network data, 2025)

The second graph shows how the Ecological Footprint and the Human Development Index are related. This shows how complicated the relationship is between development and sustainability. It shows that most countries with a high HDI (over 0.8) have better living standards and a better quality of life, but their ecological footprints are too big for the Earth to handle, so they need more than one planet to support their levels of consumption.

Countries with low human development, especially in Africa and Central Asia, have small ecological footprints, but they don't have easy access to education, jobs, and health care. This contradiction shows how hard it is to create sustainable development that protects the environment while also making people's lives better.

The diagram's "Global Sustainable Development Quadrant" shows countries with a high HDI and a small ecological footprint. This is the best place for sustainability to happen. But only a few countries have gotten to this point, which shows how important it is to change the way the global economy works to make production and consumption more efficient and good for the environment.

Algeria is in the middle of the world. Its Human Development Index (HDI) has been between 0.74 and 0.76 in the last few years, putting it in the upper-middle-income group. Its per capita ecological footprint, which is about 2.5 global hectares (gha), is a little bigger than the global sustainable threshold of 1.7 gha per person.

This means that Algeria has made a lot of progress in education, healthcare, and infrastructure, but it has done so by using more and more natural resources and fossil fuels over time. The data show that Algeria still has environmental problems, even though things are getting better. These problems include soil degradation, water shortages, and rising carbon emissions from more industrial and urban activities.

Algeria needs to find the right balance between growth and protecting the environment by using a sustainable development model that focuses on renewable energy sources like solar and wind, energy efficiency, and changing how people make and use things to fit the country's ecological capacity.

The world shows that many wealthy and industrialized countries are in ecological deficit, which means they use more resources than their local biocapacity can handle. Some places in South America, Africa, and Asia, on the other hand, have green zones with a lot of biocapacity.

This difference in space shows that there are big differences in how land is used (for example, for farming, forestry, and grazing), as well as in population density, consumption, and energy use. The map also shows that biocapacity surpluses are usually linked to low population pressures or large areas of productive land per person. On the other hand, ecological deficits are more likely to be linked to urban and industrial concentration and rising energy demand.

The two-dimensional diagram that goes with it shows how the limits of the earth and human health are at odds with each other. It shows a pattern in which the ecological footprint grows as the Human Development Index (HDI) grows. A lot of data points show that countries with high HDI use more resources than the Earth can handle. If everyone lived like these countries do, they would need the resources of many planets.

Countries with low HDI values, on the other hand, have small ecological footprints, which means that people there don't use a lot of resources and don't have easy access to basic services. This means that in order to protect the environment, people will have to suffer. The overall distribution shows that the current model of development is still closely linked to using more resources and putting out more carbon. This makes it harder to improve living standards around the world unless we make a big change to an economy that uses fewer resources and produces less carbon.

4- Analysis of the Evolution of the Ecological Footprint and Biocapacity and Their Components in Algeria

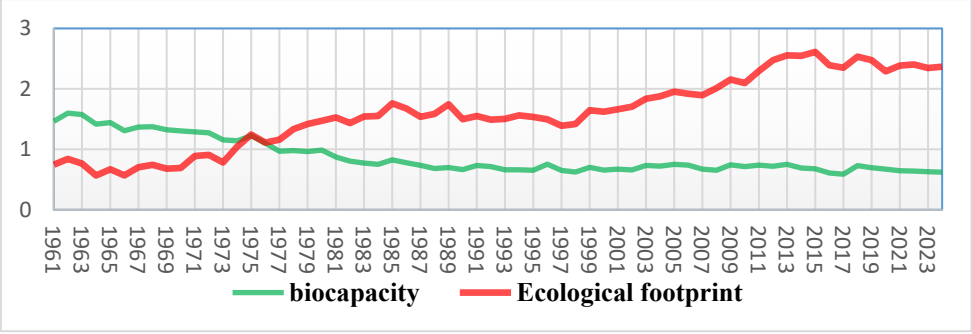
The Ecological Footprint (EF) and Biocapacity (BC) quantify the worldwide problem of sustainability by measuring human demand versus natural supply. Analyzing Algeria's EF and BC trends is critical for analyzing the country's progress toward environmental sustainability while promoting economic growth. Algeria today experiences a major ecological deficit, requiring more resources than its local ecosystems can replenish. This study examines the evolution of EF components (such as the carbon footprint) to identify the key causes of the national resource imbalance.

4-1 Ecological Footprint and Biocapacity Accounts in Algeria

Figure 5's numbers show a worrying trend in the relationship between Algeria's ecological footprint and biocapacity from 1961 to 2024. The ecological impact of the country on each person has been going up steadily. It went up from 0.74 global hectares (gha) per person in 1961 to 2.36 gha in 2024, which is almost 3.17 times as much.

As the population grows, the economy grows, and people's spending habits change, there is a greater need for food, energy, and manufactured goods.

Figure 3. Trends in Algeria's Ecological Footprint and Biocapacity (1961–2024)



Source: (global footprint network data, 2025)

Algeria, on the other hand, has seen a big drop in its per capita biocapacity, going from 1.46 gha in 1961 to 0.62 gha in 2024, which is almost 2.35 times. This drop can be linked to the country's ecosystems getting worse, cities taking over land that is good for growing things, soil erosion, and the overuse of natural resources. Algeria's ecological footprint has been bigger

than its biocapacity since 1975. This means that the country has a long-standing and getting worse ecological deficit.

The estimates for 2024 show that Algeria's ecological footprint per person (2.36 gha) is bigger than the North African regional average (1.74 gha) and more than 3.8 times the biocapacity available per person (0.62 gha). So, national ecosystems can only meet about 26% of the country's total ecological needs. This growing gap between the supply of natural resources and the demand for them shows that Algeria needs to change its policies for consumption, production, and resource management in order to achieve sustainable development. This will help bring back the balance between the goals of development and the environment's ability to support them.

4-2 Evolution of the Components of Algeria's Ecological Footprint

To comprehend the economic ramifications of ecological deficit, it is imperative to initially assess its magnitude and delineate its principal components, specifically the extent of divergence between human demand for natural resources and the ecosystems' capacity for regeneration. This also means showing how each part of the ecological footprint adds to the overall shortfall.

4-2-1 The built-up land footprint in Algeria (2000-2024)

To comprehend the economic ramifications of ecological deficit, it is essential to first quantify its extent and delineate its primary components—specifically, the extent of the disparity between human demand for natural resources and the ecosystems' capacity for regeneration. This also means showing how each part of the ecological footprint adds to the total shortfall

Big housing projects and improvements to infrastructure caused a lot of growth between 2000 and 2010. After that, things were pretty stable for a while (2011–2017), but in 2018, things got worse again. This was also when big cities like Algiers, Oran, and Constantine started to grow.

The built-up footprint has stayed at about 1.24% of Algeria's total ecological footprint for the past few years, even though urban construction slowed down during the COVID-19 pandemic.

There are a number of reasons for this general trend, but the most important ones are rapid population growth, unplanned urban development, and a growing need for housing and infrastructure, as well as business and service activities that need more built-up space. UN Habitat and other studies (Lahouari, et al., 2023, p. 29) of cities show that between 2000 and 2010, and again between 2010 and 2020, Algerian cities used between 1% and 3% of their urban land. In many cases (United Nations Human Settlements Programme (UN-Habitat), 2025), this was more than the rate of population

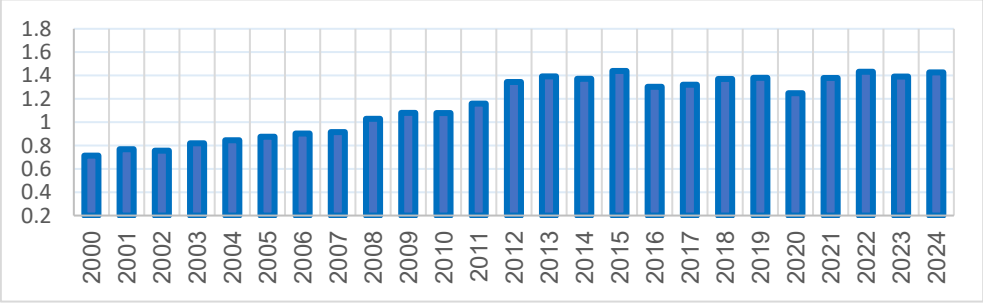
growth. This trend goes against SDG indicator 11.3.1, which looks at how sustainable urban growth is.

Also, turning agricultural or natural land into built-up areas has put more stress on the ecosystem by making land that is less productive available. To keep the environment in balance, this trend needs long-term urban planning policies that encourage efficient land use and limit horizontal urban sprawl.

4-2-2 Algeria's Carbon Footprint (2000-2004)

Figure 6 shows that Algeria's carbon footprint has grown a lot from 2000 to 2024, both in terms of total ecological footprint and as a percentage of it. In 2000, it was about 0.71 gha per person, and by 2024, it had grown to about 1.43 gha per person, almost doubling in 25 years.

Figure 4. Evolution of Algeria's Carbon Footprint 2000–2024



Source: (global footprint network data, 2025)

The carbon footprint's share of the national ecological footprint grew from 44% to over 60% during the same time period, making it the most important and influential part of Algeria's ecological framework. This trend shows that energy use is going up, industrial production is going up, transportation is going up, and fossil fuels are still the main source of energy. (International Energy Agency.

This pattern shows that carbon emissions are still the main reason for Algeria's ecological deficit. This shows how important it is to make policies for energy transition and use low-carbon technologies to protect the environment and make sure it lasts for a long time.

Algeria's carbon footprint has grown a lot, which is bad news for the environment because the country isn't moving quickly enough to switch to

renewable energy sources. It also shows how much of our energy still comes from fossil fuels.

In 2023, Algeria's carbon dioxide emissions from burning fuel reached 154.5 million metric tons ($MtCO_2$), which is 151% more than in 2000. The national carbon footprint has almost doubled in the same amount of time, which is in line with the current trend. The Global Carbon Atlas (2024) says that Algeria is now Africa's third-largest emitter, after South Africa and Egypt. (International Energy Agency, 2025)

From 2000 to 2022, Algeria's per capita CO_2 emissions went up by 6%, reaching about 3.3 metric tons per person in 2019. The World Bank says that this level is caused by population growth, urbanization, and industrial growth all happening at the same time. (International Energy Agency, 2025)

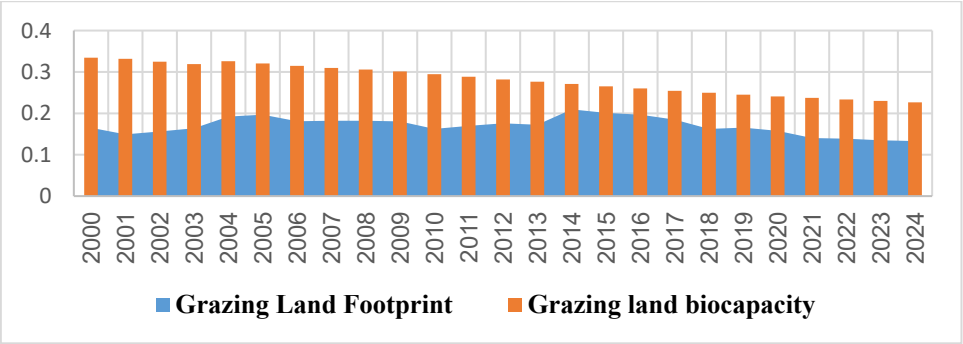
Natural gas is the biggest source of carbon emissions, making up about 62% of the total. Next is oil, which makes up 37% of the national energy mix. Coal, on the other hand, only makes up 0.3% of the mix. This distribution shows that Algeria mostly uses fossil fuels to make electricity and run businesses. (International Energy Agency, 2025).

The energy and heat generation industry is responsible for 31% of CO_2 emissions, and the transportation industry is responsible for 30% (International Energy Agency, 2025). The residential and industrial sectors add less to the total. This piece shows how Algeria's economy is based on oil and rent, and how it relies on extracting hydrocarbons to meet the country's growing energy needs while slowly moving toward a transition to renewable energy.

4-2-3 Grazing Land Footprint in Algeria (2000–2024)

The data in Figure 5 show that Algeria's grazing land footprint has been slowly going down since 2000, after going up and down for a while. This trend shows that the country as a whole has less of an impact on the environment when it comes to grazing resources. The drop is likely due to changes in how crops and livestock are grown, which could be linked to changes in how land is used, less productive pasture, and cities moving into areas that used to be grazing land.

Figure 5. Evolution of Algeria's Grazing Land Footprint (2000–2024)



Source: (global footprint network data, 2025).

Figure 5 shows that Algeria's grazing land footprint has been slowly going down since 2000, after going up and down for a while. This pattern shows that the country's ecological footprint doesn't depend as much on grazing resources as a whole. The decline is indicative of a transformation in agricultural and livestock production methods, likely associated with alterations in land use, diminished pasture productivity, and urban encroachment into formerly grazing areas.

In the middle of the series, there were small increases, such as 0.192 gha in 2004 and 0.197 gha in 2005. However, the overall trend stayed down. This decline can be linked to a number of things, such as a drop in traditional pastoral activities caused by changes in food production that favor intensive farming and food imports, as well as the effects of drought, desertification, and the loss of productive grazing land. (Ministère de l'Agriculture et du Développement Rural, 2025)

The decline of native animal herds in some areas due to drought and the loss of vegetation, as well as the increased environmental impact on natural resources, have all played a role in this downward trend.

The biocapacity of grazing lands also went down, from 0.334 gha per person in 2000 to 0.226 gha in 2024. This means that ecosystems are less able to support and replenish human consumption.

4-2-4 Cropland Footprint in Algeria (2000–2024)

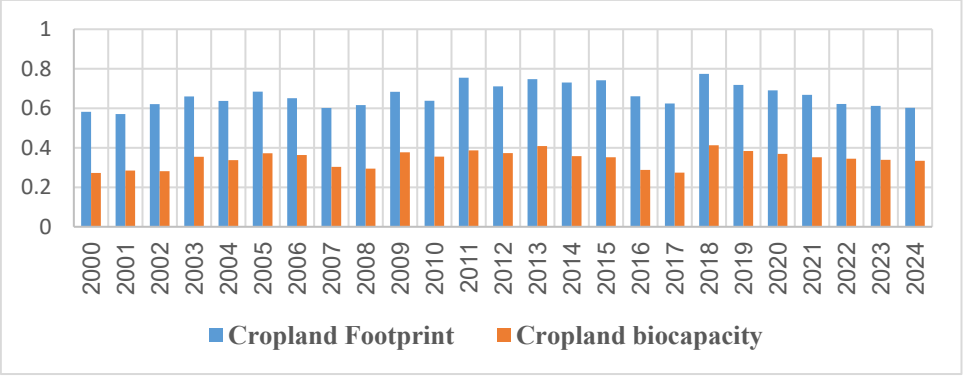
Between 2000 and 2024, Algeria's agriculture footprint changed a lot, going from 0.58 to 0.77 global hectares (gha) per person. This is shown in Figure 8. These trends show how the amount of land and agriculture used has changed over time

The overall trend shows that farmland resources are still under strain because more people are eating more food and the population is growing.

Biocapacity for cropland, on the other hand, stayed pretty stable, with a small upward trend. It stayed between 0.27 and 0.33 gha per person. This shows a fairly moderate increase in the ability to restore the environment and the productivity of farming.

The ecological footprint of agriculture in Algeria has slowly gone down, from about 36% in 2000 to less than 26% in 2024. This is because the carbon part and the growth of cities are taking over farmland.

Figure 6. Evolution of Algeria's Cropland Footprint and Biocapacity (2000–2024)



Source: (global footprint network data, 2025)

The statistics clearly support the previous trend, as Algeria's population increased from about 30.9 million in 2000 to more than 46.16 million in 2023 (World Bank, 2025) , which raised the demand for food and agricultural products. During the same period, the value of agricultural production more than quintupled (from $4.2 billion to $27.9 billion between 2002 and 2023) (FAO, 2025), while the proportion of agricultural land in the total area increased only slightly, by no more than 0.6% (from 16.8% in 2000 to 17.4% in 2023). (World Bank, 2025)

However, these data show that agricultural growth was not sufficient to meet the rising domestic demand, prompting Algeria to cover the food deficit through imports. The value of food and live animal imports rose from

about 933.12 billion DZD to more than 1,473.56 billion DZD between 2018 and 2023 (National Office of Statistics, 2024, p. 34), reflecting a growing reliance on external markets to meet national food needs.

This indicates that the increase in Algeria's agricultural footprint and ecological debt does not only reflect pressure on local resources, but also transfers part of this pressure to the ecosystems of exporting countries. In other words, Algeria is offsetting its ecological deficit through imports, creating an external ecological debt that represents increasing dependence in the field of food security.

4-2-5 Evolution of the Fishing Grounds Footprint in Algeria (2000–2024)

Information about Algeria's fishing grounds footprint from 2000 to 2024 shows that maritime operations usually have a worse effect on the environment. The footprint grew from about 0.017 global hectares (gha) per person in 2000 to 0.027 gha in 2024. This is almost a 52% rise over 25 years.

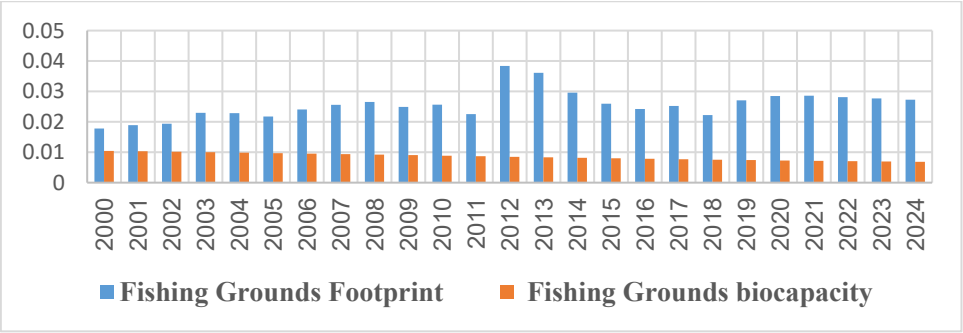
This change is happening because more people are eating seafood and more fishing is happening along the coast and in factories to meet the growing need for animal protein in the US. The overall trend shows that national marine resources are still under a lot of stress, even though there are some changes from year to year.

The fishing biocapacity has been going down steadily, from 0.0104 gha per person in 2000 to 0.0068 gha in 2024. This shows that marine ecosystems can't replace what is taken from them as easily. This drop can be linked to the depletion of fish stocks, overfishing in some coastal areas that is too much, and the combined effects of pollution and climate change on marine biodiversity.

The difference between the two curves (footprint vs. biocapacity) shows that fishing is becoming worse for the environment. This is because the ecological footprint has always been bigger than the productive capacity in most years. The fisheries footprint was only 1% to 1.5% of Algeria's total ecological footprint, which shows how weak the industry is and how it uses unsustainable extraction methods.

Because of this, Algeria now needs to import seafood to meet some of its own needs. By 2023, the value of fish and seafood imports had gone up from about DZD 11.58 billion to DZD 15.35 billion (National Office of Statistics, 2024, p. 35). This means that the country makes up for its lack of sustainable production by trading with other countries instead of making goods at home.

Figure 7. Evolution of Algeria's Fishing Grounds Footprint and Biocapacity (2000–2024)

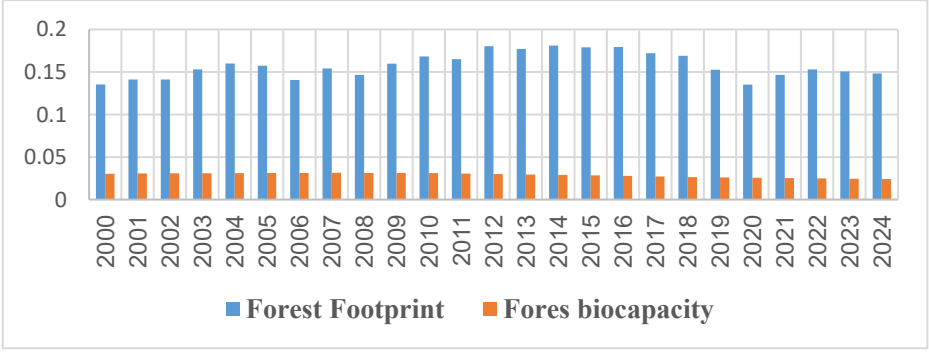


Source: (global footprint network data, 2025)

4-2-8- Evolution of the Forest Footprint in Algeria (2000–2024)

From 2000 to 2014, the forest footprint per person went up from 0.135 to about 0.181 global hectares (gha). This shows that people were putting more stress on forest ecosystems. This trend shows that more people need forest products, resources, and ecosystem services from forested areas. Beginning in 2014 and continuing until 2020, the forest footprint slowly got smaller. After that, it stayed pretty stable for a few years.

Figure 8. Evolution of Algeria's Forest Footprint and Biocapacity (2000–2024)



Source: (global footprint network data, 2025)

In contrast, Algeria's forest biocapacity has been slowly going down, from 0.030 gha per person in 2000 to 0.024 gha in 2024. This worsening trend shows that forest ecosystems are becoming less able to regenerate themselves.

Even if this has happened, people still put a lot of stress on forests, which is more than they can handle. This shows that there is an ecological debt that is specific to forests. Algeria is becoming more dependent on trade with other countries to meet its own needs. Imports of forest-based goods have helped make up for some of the shortage. The value of imported wood, cork, paper, leather, and shoes went up from DZD 5.42 billion in 2004 (National Office of Statistics (Algeria), 2014, p. 22) to DZD 24.37 billion in 2023 (National Office of Statistics (Algeria), 2023)

Conclusion

The ecological footprint is a good way to see how well economic and consumption trends fit within the limits of the planet's biocapacity. More people, consumption, and production activities put more stress on ecosystems. This is why footprint analysis is such an important way to keep an eye on how well the environment is balanced and how well sustainability is being achieved, especially in developing countries with few natural resources that want to grow their economies.

The empirical analysis of Algeria's ecological footprint (2000-2024) reveals a continuously growing ecological deficit, characterized by human consumption surpassing the ecosystems' inherent regenerative capacity. The carbon and agriculture parts are still the main things that stress the environment. This is due to the fact that industrial systems depend on fossil fuels and the demand for food is rising. Also, the biocapacity of forests, grazing fields, and fishing grounds has gone down, which means that ecosystems are getting worse and losing their ability to be sustainable

Algeria's economy is becoming more dependent on imports to meet its needs for food and the environment. This is a short-term fix for ecological debt, but it also shows that food and environmental security aren't as strong as they could be. This outcome shows that the current development model doesn't work because it doesn't find a real balance between protecting natural resources and growing the economy.

Suggestions for Policy

- To make sure that environmental factors are clearly included in national development policies, add ecological footprint indicators to planning and assessment tools.

- Strengthen environmental governance by making it easier for different groups that manage natural resources to watch each other and work together.
- Investing in clean technologies and renewable energy can help lower the carbon footprint and speed up the transition to a green economy.
- Rebuild ecosystems that have been harmed and make programs that protect forests, pastures, and fisheries bigger.
- Make food less of a need by using water and farming resources more efficiently and promoting home production that is good for the environment.

To achieve environmental balance, Algeria needs to look at sustainable development from a broad perspective. This means that protecting the environment should come before making money, not the other way around.

Bibliography

International Energy Agency. (2025, 10 27). Algeria: Emissions. Récupéré sur International Energy Agency: https://www.iea.org/countries/algeria/emissions

FAO. (2025, 10 31). FAOSTAT: Query View (QV). Récupéré sur https://www.fao.org/faostat/en/#data/QV

Donella H. Meadows, D. L. (1972). The Limits to Growth: A Report for the Club of Rome's Project on the Predicament of Mankind. New York: Universe Books.

Global Footprint Network. (2025, 10 25). What Ecological Footprints Measure. Récupéré sur Global Footprint Network: https://www.footprintnetwork.org/what-ecological-footprints-measure/

global footprint network data. (2025, 10). Récupéré sur https://data.footprintnetwork.org/

Lahouari, B., Nora, B., Hanane, S., Hicham, B., Souad, L., Mohamed , Y., . . . Kurt, T. (2023). Sustainable Development in Algeria's Urban Areas: Population Growth and Land Consumption. Urban Science , 7(1), 29.

Lin, D., Wackernage, M., Horsburgh, N., & Tyler, A. (2023). Environment Strategy Outcome on Scotland's Global Footprint – Evidence Base and Policy Levers. Global Footprint Network. Récupéré sur https://www.gov.scot/publications/environment-strategy-scotland-delivering-environment-strategy-outcome-scotlands-global-footprint-evidence-base-policy-levers/?utm_source=chatgpt.com

Mathis, W. (1994). Ecological Footprint and Appropriated Carrying Capacity: A Tool for Planning Toward Sustainability. University of British Columbia.

Ministère de l'Agriculture et du Développement Rural. (2025, 10 30). Steppes et parcours : Développement et préservation des parcours steppiques et modernisation de la filière des élevages ovin et caprin. Récupéré sur https://fr.madr.gov.dz/agriculture/developpement-agricole-dans-les-zones-seches-et-semi-seches/steppes-et-parcours/

National Office of Statistics (Algeria). (2014). External Trade Report 2004-2014. ALGER.

National Office of Statistics (Algeria). (2023). External Trade Report 2004-2014. ALGER.

National Office of Statistics. (2024). External Trade Report 2018-2023. ALGER.

Our History. (2025, 10 25). Global Footprint Network. Récupéré sur https://www.footprintnetwork.org/about-us/our-history/.

United Nations Development Programme (UNDP). (2024). Sustaining People and Planet. United Nations, Human Development Report 2024: , New York.

United Nations Human Settlements Programme (UN-Habitat). (2025). Spatial Growth of Cities and Urban Areas. Récupéré sur https://data.unhabitat.org/pages/spatial-growth-of-cities-and-urban-areas

World Bank. (2025, 10 31). Agricultural land (% of land area) – Algeria. Récupéré sur https://data.worldbank.org/indicator/AG.LND.AGRI.ZS?locations=DZ

World Bank. (2025, 10 31). World Development Indicators. Récupéré sur https://data.worldbank.org/indicator/SP.POP.TOTL?locations=DZ

worldpopulationreview. (2025, 10). Récupéré sur https://worldpopulationreview.com/:

Al-Darsi, A. B. (2023). Ecological footprint and biocapacity: Basic concepts and applications to the reality of Arab countries [In Arabic]. Development Bridge Series, 2023(164), 1–16. Arab Planning Institute.

Abbas, Q., Imran, M., & Sattar, A. (2025). From linear to circular: the impact of economic policies and technological innovations on greenhouse gas emissions in the Netherlands. Carbon Balance and Management, 20(1). https://doi.org/10.1186/s13021-025-00297-1

Albu, N., & Juneja, M. (2023). ECONOMIC FOOTPRINT AND R&D FOOTPRINT FOR GRAPHENE FLAGSHIP Measurement of the economic impact relating to Graphene Flagship's R&D activities and impact related to Graphene consortium.

Farouq, I., & Sulong, Z. (2025). Investigating the Effects of Financial Development and Inflation on the Ecological Footprint in Five Selected Leading African Economies. Fudan Journal of the Humanities and Social Sciences. https://doi.org/10.1007/s40647-025-00454-3

Marshadi, A. H. A. L., Aslam, M., & Janjua, A. A. (2025). Ecological footprints, global sustainability, and the roles of natural resources, financial development, and economic growth. PLoS ONE, 20(3 March). https://doi.org/10.1371/journal.pone.0317664

Sarwar, N., Bibi, F. un N., Junaid, A., & Alvi, S. (2024). Impact of urbanization and human development on ecological footprints in OECD and non-OECD countries. Heliyon, 10(19). https://doi.org/10.1016/j.heliyon.2024.e38058