

Chapter I: Generalities on Biodiversity

I.1. Historical Background of the Concept

The term *biodiversity* is a contraction of the English expression "biological diversity", which in French is "diversité biologique", composed of the words *bio* (from the Greek *bios* = life) and *diversity*. This term emerged in the 1970s, when research focusing on the consequences of species extinctions and the fragmentation of ecosystems or habitats gained importance.

The concept of biodiversity, as an environmental issue, became formalized in the early 1980s, and materialized during the Earth Summit on Sustainable Development in Rio de Janeiro in 1992, where the debate moved beyond the scientific level. Biodiversity protection efforts were launched using scientific knowledge and political will, with the signing of the Convention on Biological Diversity (CBD).

By the end of the 20th century, humans had become aware of their unprecedented impact on natural environments and the looming threat of depletion of biological resources.

The expression *biological diversity* was coined by Thomas Lovejoy in 1980. The term *biodiversity* itself was created by Walter G. Rosen, a member of the U.S. National Research Council, who began contracting the words *biological* and *diversity* during the preparation of a conference titled the *National Forum on Biological Diversity*, organized by the National Research Council in 1986.

The word *biodiversity* first appeared in a publication in 1988, when American entomologist E.O. Wilson used it as the title of his report. The term *biodiversity* was considered more effective in terms of communication than *biological diversity*. Since 1986, the term and the concept have been widely used by biologists, ecologists, environmentalists, policymakers, and citizens. The use of the term coincides with growing awareness of species extinction.

I.2. Definition

Earth is home to an extraordinary biological diversity, which includes not only the species that inhabit our planet, but also the diversity of their genes, the multitude of ecological interactions among them and with their physical environment, and the variety of complex ecosystems they form.

This biodiversity, which is the result of more than 3 billion years of evolution, represents a natural heritage and a vital resource on which humanity depends in many ways (Marcon, 2015).

The definition of biodiversity varies depending on the context and needs. Biodiversity represents the diversity of living beings and ecosystems, including fauna, flora, natural environments, and also humans. Biodiversity reflects the number, variety, and variability of living organisms. The concept encompasses diversity within species, between species, and between ecosystems.

In its simplest form, biodiversity is defined as biological diversity or the diversity of life. Ramade (1993), for example, defines biodiversity as the variety of living species that populate the biosphere. It is measured by the total number of living species contained in all terrestrial and aquatic ecosystems currently found on the planet.

The Convention on Biological Diversity (CBD), signed in Rio in 1992, defines it as "the variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems." Biodiversity includes the diversity of genes, species, and ecosystems, as well as their interactions.

According to Levêque and Mounolou (2001), the term biodiversity is defined as *useful nature*, meaning the set of species or genes that humans use for their benefit, whether they come from the natural environment or from domestication. More precisely, biodiversity is the dynamic interaction of organisms within changing environments.

This concept refers to the variety of life forms, including plants, animals, and microorganisms, the genes they contain, and the ecosystems they form. It is assessed by considering species diversity, genetic diversity within each species, as well as the structure and distribution of ecosystems. It is a sum of extraordinary mechanisms, a network of interactions among billions of living organisms: for example, bees pollinate flowers while foraging, allowing for rich fruit production; bacteria, mollusks, and crustaceans decompose waste and thus clean soils and waters, contributing to the nourishment of other organisms like algae... which are themselves essential for the survival of certain life forms.

So, biodiversity refers to the variation and variability of living organisms of all origins, which is assessed by considering species diversity, genetic diversity within each species, as well as the organization and distribution of terrestrial, aquatic, marine ecosystems, and ecological complexes. This includes diversity within species, between species, and between ecosystems.

I.3. Levels of Biodiversity

Three main organizational levels of biodiversity are generally recognized: Genetic diversity, Species (or taxonomic) diversity, Ecosystem diversity.

I.3.1. Genetic or Intraspecific Diversity

Genetic diversity can be defined at the level of alleles, entire genes, or larger units than genes. Even though all the cells of an organism carry the same genes, the expression of certain genes and the inactivation of others result in cells having different shapes and functions.

Genetic diversity is the **foundation** of biodiversity. It consists of the genetic variability found within living organisms—in other words, the genetic differences between populations of the same species and between individuals of the same population.

I.3.2. Species or Interspecific Diversity

This corresponds to the **diversity of species**. Each group can therefore be characterized by the number of species it contains. However, to describe the number of anatomical organizations, it is more appropriate to use the term **disparity**.

I.3.3. Ecosystem Diversity

This is the variability that exists at the **ecosystem level**, taking into account the functions of species and the interactions among them. The **services provided by ecosystems** are the benefits that ecosystems offer to humans. These include:

- **Provisioning services**, such as food, clean water, wood, fiber, and genetic resources;
- **Regulating services**, such as climate regulation, flood control, disease regulation, water purification, and pollination;
- **Cultural services**, such as recreational, aesthetic, and spiritual benefits;
- **Supporting services**, such as soil formation and nutrient cycling.

I.4 The Many Faces of Biodiversity

I.4.1 Biodiversity as a Product of Evolution

Biodiversity, as it exists today, is the result of evolution over many decades. Resistance, sensitivity, refuge-seeking, adaptation, interaction, development, and extinction are all behaviors displayed by living beings over time to maintain their place within current biodiversity.

I.4.2 Biodiversity as a Food Resource

All food sources are part of biodiversity, or their raw materials originate from it. Hunting, gathering, agriculture, and aquaculture are activities based on biodiversity products. How to manage biodiversity as a food resource remains a major concern for humanity. Irrational practices, such as the excessive use of resources, the focus on high-yield crops, and the introduction of fertilizers and pesticides in modern agriculture, threaten current biodiversity. Modifications to natural ecosystems create new invasive species and risk the loss of rare or sensitive species.

I.4.3 Biodiversity as a Commercial Resource

Biological biodiversity is considered a raw material used in various industries (pharmaceuticals, cosmetics, agri-food, textiles, etc.). Developed countries exploit the resources of developing countries by purchasing them at low prices. In return, these developing countries import industrialized products made from their own resources at high prices and with taxes.

This is known as biopiracy—the exploitation of biotic and abiotic resources by developed countries. In response, developing nations turn to patents to protect their resources.

I.4.4 Biotechnology

Biotechnology is an advanced technology that utilizes cellular and molecular processes to create products and services. Among these techniques is transgenesis, which involves transferring a part of the genetic makeup of one organism to another to enhance a specific trait or phenotype. Through technological advancements, humans can now guide evolution by creating new organisms (GMOs). Thus, mastering biotechnology offers solutions to problems such as pollution, energy sources, and manufacturing.

I.4.5 Biodiversity to Be Protected

This includes species that are sensitive, rare, or endangered, such as polar bears, tigers, elephants, etc. The main threat to these species is human activity, which ultimately leads to the extinction of life on Earth. “Humans are a part of biodiversity and draw all their needs from it.”

I.4.6 Harmful Biodiversity

Populations cannot grow indefinitely. Expanding populations are quickly limited by various factors, including the availability of resources, the emergence of diseases, genetic issues, infertility, etc. Humans have classified biodiversity into useful and harmful categories based on their own needs and perspectives. But the question remains: Do harmful species really exist on Earth?

Guided by this point of view, humans have always fought against certain parts of biodiversity to preserve their way of life. Predators of domestic animals, parasites, viruses, bacteria, crop pests, and indoor insects—all belong to the biodiversity that humans seek to exclude.

However, after extensive ecological studies, it has been discovered that every population has its own **control factors**, including the human population. The very factors considered dangerous to humans are often **natural regulators**, helping maintain balance among species.

I.4.7 Biodiversity and Societal Rights

Biodiversity is sometimes compared to a library. The irreversible loss of species results in the loss of resources and knowledge. The importance of interactions between living beings, populations, and ecosystems is evident in the direct and indirect impacts of species extinction on the ecological systems they are part of.

Global changes affect ecosystem functioning not only directly but also indirectly, through their impact on biological diversity. Humans bear the responsibility for destroying biodiversity, even though economic and social development remains a priority for countries. Thus, states have sovereign rights over the use and conservation of biological resources.

The use and conservation of biodiversity are often the source of conflicts of interest, the resolution of which depends on choices made in terms of economic development and the use of biological resources.