DEMOCRATIC AND POPULAR REPUBLIC OF ALGERIA
MINISTRY OF HIGHER EDUCATION AND SCIENTIFIC RESEARCH

Nour Bachir El Bayadh University Center

Institute of Natural and Life Sciences

Department of Ecology and Environment

"Handout"

"COURSE: CONSERVATION AND SUSTAINABLE DEVELOPMENT"

Dr. MEKHLOUFI Moulai Brahim

Associate Professor, Class A

Nour Bachir University Center - El Bayadh

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SYLLABUS

Conservation and Sustainable Development

HOURS VOLUME

Teaching Unit	VHS	VHS Weekly				Coeff	Crédits
	14-16 weeks	C	TD	TP	Autres		
UEF 3.1.2(O/P) Ecology of Populations and Communities							
Subject 4: Conservation and Sustainable Development	22h30	-	-	-	15h00	02	04

Teaching Objectives:

The knowledge gained in this module will enable students to precisely understand the causes of biodiversity erosion (both abiotic and biotic factors) and its consequences on ecosystems worldwide, with a focus on North Africa. Additionally, students will explore urgent measures that need to be implemented, including case studies.

Recommended Prerequisites:

Students should have a solid understanding of ecological factors that govern species distribution, including bioclimatic, phytogeographic, orotopographic, etc., factors. This foundational knowledge will facilitate a comprehensive grasp of the conservation and sustainable development course content.

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1-Introduction to Biodiversity:

According to the CBD (Convention on Biological Diversity, Article 2), biological diversity represents the "variability of living organisms of any origin, including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, and between species and ecosystems. '

In the form contracted "Biodiversity", this expression was used in 1985 by the American Rosen in a congress whose report was published in 1988. The latter, with the impact of the United Nations Conference on the Environment in Rio de Janeiro in 1992, stimulated research and made the concept of biodiversity famous in the media. The "Convention on Biological Diversity" adopted by 189 countries entered into force on 29 December 1993. This convention stresses the importance of biodiversity and its conservation and the fact that natural resources are not unlimited. It also stresses the need for sustainable development and its implementation. It establishes rules for the equitable sharing of biodiversity resources, particularly those for commercial use. We can see that biodiversity is at three different but complementary levels:

1-1-Genetic diversity (genes = intra-specific):

«It is the variety that exists between genes (alleles) or chromosomal structure within the species». Genetic diversity is the diversity that exists within a species, between individuals of the same species. It may or may not be apparent. It refers to the variety of genes or chromosomal structure within species and

Figure 01: Genetic diversity.

Occurs both within and between species. The more diverse a population or species is in terms of genes, the more likely it is that some of its members can adapt to changes in the environment. On the contrary, the less diversity, the more individuals become similar to each other and it becomes unlikely that one of them has the ability to adjust to different living conditions

.

1-2-Species diversity (species = interspecific):

It is the variety that exists at the level of the different species found in a given area. It distinguishes species from each other (morphological, anatomical, genetic, molecular, etc.). The specific diversity corresponds to the diversity of species in a region, expressed by the number of species encountered, but also by their belonging to different genera, families or classes. Specific diversity is the measure of biological diversity within a habitat or geographical area, and therefore the diversity of fauna and flora.

2-Ecosystem Diversity:

Concerns the different habitats with all its components (biotic and abiotic as well as the different relationships that may exist between them). The relationships between living beings are very complex, they can be trophic (food chains, symbioses, parasitisms, etc.), genetic (gene flow)... The relationship between the environment and living beings is also of paramount importance in the expression of biodiversity. In other words, habitat is the support of life. Any damage to its balance can only adversely affect all the beings it shelters. Extrapolation can also be made to the whole of our planet, which has known and continues to know multiple and successive aggressions resulting in irreversible disasters accompanied by the disappearance of all forms of life.

2-1-The concept of species:

Linnaeus materialized the species by a type individual: (holotype): The species is a set of identical individuals between them, and with the "type" specimen, that is to say the specimen used to describe and characterize the species on the morphological level. This "type" is deposited in a Museum where it serves as a reference for subsequent comparisons. Within the same species, subspecies can be distinguished.

2-2-Evolution of biodiversity:

Over time Since the first life forms appeared on Earth about 3.8 billion years ago, life has continued to diversify. The fossils present in the rocks today make it possible to reconstruct the biodiversity of the past, different from the current biodiversity. Modern radiochronology methods based on the dating of the oldest known minerals (Zircon*) and astronomical data allow the Earth to be 4.567 billion years old and to date the geological epochs absolutely. The oldest known traces of life are 3.5 to 3.7 billion years old.

Each ecosystem corresponds to a series of complex relationships between biotic (living) elements such as animals, plants and microorganisms, and abiotic (non-living) elements such as sunlight, air, water and nutrients. The diversity of ecosystems is the result of interactions that the species they support have developed between them and with their environment. Relationships that provide each species with the conditions and resources necessary for its survival. It refers to the presence of different types of ecosystems. This concerns the diversity of habitats, biotic communities and ecological processes in the biosphere. It took millions of years of evolution to accumulate this rich diversity in nature, but we could lose all this richness in less than two centuries if current rates of species loss continue. Biodiversity and its conservation are now vital environmental issues of international scope as more and more people around the world begin to realize the critical importance of biodiversity for our survival and well-being on this planet.

CHAPTER 02

The main causes of species extinction

1-introduction:

Throughout the history of the Earth, species have appeared and others have disappeared. A species is born, lives and dies. Extinction is a normal evolutionary process The history of life on Earth has been marked by periods of crises characterized by the disappearance of a large number of species. Many animal and plant lineages have become extinct and today's biodiversity represents only a small portion of all the species that have lived on Earth in the past.

1-1-The Main Extinction Episodes:

A crisis involves mass extinction that affects not only species but entire families. It must take place rapidly on the scale of geological times (even a million years is a relatively short period for a geologist) and must be felt on a global scale.

On our scale, the great crises of biodiversity do not resemble the apocalyptic scenario of a shock that would instantly wipe out all life. On the contrary, they occurred over a long time, like the disappearance of dinosaurs whose decline occurred over more than 5 million years. And each time, life forms have survived.

Over the past 500 million years, corresponding to the rise of biodiversity, the Earth has experienced several extinctions, the largest of which occurred about 250 million years ago, in the Permian-Triassic.

- **Around -450 million years, Primary Era (Paleozoic)**

The Earth experienced a **first great crisis at the end of the Ordovician-Silurian**, when life was exclusively marine. It would be due to an intense episode of glaciation and would have caused the disappearance of 60 to 70% of the species.

- **Around -358 million years, Primary Era (Paleozoic)**

The extinction of the Devonian causes the disappearance of 75% of the species, due to significant climatic variations and the fall of the oxygenation of the seas.

- **Around -252 million years, At the boundary between the primary and secondary era (Paleozoic-Mesozoic)**

The Permian-Triassic crisis is the third and greatest extinction the Earth has ever known. It causes the disappearance of more than 90% of species, both terrestrial and marine. This unprecedented crisis was essentially caused by two major volcanic episodes.

- **Around -200 million years, Secondary Era (Mesozoic)**

The Triassic-Jurassic crisis spans nearly 17 million years, a record in comparison to other crises ranging from 1 to 2 million years. It leads to the disappearance of 70 to 80% of species as a result of Atlantic volcanism.

- **Around -66 million years, Secondary-tertiary era (Mesozoic-Cenozoic)**

The last great crisis of the Cretaceous-Paleogene is undoubtedly the best known, because it corresponds to the extinction of one of the most famous groups of fossil animals, the great reptiles (including some dinosaurs). It is consistent with a major volcanic episode, in Dekkan (India) to which is added the fall of an asteroid in the Yucatan peninsula (Mexico) which impacted the entire planet.

2-The main causes of mass extinctions:

All species live in a certain range of environmental conditions such as temperature, oxygen concentration, light. . etc.; if these conditions were to fall outside the range required by a

particular 10 species in a given locality, the existence of that species in that locality becomes impossible.

Many speculations about the origin of these mass extinction periods remain:

1- Disastrous climate changes linked to periods of glaciation, themselves due to cyclical decreases in solar flux: the energy radiated by the sun is not absolutely constant, it can be minimal with the consequences of colder climate episodes.

2- Other specialists attribute these climatic variations to the existence of a period of intense volcanism at the end of the Cretaceous, which attests to immense basalt deposits in various regions of the globe, particularly in India on the Deccan or Dekkan plateau of western India which covers an area of 500,000Km2, consisting of a stack of lava flows over 2000km thick. In the northwestern United States especially in Oregon and Idaho where such layers of lava cover hundreds of thousands of km2.

3- Cosmic disasters affecting the entire planet and marking the end of secondary (Cretaceous). This hypothesis was developed from 1980 by Alvarez and colleagues (University of California) following the discovery in northern Italy, Denmark, and other continents of deposits abnormally rich in Iridium (30 times and 130 times higher than normal) which form a thin layer of clay in Cretaceous shale and other sedimentary strata.

2-1-The risk of extinction:

Ecological researchers have focused their studies on the factors that increase the risk of extinction.

Population size: Small changes in birth rates, mortality or environmental conditions affect small populations more severely than large ones.

Range: In general, the greater the range of a species, the lower the probability of extinction is for Cretaceous bivalve and gastropod populations living in small (1000km2), medium (1000-2500km2) and large (2500km2). range, it has been shown that species with small ranges suffer higher rates of extinction.

Sex ratio: Two populations of the same size do not respond to environmental disturbance in the same way;

The population may produce few males or females or have no offspring due to environmental disturbance this population may disappear.

Biotic potential: A population is all the more likely to perpetuate itself because the intrinsic fertility of the individuals that constitute it is greater.

Inbreeding: correlated with decreased genetic variability, spread of hereditary defects in particular physiological deficiencies resulting in decreased longevity and increased mortality; in addition to the slightest environmental accident such populations cannot continue.

Adaptation: the ability to colonize new sites, tolerance to environmental pollution, the ability of a species to adapt quickly to rapid changes in the environment is therefore a crucial factor for its survival.

3-The mechanisms of extinctions:

In any ecosystem, some species are commonplace, others rare and therefore, a priori more vulnerable to extinction risk than those with abundant populations. The value of the biotic potential of a species is the major criterion of its ability to survive, as it measures its reproductive capacity. A population is all the more likely to perpetuate itself as its intrinsic fertility is greater.

To this is added another genetic parameter, negative, inbreeding, which makes the survival of small populations uncertain. It is generally manifested by a decrease in fertility, or even sterility of individuals and an increase in the frequency of congenital defects, in particular physiological deficiencies, which results in an immediate and significant increase in the mortality of individuals affected.

In addition, the increase in vulnerability to the slightest ecological accident of such isolated populations, which are often few in number, is another factor that compromises their chances of survival. Depending on the intrinsic characteristics of each species, it is possible to define a theoretical minimum population necessary to ensure the sustainability of their populations, from which the concept of minimum viable population (= PMV) is derived.

All other things being equal, the greater the number and biotic potential of a population, the more likely it is to persist. For example, the MVP for homeothermic vertebrates has been calculated from purely genetic considerations related to the decline resulting from inbreeding.

It fluctuates from 50 to 500 individuals depending on the species so that the probability of survival of the population concerned is greater than the century. Moreover, it is considered as a first approximation that the surviving population of a homeothermic vertebrate must be a thousand individuals for the species to present 95% chance of not disappearing in a millennium.

CHAPTER 03 :

Habitat fragmentation

1- Habitat fragmentation :

1-1-Introduction :

It is the leading cause of species extinction worldwide. Fragmentation occurs when a large ecosystem is transformed by human action into many fragments, small in size, spatially isolated. It consists of the division of the landscape (woods, plains, forests, etc.) into smaller and isolated places, separated by landscapes transformed by man (agricultural fields, cities, roads, etc.).

Fragmentation of a landscape reduces the area of original habitat. For a species to survive in a landscape or watershed, it must have sufficient access to habitat resources to maintain the minimum viable population (VMP) which is defined by the smallest number of individuals required to support a population for the long term. Indeed, the maintenance of an MVP is dependent on the functioning of metapopulations (faunistic populations that are separated in space but interact through the dispersal of animals).

The fragmentation of natural spaces appreciates on biodiversity by the presence of barriers difficult to cross, main waterways and major terrestrial transport routes, and by the decline of the surfaces of spaces not fragmented. The fragmentation of natural areas is steadily increasing, while the total surface of terrestrial natural environments is decreasing. In ecosystem assessment, ecological fragmentation is considered as one of the first causes of damage to biodiversity, before pollution.

Fragmentation or fragmentation of ecosystems/ habitats/ ecolandscape/ ecological includes any artificial phenomenon of fragmentation of space, that can or could prevent one or more species from moving as they should and could in the absence of a fragmentation factor. With the concept of heterogeneity, fragmentation is one of the theoretical bases of landscape ecology. Individuals, populations, and species are affected differently by habitat fragmentation. They are more or less vulnerable according to their adaptive abilities, their degree of specialization, their dependence on certain eco-landscape structures.

Fragmentation of natural areas is assessed by effective/actual mesh size. The indicator reflects both the area of natural areas in the territory and their degree of division. A small effective mesh size indicates a fragmentation of the natural areas of the studied territory. The smaller the size, the more fragmented the natural spaces. The evolution over time and the variation in space of the effective mesh size make it possible to follow the pressure of habitat fragmentation on biodiversity.

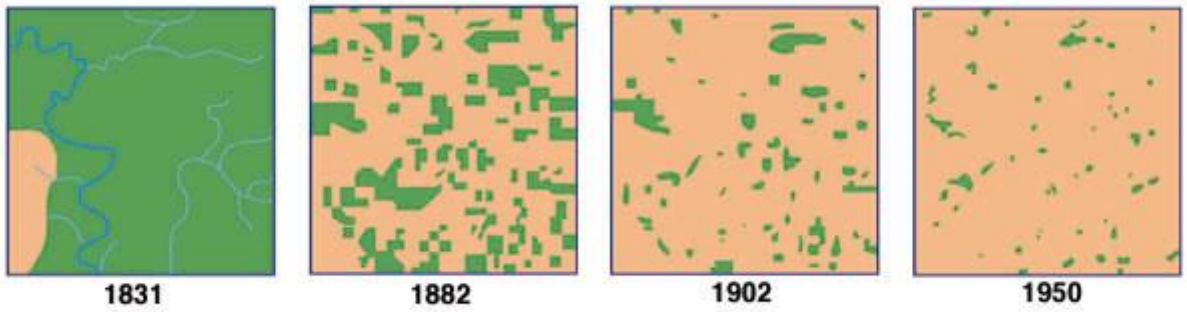

Figure 02: Fragmentation of natural areas.

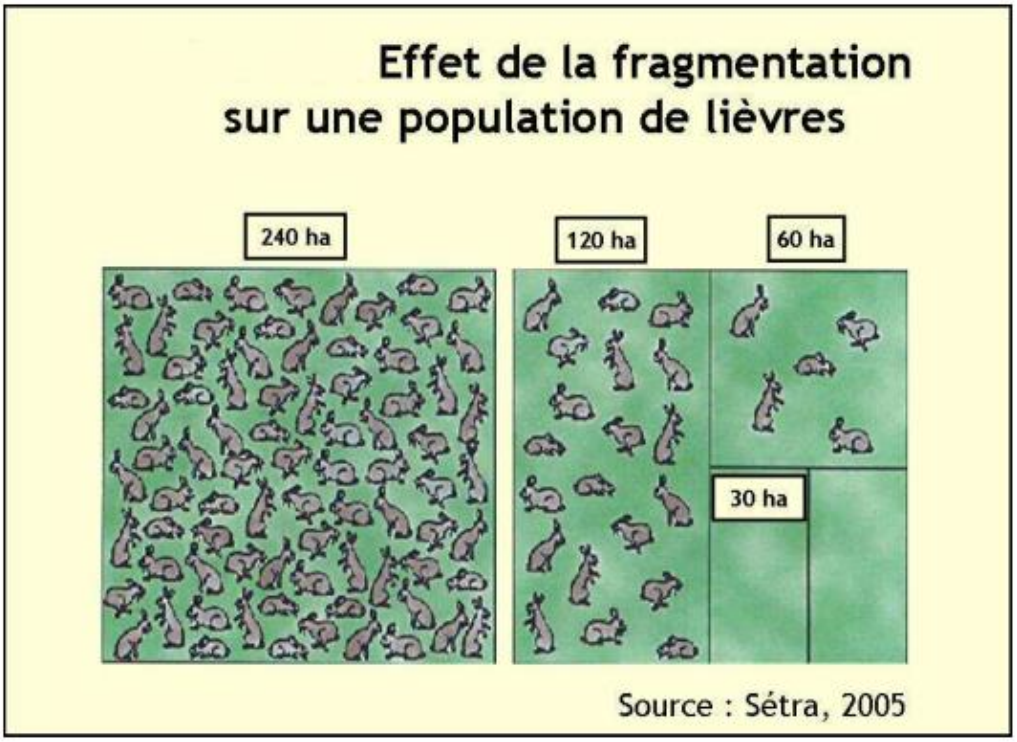

Figure 03: Effect of fragmentation on hare population.

Other factors include their ability to fly or clear obstacles (walls, fences, roads, pesticide-treated areas, etc.), and the biology of their population. For example, wild birds, which fly and can therefore exploit different «spots», seem much less affected by the decrease in forest cover than by the fragmentation of the forest itself (with a few exceptions, notably due to "edge effects".

2-A border: A border is a boundary between two environments, one of which is usually forest, for example between a forest and a meadow, a clearing, a beach. The edge has particular microclimatic and ecological conditions and sometimes specific micro-habitats, favorable or on the contrary unfavorable to species of adjacent environments.

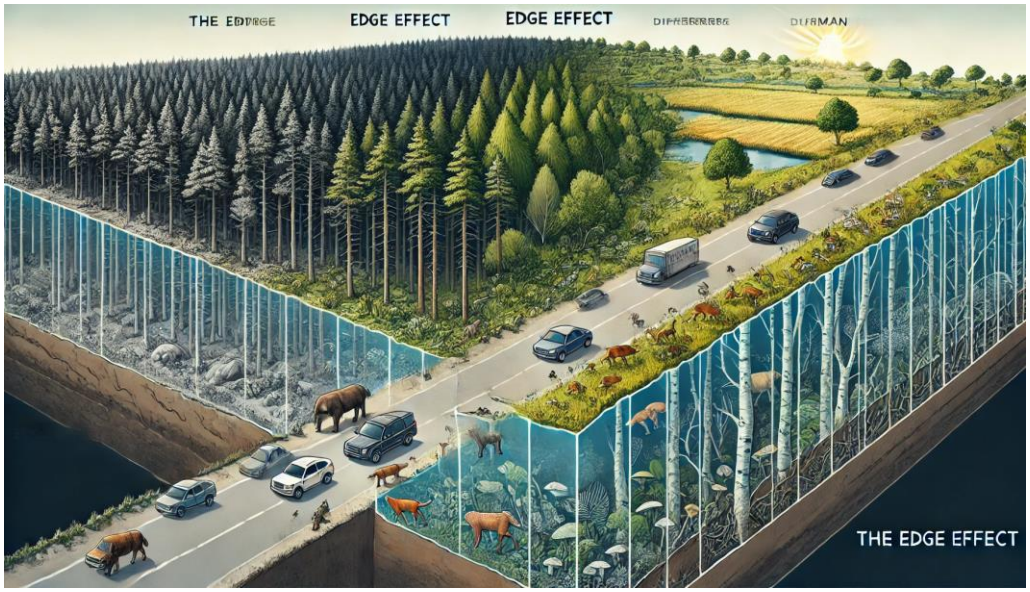

Figure 04: edge.

The share represented by the edge in the ecosystem is increased in case of fragmentation. Specific ecological conditions are present in the edge ecosystem compared to the central zone: sunshine, wind regime or temperature regime will vary. These different conditions between the edge and the heart zone induce the presence of different fauna and flora.

The initial habitat will therefore be denatured due to increased edge effect, which will alter local diversity and population dynamics. A new procession of species will be present on this space at the expense of that of the heart space. If the latter is home to endemic species, the reduction of the surface of the habitat can endanger these populations, and cause their extinction.

3-Relevance:

The fragmentation of natural environments can be unfavorable to many species, on the one hand because of the weakness of the accessible surfaces, and on the other hand by the isolation, the partitioning/ rapture of the different natural spaces.

The effective mesh size is an indicator that has been used in many studies on the fragmentation of landscapes or natural areas of varied areas and for very different territorial levels of monitoring (from the European continent to a small geographical region for example).

4-Habitat destruction and fragmentation (of natural environments):

Habitat destruction and fragmentation are linked in particular *to deforestation*, agricultural land expansion, *increasing urbanization* and *forest fires: this particularly affects tropical forests, grasslands, wetlands and bogs.*

5-Deforestation

Forests are the most biodiverse ecosystems. They offer people a range of values, from wood, pulp, rubber, to environmental services.

Just under 10,000 years ago, about 4 billion hectares, almost half of the earth's surface was covered by forests. During the industrial era, about 40% of the wooded areas disappeared. Over the past fifty years, man has razed 20% of the original virgin forests. Every two seconds, the forest recedes the size of a football field. Every year, between 13 and 15 million hectares of forests (the equivalent of three times the surface of Switzerland, or 1/4 of the surface of France) are destroyed worldwide. If deforestation continues in this way, the forest will have completely disappeared within 50 years.

Deforestation is a phenomenon that affects tropical forests especially in Southeast Asia, Africa and America. Among the virgin forests most affected by this

5-5- destruction: *the equatorial forests of the Amazon, Papua New Guinea, Indonesia, Malaysia, Central Africa, Russia, Canada and the United States*. One of the primary causes of deforestation is the exploitation of wood that cuts large tracts of forest for American and European markets. Global wood production has increased by 60% over the past four decades and is expected to continue to grow in the coming years, especially in emerging economies such as China and India. This industry concerns *wood-material* that is used in the pulp and paper industry, *furniture and plywood, and wood-energy or* fuelwood *is converted into coal thus providing 10% of the world's energy. It is also used as a* modern biofuel *to produce electricity, gas and fuels.*

The exploitation of wood leads not only to the disappearance of a high number of tree species, but also of plant species, millions of insects and multitudes of animals. Deforestation can cause animal and plant imbalances. Indeed, the animals are hunted from their natural habitat and disappear little by little. It should also be noted that if a plant species disappears, it leads to the disappearance of animal species that feed on them. Deforestation of the tropical forest (mainly the Amazon rainforest) is one of the main causes of climate change currently observed (melting glaciers, extreme weather trends, temperature records). It can also cause *soil erosion, disturbance in the water cycle* and *decreased oxygen renewal in the* atmosphere.

Other causes of deforestation include *clearing* of forests to gain agricultural land, *forest fires,* acid rain *due to air pollution and* biological aggressions *(insects, etc.).*

6-Indicator methodology:

The calculation method requires the use of a geographical information system with a layer of information on natural areas and a layer of information on obstacles fragmenting environments. The intersection between the two layers and the calculation of the surfaces of the cut elements make it possible to use the values produced in the formula of the effective mesh size established by Moser et al.

$$\mathbf{m = 1/A_t * \Sigma(A_i * B_i)}$$

where **m:** is the effective mesh size,

$\mathbf{A_i}$: the surface of each of the fragments of natural spaces within the territory,

Bi: the total area of each of the fragments of natural areas, including where applicable outside the territory under consideration (Bi Ai),

and At: the total area of the territory considered (At Σ Ai; At = Σ Ai) if the territory consists only of natural areas).

This indicator has the advantage of considering the different forms of fragmentation of natural areas. The fragmentation of a natural area may result from changes in size and shape related to the following processes:

Perforation (natural space diminishes in surface while keeping the same external perimeter); the incision (the natural space decreases on the surface and its external perimeter increases); cutting (natural space is no longer a single block); dismemberment (the initial natural space is cut out and the natural surface decreases); reduction (natural space diminishes in surface area and decreases its external perimeter); extinction (the natural space disappears).

Between two dates, a natural space may undergo changes resulting from a combination of these processes that strongly fragment it:

it may be perforated by developed agricultural areas, incised by the linear elements of the road network, traversed by increasingly dense road traffic, incised and divided into two distinct elements by a high-speed railway, with a general reduction of its outer fringes.

These varieties of forms cannot be easily considered by too simple indicators, such as the density of transport lines:

- 1 km of road or rail line in an area of 1 km² does not specify whether this line makes the natural space undergo a perforation, incision or cutting. The effective mesh size takes into account the number of different natural elements present in a territory and the proportion of these elements on the surface.
- It allows a good integration of the different fragmentation processes in their morphological properties, a good consideration of the variations of spatial forms.
- This indicator includes natural areas, part of which is outside the territory under consideration. In other words, the administrative boundary of the territory that crosses a natural space has no fragmenting effect on this space.

The most sensitive species are the first ones that will be affected by fragmentation. A loss of habitat will therefore cause a decrease in specific diversity and a change in the composition of communities. These fragmentation-sensitive species are: Naturally, rare species with low population density or limited geographic distribution.¬ Species that have low fertility or a short life cycle. ¬ Species that require a large area of habitat to ensure long-term population viability. ¬ Species with low dispersal capacity, which will therefore not be able to reach an

undistorted habitat. ¬ Species that can only live in core areas (and therefore not in edge areas) or species that will be vulnerable to predators in edge areas. ¬ Species vulnerable to human exploitation. Data from 35 years of experiments have shown that fragmentation, including deforestation, results in a 13% reduction in biodiversity [20] 75% and above all deteriorates the functioning of ecosystems that offer free services and benefits. The most well-known case in Algeria is the passage of the East-West motorway in the El Kala National Park (PNEK), center of Mediterranean biodiversity. Unfortunately, it is not the only one and not the last either.¬

CHAPTER 04:

Consequences of species invasions on biodiversity

1- Voluntary biological invasions :

In the field of ecology, the notion of biological invasion was defined by Williamson in 1996 as, over a period identifiable at the geological or paleontological time scale, an «invasion» characterized by the sustainable increase in the range of a taxon (whether one or more populations, and whether this invasion is natural or anthropogenic).

In ecology, the adjective allochthone is used to designate several phenomena. In invasion biology, it refers to species of foreign origin to the local biome.

These are most often organisms introduced by man, either voluntarily, from an economic or aesthetic perspective, or accidentally. In limnology, allochthonous organic matter refers to the organic matter present in an aquatic ecosystem that is produced outside this ecosystem, usually on the watershed. This organic matter can be used by aquatic food webs and reflected in their biomass, a proportion then called allochtonia. It opposes native organic matter as the biomass produced within the aquatic ecosystem by phytoplankton, benthic algae and macrophytes.

- Example: macrophytes are a generic term for all aquatic plants visible to the naked eye. Whether phanerogams (flowering plants), rhodophytes (red algae), chlorophytes (green algae), or phaeophytes (brown algae).
- Many macrophytes tend to regress due to the degradation of water quality (water pollution, warming, acidification of rainfall and general eutrophication trend) especially of lacs1 and retreat of wetlands.

Figure 5: macrophytes.

epidemiology also deals with biological invasions. Occasional biological invasions have occurred at geological scales, contributing to the evolution of species. But in recent centuries and even more in recent decades, man has strongly accelerated this process to the point that it is now recognized as the second cause of accelerated decline of biodiversity, just after the destruction and fragmentation of habitats, in which he participates.

- Why does a species become invasive?

The reasons why a species becomes invasive are difficult to determine. Overall, this is due to its arrival in an ecosystem in which it does not encounter any predator, pathogen or parasite likely to slow its expansion. It also represents a competition to which native species are not adapted: they therefore generally decline rapidly.

Species introductions are largely caused by human activities. These may be intentional introductions for various reasons: exploiting the potential of a new species, using ornamental plants, growing a new species, raising a species for its fur, etc. Thus, several species of fish were imported from other continents and voluntarily released into the rivers of metropolis to enrich the diversity of fish: this is the case for example of the perch sun. As another example, many plant species were imported to decorate aquariums, before accidentally ending up in the wild: water hyacinth, jussies, Canada's elodee, etc., have become invasive. Species introductions can also be involuntary: unexpected transport due to river and sea trade or the construction of canals connecting two previously independent seas, untimely release at the same time as ballast water, the seed trade, etc. For example, crepuscles were accidentally transported to the coast of the English Channel during the oyster trade.

Photo 01:Water hyacinth, invasive alien species.

Photo 02: Cactus moss (Campylopus introflexus), a species of moss in the Dicranaceae family, native to the southern hemisphere and becoming invasive in Europe and North America.

2-Potential impacts of species introductions:

Invasive alien species are likely to impact the biodiversity of an environment. They can cause the disappearance of native species in several ways: hybridization, predation, disease transmission, etc.

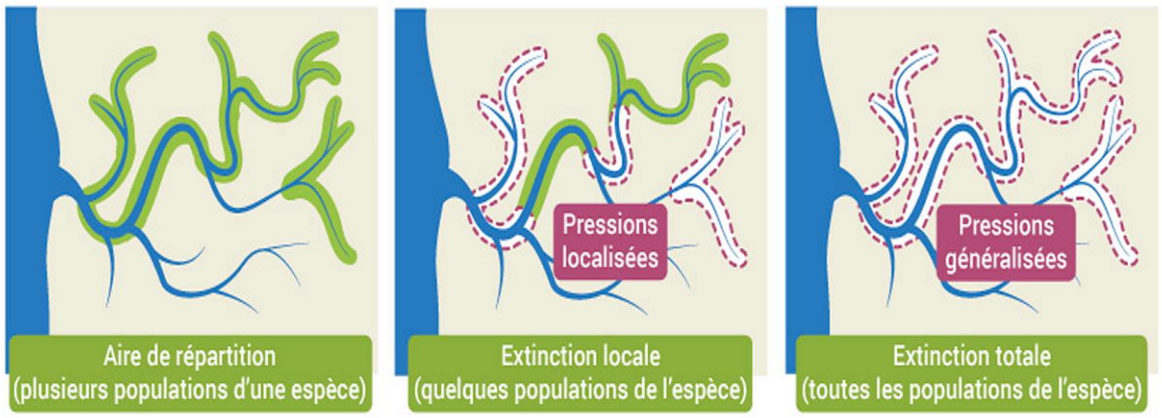

Figure 07: Deflate type of extinction.

3-Environmental effects:

Affecting islands and continents, biological invasions would represent the second cause of biodiversity alteration, after habitat degradation and reduction. Caused by microorganisms, animals, or plants, they are largely facilitated by human interventions. Their effects cascade to indigenous species, food chains and ecosystems. Human activities are not spared.

- The seriousness of the problem is recognized, but the response, in terms of will, means and results, is not yet up to the stakes.

✓ **Main causes:** the cause of voluntary and involuntary introductions of alien species, in three ways:

- direct introduction of non-native species (e.g., cultivated, hunted, reared, companion animals, including, ornamental or silvicultural tree),
- anthropogenic alteration of habitats (e.g., canal development linking two watersheds or two seas ,)
- changes in ecosystem and food web structure:

especially in the old world where intensive agriculture has early contributed to a trivialization of landscapes and food webs, while at the same time, the hunting and hunting of large predators (have in Australia for 10,000 years) made the great predators disappear. The introduction of dogs, rats, cats, sheep or cattle and goats into many islands has been a frequent cause of rapid decline in biodiversity.

Any introduced species will not become invasive. , in the mid-1990s, it was estimated that only about 10% of introduced species outside their environment survive, and that only 10% of these species will overflow or generate "major disturbances." However, this empirical rate

may underestimate reality, warned Wilson in 1993, because some species require a significant time before constituting sufficiently significant populations to develop all their ecological impacts.

Moreover, this cause and its impacts may not be immediately perceived or confused with other causes. Sometimes the brutal effects of a biological invasion seem to be able to weaken over time, after a first shock, which in this case may not even have been spotted by man.

5- Introduction of exotic animals:

It has been found that the voluntary or involuntary introduction of certain foreign animal species into an area has adverse effects on local wildlife. Animals that are imported sometimes arrive with diseases that are transmitted to native animals often lacking elements of resistance (antibodies) against these diseases.

One of the most famous cases is the voluntary introduction of the rabbit in Australia where 12 pairs imported in 1859 had given in 1900, a population 800000 individuals. Today this ever-growing population has become uncontrollable and a real scourge for cultures.

In the 16th century, Europeans unwittingly brought the *Rattus rattus* (rat) to Jamaica. The rat has multiplied so that it has become a problem for sugar cane plantations. To fight the rats the viper was used which, unfortunately, began to bite the workers of these plantations. As a remedy, the gray mongoose of India was introduced into this country by the planters.

- After its introduction, there was a noticeable decline in the rat pest population, but as the rat became scarce, the mongoose indiscriminately attacked many other vertebrates (lizards, poultry, turtle eggs). From these examples we can draw a lesson

that when we want to introduce an exotic animal into our region we must first study the ecological consequences that could occur.

Photo 03: The Green Gecko of Bourbon (*Phelsuma borbonica).*

6-The different steps for an exotic species to be implanted

6-1-First step in the process:

The first, most logical, is the need for the species to be transported from an area within its range to a new area outside its range (which it could not have reached by natural means because of geological or hydrographic barriers…). The transport of exotic species is often due to human activities such as international transport (planes, boats, etc.). The species must have some ability to disseminate its propagules so that they can be captured and transferred by man (in the case of involuntary introductions).

6-2-Step 2 of the process:

The second process depends on the ability of the species to adapt to new environmental conditions (different from those encountered in its range) encountered at the new site. A species without sufficient ecological plasticity will not be able to survive new environmental conditions.

6-3-Step 3 of the process:

The third process is the ability of the species to draw the resources necessary for its development, to defend itself against natural enemies or conversely to create mutualistic relations with other species.

7-Invasive alien species:

These three processes are the necessary steps for an exotic species to establish itself. However, for an alien species to become invasive (this is not always the case, usually 1 in 100), it must expand and establish new populations at new sites.

This propagation of the species depends on the ease of the latter to settle in the new environment (natural species that «survives» on the new environment or species that has adapted very well with ease), the connectivity between the different patches of the landscape or depends on the dispersal mode used by the species. Moreover, an exotic species will be easier to settle in environments already disturbed and weakened (by human activities in particular) than in healthy environments.

The success of an invasive alien species (and thus the extent of the damage caused) depends on the area it has managed to occupy. The propagation factors of the species are therefore crucial to consider in the evolution of biological invasions.

8-Consequences of pollution on species exploitation on biodiversity

8-1-**Pollution problem:**

- ✓ The existence of life on our planet Earth is threatened not only by demographic explosion or overexploitation of natural resources but also by other phenomena whose industrial growth characterized by poorly controlled pollution.

- This industrial growth has enriched the environment with undesirable chemicals since the 19th century. These harmful substances are called *pollutants.*

- They are released into the atmosphere to fall back on ecosystems or they are simply dumped into water or buried in the ground by man. This release into the environment of toxic substances harmful to human health and ecosystems is *pollution.*

8-1-1-Organic pollution:

Organic pollution in the strict sense, is characterized by a marked depletion of the receiving environment in oxygen, an increase in turbidity, the frequent presence of toxic ammonia or phenolic compounds, carbon dioxide, resulting from anaerobic fermentation, next to nutrients that have not yet been altered (bleak and roach are often found at the outlet of sewers).

- They also give muddy deposits. The vase itself, not only has a very high bacteriological activity, but concentrates tens and hundreds of times anions and cations that it restores to the water that overcomes it only in ways still poorly known.

8-1-1-1- Action of organic pollution on wildlife:

The absence or scarcity of oxygen, the presence of carbon dioxide in abnormal quantities, that of toxic compounds, the turbidity of water necessarily create precarious

living conditions for living beings to which very few resist. During self-purification, environmental conditions (oxygenation, etc.) vary; first worse after a certain distance from the source of pollution than immediately afterwards, they generally improve gradually; Living beings are therefore more or less able to adapt to these new characteristics.

Because there is some linkage between the polluted environment and aquatic organisms, consideration was given to using them as indicators

- **The protozoa**

Protozoa play an essential role in the destruction of organic matter. In highly polluted areas, a few Flagellates such as ***Bodo sp.***; then, as conditions improve, bacteria-eating protozoa: ***Colpidium colpoda, Glaucoma*** *and* ***Paramecium,Carchesium, Vorticella***; finally algae eaters: ***Chilodonella, Spirostomum, Stentor, Coleps, Didinium, Lionotus,***

Protozoa can hardly be used in practice as indicators of pollution:

- Cash lists are not enough; they must be accompanied by the enumeration of the individuals, some of these species being able to be found in reduced quantities in unpolluted waters it is difficult to have a valid sampling of the microscopic animals of a river, given the great diversity of micro habitats offered by the environment;
- exact determinations are often difficult but necessary and require the presence of specialists; certain genera, at least (*Amoeba, Paramaecium, Trachelomonas,* e t c .). have, in fact, large variations in sensitivity according to the species. This is why protozoa are rarely used in practice as indicators.

- **Macroinvertebrates.**

The same is not true for microscopic metazoans that are generally easier to identify. Many studies have been done in Central Europe, Britain and the United States on their indicator value.

The first effect of organic pollution on macro invertebrates is to reduce the diversity index of the community concerned, that is, the ratio of the number of species to the number of individuals.

Energy production from fossil and nuclear fuels, the chemical and biotechnology industry and agricultural activities are the basis of this pollution. The effects of pollution are somatic (skin, respiratory, hepatic or nervous lesions) or germinal (sterilization, teratogenicity, mutation). Pollution products are toxic. This toxicity may be acute subacute or long-term.

Associations, more than so-called «characteristics» species taken in isolation, give valid indications of the degree of pollution. The presence of one of these species, without indication of the number of individuals at the unit of surface, is by no means significant. The species of the polluted zone can be found in microhabitats of the clean zone, but they are found in small numbers.

Similarly, pollution-sensitive organisms are likely to live in winter and spring when the water is high, the temperature low and the degree of oxygenation high in relatively polluted water, but their presence is only momentary: they are never in large quantities and reproduce quite badly.

A number of local ecological factors can change the environment and therefore the indicative value of a species and even that of an association: erosion, variations in flow, nature of the soil, location of tributaries, predation, etc.

This must be considered in order to properly diagnose pollution with biological indicators.

Since the degree of sensitivity to pollution often varies **with species of the same genus, it is important to make rigorous determinations,** which is not always easy and generally requires the presence of many specialists.

- The conclusions of some earlier works are flawed, due to faulty sampling and sampling methods. These studies must be put back in the works.
- Thus, to cite just one example, to count the organisms living in the vase, such as **Tubifex,** the harvesting devices must penetrate at least 11 cm . The work to be carried out in the laboratory and in the field to specify the real sensitivity to organic pollution of many organisms, **requires teams of specialized researchers,** which makes their realization difficult. Thus the study of, was made in collaboration with the sections of bacteriology, chemistry-physics, biology of the Robert Taft Sanitary Engineering Center, the large Cincinnati Centre for Pollution Studies and the assistance of 11 specialists in species identification.
- However, **from a** practical point of view, it is possible to use aquatic fauna in the diagnosis of organic pollution by using one or other of the indicated methods of real interest which, when used, must be improved.

Photo 04: The red tubifex tubifex tubifex belongs is a vase worm , included in a class of all kinds of burrowing worms, including earthworms. Vase worms are very popular with most freshwater fish.

9- Major pollution sites:

The pollution problem affects virtually all ecosystems but to varying degrees. Regions that appear less concerned, such as Africa, are also affected. Winds, marine currents, rivers, rainwater, and oceans are the basis for the dispersion of pollutants around the world.

Pesticides used in Morocco to kill locusts or migratory locusts have been detected further on the Pacific islands by spreading through the ocean waters. There are many examples of this.

the sites most affected are the atmosphere, inland waters (fluvial, lacustrine), marine waters and the continental domain.

The main pollution sites that we have symbolized by the letters A, B, C, D, E, are represented in Table VI.

9-1-Types of Pollutants:

Depending on their nature:

- **Physical polluants : ionizing radiation, noise....**
- **Chemical polluants :** hydrocarbons, plastics, pesticides, nitrogen derivatives, cement dust, organomercuriels, dioxin, detergents, chemical waste
- **Biological pollutants: dead organic matter scattered in nature, microorganisms, biological waste...**
- **-Radioactive pollutants:** radioisotopes, radioactive radiation...
- **Aesthetic or visual pollutants: poor urbanization for** example
- Among these factors those that pollute nature more and present a danger are chemical, nuclear, or radioactive pollutants.

Organic pollution in the strict sense, is characterized by a marked depletion of the receiving environment in oxygen, an increase in turbidity, the frequent presence of toxic ammonia or phenolic compounds, carbon dioxide, resulting from anaerobic fermentation, next to nutrients that have not yet been altered (bleak and roach are often found at the outlet of sewers). They also give muddy deposits. The vase itself, not only has a very high bacteriological activity, but concentrates tens and hundreds of times anions and cations that it restores to the water that overcomes it only in ways still poorly known.

9-2-Air Pollution:

Air pollution is caused mainly by chemicals. The atmosphere, and particularly: the troposphere (0-10 km) and the stratosphere (10-50 km) play a major role in the dispersion of pollutants and their distribution in the various biotopes. The troposphere alone contains 80% chemical pollutants. The circulation of these substances is very fast because of the vertical and horizontal movements of the air masses (winds). Much of the atmospheric pollutants are brought back to the soil and hydrosphere by precipitation. Some pollutants, once on the Earth's surface, infiltrate, contaminate the groundwater and end up in rivers. Others go into the hydrosphere without going through the ground. Large amounts of air pollutants are also absorbed by living things directly or through food chains.

Air pollutants come from the use of fossil fuels from industry which releases huge amounts of dust and by-products into the atmosphere, fermentations of organic wastes releasing gases rich in hydrogen sulphide and other sulfur derivatives. These pollutants also come from power plants and nuclear weapons that release radioactive gaseous nuclei into the atmosphere. Air pollution is especially intense in urban areas where vehicles, homes and factories are concentrated. The principal air pollutants are gases and solid and liquid particles.

- ***Carbon dioxide (CO2***): We are talking about the greenhouse effect *that is characterized by the increase in global temperature.*

The Earth's temperature by increasing under the action of excess CO2 in the atmosphere will be able to melt, if we are not careful, the polar ice cap, the ice pack of the Arctic Ocean, the eternal snow lying on the high peaks of the mountains.

If all these solid waters were to liquefy, ocean levels would rise to about 80 m. Many cities and especially those of Holland (Netherlands) would be underwater. Other air pollutants such

as dust, nitrous oxides and chloro-fluoro-methanes or chlorofluorocarbons also contribute to global warming. The United Nations Framework Convention on Climate Change was signed in 1992 at the Earth Summit in Rio de Janeiro. It entered into force on 21 March 1994.

In 1997, the parties to this convention adopted a protocol in Kyoto to reduce their production of greenhouse gases responsible for global warming. The Kyoto Protocol entered into force and was ratified on 16 February 2005 by 156 countries less the United States and Australia

- **Carbon monoxide:**

This gas, produced during incomplete combustion in engines, is a highly toxic reducer. It has asphyxiating properties and easily replaces oxygen by attaching to hemoglobin. Once carried by the blood it accumulates in the organs and the brain which is the motor organ of the animals. An engine burning 1000 l of gasoline releases 290 kg of carbon monoxide into the atmosphere.

In addition to carbon monoxide from the engine, another amount comes from bush fires, electric discharges into the atmosphere, charcoal preparation, incomplete combustion...

- ✓ **sulphur derivatives:**

These are mainly sulphur dioxide and hydrogen sulphide. Sulphur dioxide is normally found in trace amounts in the air. It comes mainly from volcanoes. Its concentration can increase because of the metallurgical industries which, when roasting produce large quantities of SO2.

Approximately 180 million tonnes of SO2 are released into the atmosphere annually. This gas, when dissolved in atmospheric water, falls back to earth as acid rain consisting of H2SO4 or H2SO3. These rains, with pH up to 4, cause chlorosis and leaf necrosis. They are also corrosive to buildings and make the soil acidic.

Sulphur dioxide from plants sometimes forms a kind of smoke (acid smog) over agglomerations in industrialized countries. They cause lung diseases such as chronic bronchitis. Hydrogen sulphide also comes from volcanism and anaerobic fermentation. It is very toxic but it quickly turns into sulfur dioxide.

- ***Nitrogen oxides:***

These are NO2, N2O5, NO. These substances are naturally produced by anaerobic microbes, volcanism and electrical discharges at the level of the atmosphere. To the amount produced naturally are added oxides released by the engines of supersonic aircraft. Like chlorinated compounds (Trichlorofluoromethane or CFC11, Dichlorofluoromethane or CFC12), nitrogen oxides would be the basis of the destruction of the ozone layer that protects living beings from ultraviolet rays from the sun and acid rain. The hole observed in the ozone layer above the Antarctic could be caused by the abundance of these oxides in the atmosphere!

It was in 1985 that the alert was given with the discovery of a significant decrease in the concentration of Ozone during the months of September and October over the Antarctic continent. This is a reduction of nearly 50% of the total Ozone content, occurring during the southern spring and extending over the entire surface of Antarctica. It is this relative decrease in the thickness of the stratospheric Ozone layer compared to its standard or initial thickness of 300 Dobson or 3 mm that is called «ozone hole». Since the late 1970s, Ozone has increased in some places from 3 mm to 2 and even 1.5 mm today, on average for the month of October. In 2000, 2001 and 2003, the ozone hole reached an area never seen before 2000, while the one in 2002 was the smallest that has been observed since 1998. Why these changes in dimensions?

- ***liquid and solid particles:***

Dust from heavy metals and cement plants is the liquid particles (aerosols) dispersed in the air also pollute the atmosphere. They are projected there to fall back into ecosystems by dirtying them and causing various diseases to man. They clog the leaf stomata and consequently decrease photosynthetic activity.

9-3-Land Pollution:

Soils can be polluted by uncontrolled use of pesticides, fertilizers, microorganisms, and solid waste. Many pesticides (insecticides, herbicides, fungicides, raticides, acaricides....) are very toxic and capable of producing serious diseases in humans and animals. These substances can be ingested directly or indirectly by humans. Indeed, some plants accumulate these substances. Animals or humans absorb them by consuming contaminated plants. The action of pesticides can be immediate after direct ingestion of a recently sprayed plant or in the long term, via food chains. Some herbicides such as 2,4, D and 2,5,D, Picloran and cacodylate used respectively on Dicotyledons and Monocotyledons and causing defoliation of plants, are major soil pollutants. They were also used as weapons in Vietnam by the Americans.

Some insecticides such as organochlorines, organophosphates and carbamates accumulate in the soil with very slow decomposition. They are hardly biodegradable. An example is the case of the few organochlorines that persist in the soil.

D.D.T (Dichloro-Diphenyl Trichloroethane) disrupts the metabolism of Ca. Birds that absorb plants or grains in which there is DDT lay very fragile eggs.

Fertilizers are also among the soil pollutants because of the large amounts of impurities they contain. In addition to the three important elements in chemical fertilizers N, P, K there are

many other additional elements that are toxic (As, Cd, Cr, Co, Pb, Ni, Se, V, Zn....). Some plants accumulate nitrates which lead to the synthesis of nitrosamines which are carcinogenic. Soil can be polluted by cadavers and animal droppings as well as by microorganisms (biological soil pollution).

In addition to these different soil pollution, we can also add pollution due to non-biodegradable waste that not only clogs the soil, but also makes it unusable. This is the case of pollution due to broken bottles or plastic packaging. Radioactive waste from nuclear industries also makes soil radioactive.

9-4-Water Pollution :

Most air and land pollutants are drawn into the aquatic environments they pollute. The droppings make the waters dirty and smelly. The bodies released into the water produce smelly and toxic substances such as putrescine, cadaverine, scatol, H_2S.

Nitrogen and phosphate fertilizers used on land are driven by rainwater. When they arrive in aquatic environments, they cause a high production of phytoplankton, which in death causes deoxygenation of the water. Among the pollutants of the aquatic environment, detergents and oil should not be forgotten. Freshwater pollution is not only chemical, but also biological and physical (radioactive, thermal). The ocean is the arrival point of all pollutants.

There are heavy metals, pesticides, detergents, petroleum products, organic matter, various germs, radioelements.... and especially that man considers this environment as a garbage can. We must also report catastrophic pollution due to accidents such as the Torrey-Canyon disaster during which 118,000 tons of oil spilled over several thousand km2 of sea.

9-5-Note on radioactive pollution

The nuclear industry produces several thousand tons of radioactive waste and radioisotopes per year. This waste is taken up in the food chains to accumulate in certain organisms or organs up to doses dangerous to the living being itself-even or for the consumer. On parle alors de *bio-accumulation* radioactive. Studies show that in rats chronically contaminated with depleted uranium (1 mg per day), radionuclides accumulate in most organs (kidneys, skeleton, small intestine, brain, muscle, liver...) according to a complex process. Moreover, enriched uranium seems to modify certain functions of the nervous system in rats after chronic contamination (1 mg per animal per day): disturbance of the sleep-wake cycle, reduction of spatial memory abilities, increased anxiety behaviours. Chronic administration of depleted uranium affects cytochromes P450. This family of enzymes plays a major role in the elimination process of xenobiotics (substances foreign to the body such as drugs, pollutants or pesticides).

Radioactive pollutants are the products of nuclear fission of 137Cs, 90Sr, 131I... emitted during bomb explosions and neutrons from certain nuclear reactions. Radioactive iodine, for example, is produced in very large quantities by bombs and reactors. It adheres to plants and is concentrated in the tyroid glands of animals. In general, it is through plants that radioelements enter the food chains. From there, they move to the various levels of consumers where they concentrate.

One of the major environmental problems is the disposal of waste from the nuclear industry. Dumping them in the sea or burying them, is not solutions because they continue to emit toxic

radiation to living beings. The nuclear industry, thermonuclear power plants, also cause thermal pollution in their environment.

The problem becomes even more serious when thermonuclear power plants explode. This is the case of the CHERNOBYL disaster. This is a particularly serious nuclear accident that occurred on 26 April 1986 at the Lenin nuclear power plant 15 km from Chernobyl and 110 km from Kiev in Ukraine. This accident caused more than 100,000 deaths, more than 200,000 disabled with millions of cases of fatal and non-fatal cancers. Its effects are still observed

10-Other pollutants:

- ***NAP (peroxyacetylnitrate):***

The NAP is formed from hydrocarbons found in automobile engines. This substance causes premature leaf fall in plants, but also irritates the eyes of man.

- ***Dioxin and furans:***
- Dioxin and furans are pollutants that are also found in large quantities in industrialized countries following the excessive use of fossil fuels and waste incineration.
- ***The exhaust gas:***
- It contains not only many gases from combustion but also lead.
- ***Mercury:***

This is a very toxic pollutant. It is found in the form of organomercuriels, mercury oxides or mercureux and mercuric ions used in the manufacture of brightening antiseptic

soaps. A case of secondary poisoning by this metal was observed in Minamata (e.g. mercury pollution of Minamata Bay).

To deal with the pollution problem, we need to look at a new economic order. Economic production is not enough. We must also consider the ecological consequences that can occur because man risks destroying himself without knowing it while wanting to produce more. It must choose low-polluting energy sources such as hydroelectricity, geothermal, biomass, solar and wind energy (new energies).

It must also use less polluting fuels than oil. It must comply with regulations and texts aimed at reducing greenhouse gas production and destroying the ozone layer (Kyoto Protocol, Montreal Convention). The condition of vehicles will also have to be regulated. Cultural practices that use chemical fertilizers and pesticides must be replaced by ecological agriculture using green and organic fertilizers or agro-forestry species (Agroforestry) to enrich the soil. Techniques such as composting and biological pest control should be encouraged.

In the development of cities, man will have to create special protection zones to purify the air and serve as a place of emergency relief in the event of disasters. As regards waste, recycling techniques must be put in place to avoid congestion and contamination by radioactive waste.

To protect biodiversity, it is necessary to create nature reserves in all environments and restore forests, even artificial, in places already deforested and respect national and international texts relating to conservation, hunting and wildlife trade (hunting permits, CITES or Washington Convention, Algiers Convention...)

- **Microbiological pollution**

  - ✓ Microbiological pollution results from the presence in the water of microorganisms that are carried by water and are responsible for many waterborne diseases (Figure 5).
  - ✓ Water can be a favorable environment for the development of bacteria and viruses harmful to human health of the populations that use it for their needs.
  - ✓ Pathogenic bacteria (*Vibrionacea*, *Enterobacteriaceea*, etc.) are responsible for the main waterborne diseases.
  - ✓ Parasites are also the cause of several other diseases (infectious hepatitis, meningitis, etc.).

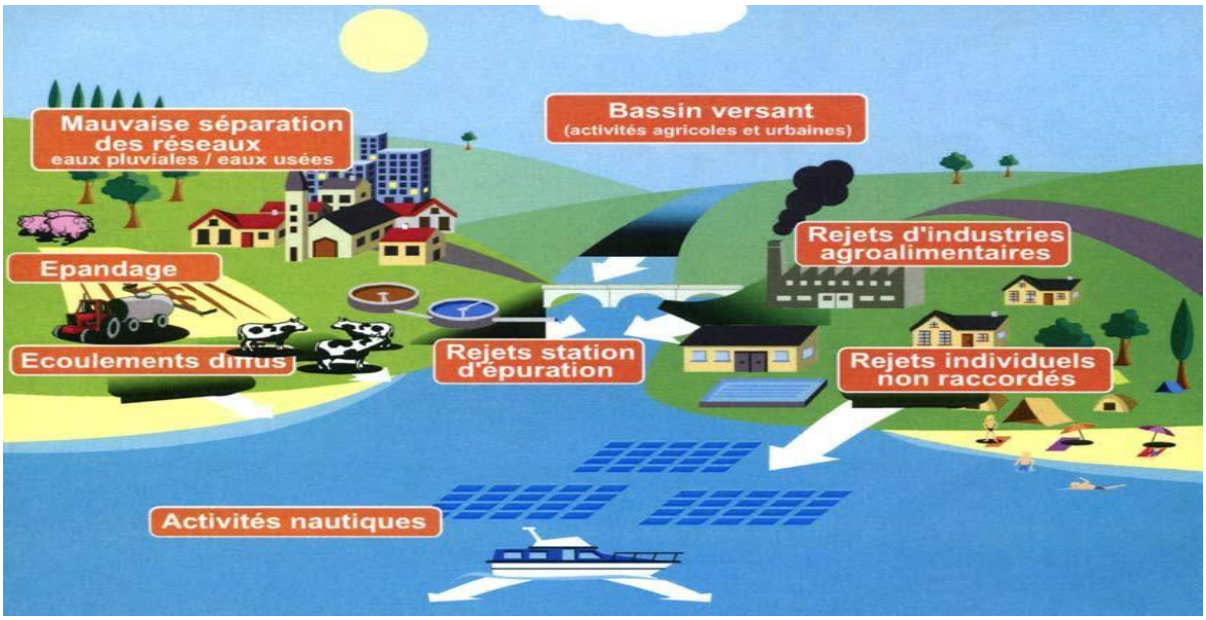

Figure 8: Sources of contamination and transfer to shoreline.

Table 01: Main types of pollution of inland waters, nature of pollutants and their origins.

Type of pollution	**Nature**	**Source or causative agent**
Physical: Thermal pollution	Hot water discharge	Thermal power plants
Radioactive pollution	Radioisotopes	Nuclear facilities
Mechanical pollution	Suspended solids	Industrial waste water
Chemical: Fertilizers	Nitrates, phosphates	Agriculture, laundry
Metals and metalloids	Mercury, cadmium, lead Aluminum, arsenic	Industries, agriculture, acid rain, combustion
Pesticides	Insecticides, herbicides, fungicides	Agriculture, industries
Organochlorines	PCBs, solvents	Industries
Organic compounds of synthesis	Many molecules	Industries

Detergents	Surfactants	Domestic effluents
Hydrocarbons	Petroleum and derivatives	Oil industry, transport
Biological: Fermentable materials	Carbohydrates, fats, proteins	Domestic, agricultural and food effluents
	Ammonia, nitrates	Livestock and fish farms
Microbiological pollution	Bacteria, viruses, fungi	Municipal and livestock effluents
Invasive species	Plant species, animal species, GMOs	Botanical gardens, research laboratories

11-Biocenotic affects:

In general, chemical control (herbicides, various pesticides) results in the depletion of biocenoses, in other words, the reduction of the biodiversity of the ecosystems in which it is *practiced.*

11-1-Extirpation or decrease of food species:

Herbicides kill weeds, the entomofauna that depends on them and that can serve as food for insectivorous birds. There is also the loss of vegetation cover, which serves as a

refuge for some birds and mammals during the bad season. In the state of Montana, carbaryl used against locusts had reduced the avine stand to 17% of its original density.

11-2-Disappearance of competing species:

Herbicides by removing, for example, dicotyledons from a region cause the proliferation of various grasses. In England, under the action of herbicides some more sensitive species such as *Dactylis glomerata* have been replaced directly by other grasses such as *Fertuca sp. , Poa sp.*

11-3-Disappearance of predators or natural enemies:

Insecticides have particularly serious effects on insect predators and parasites. When the pest is destroyed, even 90%, while the predator or the endoparasite of the pest has been eliminated from the environment, the populations of this pest recover very quickly. It is difficult to control a pest in the absence of its natural enemies. In other cases, the application of insecticides promotes the proliferation of secondary pests, less sensitive than the target species but also fewer in number than it initially.

12- Impact of pesticide use on other elements of biocoenosis:

During the use of pesticides, other elements of the biocenosis undergo poisoning sometimes fatal directly or indirectly.

Wild bees are particularly affected. This results in reduced honey production and plant pollination. In Brazil there is already a strain of wild bees resistant to D.D.T. and whose honey contains high concentrations of this product.

Poisoning of bees, pollinators, has significant consequences in plant reproduction.

Birds and especially raptors are affected by the consumption of poisoned prey (secondary poisoning). Another problem with pesticides is the emergence of resistance. According to the O.M.S., insecticide resistance occurs when an insect population develops the ability to survive a dose of toxic that was lethal to most individuals.

Suppose that the larvae of a species, especially insects such as the mosquito anopheles, vector of malaria, are treated on a large scale in D.D.T, the probability is high that there are some larvae that acquire in their genes the information necessary for the degradation of D.D.T. in the body. They thus escape the deadly action of this product.

By reproducing, surviving larvae spread information and rapidly reproduce populations of D.D.T. resistant anopheles within a few years.

13-Action on the environment:

13-1-Air Contamination:

When a pesticide is applied, only a tiny amount reaches the target organisms. More than half of the product passes directly into the atmosphere.Air pollution by pesticides in urban areas of Colombia would be related to the intensive use of these products in neighboring agricultural areas.

13-2-Soil and Groundwater Contamination:

- Nearly 500000 tonnes of pesticide active ingredients are applied annually in the Third World country.

Most of these toxics pass through soil and surface water. Percolation and infiltration water diffuses pesticides into the soil. Man believed for a long time that groundwater was

protected from pesticides by rocks and soil horizons. Curiously, this is not the case. In El Salvador, relatively high concentrations of pesticides have been found in groundwater.

Figure 09: Soil and groundwater contamination.

CHAPTER 05:

Sustainable development

1-**Definitions:**

There are many definitions of sustainable development, the most famous of which is perhaps the Brundtland report. Sustainable development is development that meets the needs of present generations without compromising the ability of future generations to meet their own. Two concepts are inherent to this notion: (i) the concept of "needs", and more particularly the essential needs of the most deprived, to whom the highest priority should be given, (ii) the idea of the limitations that the state of our techniques and social organization imposes on the ability of the environment to meet current and future needs.

Desertification processes in most arid areas of the world are leading to degradation of steppe soils and vegetation, jeopardizing the food security of 900 million people. However, the degradation of natural ecosystems by livestock is controversial: some studies have shown that grazing and, more broadly, herd feeding practices can have a positive role in maintaining ecological balances.

Livestock farming, as a user of these ecosystems, especially to feed the herds, is often designated as responsible for deforestation and desertification.

2-Sustainable Rural Development Strategy:

To fully understand the concept of sustainable development, we must first define the notion of resource.

2-1-Resource Identification:

5Resource and Skills Theory highlights the importance of identifying and using resources effectively to build a strong competitive advantage. Considers resources as “tangible and intangible assets that are semi-permanently attached to a business”. Then proposes the

following definition: “all assets, capabilities, organizational processes, attributes of the firm, information, knowledge, etc., controlled by a firm, which enable it to design and implement strategies likely to increase its effectiveness and efficiency.” This definition links to the concepts of effectiveness and efficiency. However, it has the defect of being general, therefore subject to criticism, not very useful and operationable. More recently, consider only the concept of resource “refers to an asset or raw material (tangible or intangible) that an organization owns, controls, or has access to almost permanently.”

Figure 10: Development indicator.

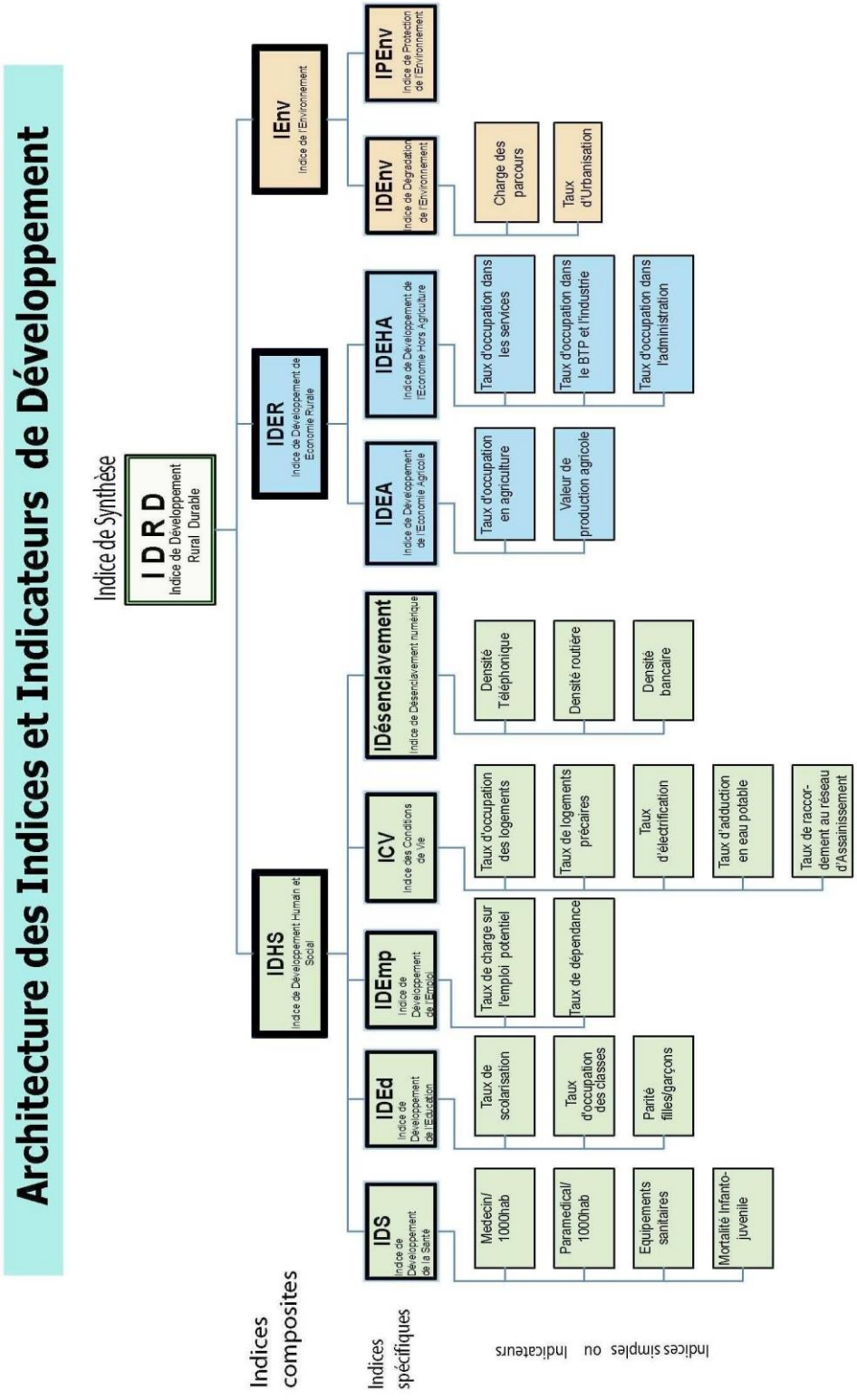

Table 2: Global and national agricultural and rural policy developments

Years	World/Europe	ALGERIA
1960/ 1970	1962: Entry into force of the common agricultural policy (CAP)	1962 : · Self-management · Agrarian revolution
1980/ 1990	Introduction of production quotas (example: Milk) and emergence within the framework of agricultural and regional policies of the concept of multifunctionality of agriculture and rural development	· Restructuring of agricultural holdings, · Liberalization of agricultural markets, · Privatisation of farm management, · Restitution of nationalised land
1992	· Rio de Janeiro Summit - Emergence of the notion of sustainable development that attaches particular importance to the balanced development of natural resources of the territories and consequently to rural development · Reforms of the Common Agricultural Policy of the EU in principle basic the gradual shift from price support (guaranteed price system) to direct aid to farmers	National consultation on agriculture, recommendations on the tasks of agriculture, perspectives and the need to promote new framework instruments. · continued reorganization of the cooperative system

1994	WTO: Marrakech Agreements - Opening up agriculture to world markets	· Structural adjustment plan · Implementation of National Agriculture Consultation Recommendations Begins · Crédit mutuel agricole · Interprofession regulation systems, · chambers of agriculture, · price support review · Adaptation of agricultural production systems · Risk management · Concept of farmer · Dissolution of supply boards.
1995	· Barcelona Declaration	· Barcelona Declaration · Agricultural Land Conference · Major Works Program
1996/ 1999	· World Food Summit: Fighting hunger and household food security · CORK Declaration (EU): Rural preference, Integrated, multidisciplinary and multi-sectoral approach, diversification of economic and social activities in rural areas,	· National Conference on Agriculture, · Major Works Program · Development of land by concession, · National Reforestation Program · Agricultural sector policy, · Recognition of the farmer, · Rural Employment Program …

	Sustainability	
1999/ 2001	Berlin: New reform of the EU Common Agricultural Policy · emergence of rural development regulations (RDR)	· Preparation and launch in 2000 of the National Agricultural Development Plan (PNDA): New procedures to support agricultural activities and attempt to ensure consistency between sub-programmes (forests; land development; NEPAD/ The impetus for a new type of SOUTH-SOUTH and SOUTH-NORTH partnership promoting sustainable development, sustainable good governance of the territories
2002	· Johannesburg World Summit: Sustainable Development · World Food Summit 5 years later (fight against world hunger)	· Extension of the PNDA to the rural dimension: PNDAR · Signing of the Association Agreement with the EU
2003	· WTO: Doha - Special measures for agricultural and rural development in developing countries New EU common agricultural policy (entry into force 2006/2013):	Elaboration of the National Sustainable Rural Development Strategy (SNDRD) and commitment of a pilot phase of implementation (2002/2004)

	1st pillar: agricultural production and market organisation 2nd pillar: rural development - environment	
2005	Enterprise agriculture (EU): main focus of agricultural policies, announcement of the end of agricultural export subsidies (Hong Kong/ WTO) and commitment of separate policies of Sustainable Rural Development	• Adaptation of support systems for agricultural activities • Attempt to link agricultural and non-agricultural activities Launch of the implementation of the National Strategy Sustainable Rural Development 2005
		• Formalization of the Rural Renewal Policy and consolidation of the implementation of the National Strategy Sustainable Rural Development (2005-2015)

The concept of sustainable development as the main focus and guiding principle in all stages of scientific reasoning. To fully understand the concept of sustainable development, we must first define the notion of resource:

2-3-Defining a resource:

A resource is an element that is useful for human societies. This usefulness and the importance given to a resource stem from social needs. It is considered that needs increase with population growth and economic development, but over time,

The quantity of available resources is constantly reassessed according to the scarcity, changes in use and the possibilities of recycling elements considered as resources

2-4-The concept of sustainable development:

Emergence of the concept of sustainable development. This concept originated in the concerns of 18th-century thinkers, such as Althus1, who raised the question of the relationship between population and available resources. The Club of Rome, founded in 1968 and bringing together academics, researchers, economists and industrialists from 53 countries, aimed to reflect on global planetary problems, and proposed solutions to national leaders. The limits ofgrowth, or Meadows report, was the first publication in 1972sa. The conclusions of this first international research on the planet's resources announce the concept of sustainable development. Written under the direction of Meadows and Forester (depletion of the planet's resources by the end of the 21st century).

In fact, the research team is mainly questioning the growth model, which could lead to an economic collapse. In the midst of the oil crisis and published the same year as the Stockholm conference, this report was accused of catastrophism and its conclusions are still contested today. In 1972, the United Nations Conference on the Human Environment (CNUEH) in Stockholm, whose motto was "one land", led to a declaration, a programme of action and a monitoring institution: the United Nations Environment Programme (UNEP). This conference takes place in a context where growth is accused of being «unsustainable», insofar as the

drawdowns it induces on raw materials and resources seem to go beyond the limits that the planet can bear.

The «sustainability» of development does not imply the preservation of natural resources, which would lead to their no longer being used, since most of them are not inexhaustible, but to reduce harm to the environment so that development remains environmentally sustainable in the long term. The concept was promoted as a global priority in 1992 at the Rio Summit, where participants sought to define the practical modalities for its implementation. To be sustainable, development must integrate three inseparable dimensions:

- **Economic**: it is about developing economic growth and efficiency to promote the creation of wealth for all through sustainable modes of production and consumption. The economic pillar includes:

  Rational use of resources and natural environments; An evolution of international economic relations (e.g. fair trade, ethical trade, etc.);

The integration of environmental and social costs into the price of goods and services. Ethical trade aims to promote and develop good working conditions among producers. The notion of ethics comes from the Greek and has a less pejorative connotation than the word "moral". This notion refers to a certain idea of "good".

Ethical trade involves a respectful production chain in work and production methods: respect for employees and the environment, both socio-economic and natural. And this is based on recognized international standards, such as those of the International Labour Organization, the ILO, for example.

On the other hand, fair trade mainly concerns North-South trade relations or applies to trade operations promoting the economic position of small producers and owners to avoid their marginalization in the global economy (fair remuneration for the work of producers, respect for human rights, etc.).

- **Social**: it is about satisfying human needs (in terms of health, housing, education, consumption, etc.) and meeting a goal of social equity. The social pillar is based in particular on:
- Meeting the basic needs of the population;
- The fight against exclusion and poverty
- Reducing inequalities
- Respect for the cultures.
- **Environmental**: it is about preserving, improving and enhancing the environment and natural resources in the long term. The environmental pillar is essentially based on:
- Sustainable management of natural resources
- Maintaining major ecological balances (climate, biodiversity, oceans, forests, etc.);
- Reducing risks and preventing environmental impacts.

The theoretical foundations of sustainable development Sustainable development is the expression of a realistic policy, of a overcoming of the ecological «utopias» of the years 1960-1970. This conception of development is situated at the confluence of several ideas,

some of which recall the neo-Malthusian theories issued by the Club of Rome in the years 1960-1970 – which foreshadowed a rapid depletion of the main natural resources, including energy – while others are adjusting to the current globalization of the economy. The idea of the need for sustainable development starts from the observation that the poorest countries of the planet are underdeveloped and must follow development policies adapted to their needs, these policies are seen as the only ones capable of allowing them to catch up, or at least part of it.

The development experiments carried out since the end of the Second World War having shown their limits, it is necessary to analyze them and to criticize their shortcomings, in order to invent new more effective policies, which take into account the strong constraints of demography and the environment.

To the immediate economic analysis is therefore added a prospective analysis, which aims to put in place the elements to create the conditions for the development of countries in this area in the medium and long term, This implies, first of all, not wasting immediately available resources. While the concept of sustainable development is similar in many respects to the policy advocated by most European environmental parties, it does not contradict the capitalist conception of economic and industrial development.

The «sustainability» of development even becomes a guarantee of growth, which generates new needs, thus new markets, particularly those related to environmental protection, but also to water distribution or energy savings. The World Bank, in its 1992 report (Development and the Environment), stated that “There is no difference between the objectives of development policy and appropriate environmental protection. Both must have a view to improving well-being.” This way of posing the problem, relatively new at the beginning of the 1990s,

eventually eclipsed the utopian side of political ecology, and thus pushed ecological concerns into the field of commercial and industrial realism. For example, the World Trade Organization notes that there is no "political contradiction between safeguarding an open, non-discriminatory and equitable multilateral trading system, and actions, even unilateral, to protect the environment."

In 1992, the Rio Summit brought together some 150 Heads of State and Government to outline "development that meets the needs of the present without compromising the ability of future generations to meet their own needs." Each country is committed to developing and implementing its own sustainable development strategy.

3-Biodiversity conservation (in situ and ex situ):

- **What is the conservation?**

It is the awareness of the importance of certain species or human works in the planetary environment that determines their protection for their maintenance.

3-1--Biodiversity conservation:

Conservation involves sites, habitats, communities and ecosystems. But the species will be the units used in conservation that are most easily defined.

3-1-1-the Methods:

Identifying suitable sites for one or more threatened species is an effective way to guide conservation actions. As well as species that have a very limited repair area can be a useful guide in identifying key sites for conservation. Finally, there are sites that are distinguished by their great richness and diversity in species related to the ecosystem, landscape and habitat within the framework of biological diversity.

The biodiversity conversation aims to find ways to make people live in balance with their resources.

It thus assumes the relationship between Man and nature but above all the relationship of Man with his fellow men. As nature is destroyed, the rich become richer and the poor become poorer. Who pays the price? Conservation should not be considered purely biological, but it is about finding ways to encourage human beings to behave in ways that are consistent with conservation objectives

3-1-1-1-In-situ conservation

In situ conservation is a technique for the conservation of wild fauna and flora that occurs on the ground in the natural environment. This process concerns endangered ***animal or plant species in their natural environment. Its objective is to protect the habitat of species by reducing threats to the species.***

Plant conservation should be based primarily on in situ conservation *("in-site conservation"). It allows* the protection, maintenance *and* reconstitution of populations of species *on the ground in their natural environment and, in the case of domestic and cultivated species, in the environment where they have developed. This strategy is the only one that allows a long-term success in safeguarding plant communities and maintaining their diversity*

This strategy is the only one that allows **long-term success**, especially for the protection of plant communities and the maintenance of their diversity. Its importance is underlined in international and European conventions and legislation; it is one of the foundations of sustainable development concepts.

Protecting natural environments is not always enough to guarantee the maintenance of endangered species. Many species continue to disappear even within protected areas. Moreover, the conservation of wild species in their natural environment requires more specific ***actions than a simple protection of the species and its habitat. These actions include field measurements, species monitoring, biological and ethological studies…***

Generally focused on ecosystems, in situ *conservation* is the only rational method currently available to conserve a wide variety *of ecosystems, species and genes*, now vulnerable, threatened or endangered by the implementation of *management plans and nature reserves.*

- ***Case of protected areas***

IUCN (the International Union for the Conservation of Nature) defines a protected area as "a geographically delimited portion of land, water or marine environment dedicated specifically to the protection and maintenance of biological diversity, to ensure long-term nature conservation and associated ecosystem services and cultural values. For these purposes, this geographic space must be legally designated, regulated and administered by effective, legal and other means."

A protected area has as its primary function the protection of a territory's biodiversity and ecological processes. It therefore has several benefits:

  - ***Environmental benefits:*** maintenance of biodiversity, conservation of genetic resources, protection of natural landscapes, protection of endangered species, protection of flora and fauna habitats.

– ***Social and economic benefits:*** diversification of local and regional economy,

maintenance of landscape qualities, education and public awareness.

According to UNEP (United Nations Environment Programme), the number of protected areas reached 100,000 in 2003, with an area of about 12% of the land area and 0.5% of the oceans. The *countries with the highest percentages are* Venezuela, Ecuador (Galapagos Marine Reserve) and Denmark *(Greenland National Park). Two large marine reserves are dedicated to coral reefs (Australia and Hawaii).*

Photo 05: In situ conservation.

In situ conservation is a technique for the conservation of wild fauna and flora that occurs on the ground in the natural environment. This process concerns endangered animal or plant species in their natural environment. Its objective is either to protect the species' habitat or to reduce threats to the species' habitat.

The advantage of in situ versus ex situ (outside the natural environment) maintain population restoration in the very environment in which their distinctive traits have developed and in which they may continue to evolve with their predators and parasites.

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4-Convention on Biological Diversity:

The Convention on Biological Diversity (CBD) is an international treaty adopted at the Earth Summit in Rio de Janeiro in 1992, with three main goals: (a) the conservation of biological diversity (or biodiversity), (b) the sustainable use of its elements, and (c) the fair and equitable sharing of benefits arising from the exploitation of genetic resources.

Article 8of this Convention states:

Each Contracting Party, to the extent possible and as appropriate:

- Establishes a system of protected areas or areas where special measures must be taken to conserve biological diversity;
- Develop, where necessary, guidelines for the selection, establishment and management of protected areas or areas where special measures are required to conserve biological diversity;
- Regulates or manages biological resources of importance for the conservation of biological diversity within and outside protected areas to ensure their conservation and sustainable use;

- Promotes the protection of ecosystems and natural habitats, as well as the maintenance of viable populations of species in their natural environment;
- Promotes sustainable and ecologically sound development in areas adjacent to protected areas with a view to strengthening their protection;
- Rehabilitate and restore degraded ecosystems and promote the recovery of threatened species through, among other things, the development and implementation of plans or other management strategies;
- Establishes or maintains means to regulate, manage or control the risks associated with the use and release of living and modified organisms resulting from biotechnology that may have adverse impacts on the environment that may affect the conservation and sustainable use of biological diversity, also taking into account risks to human health;
- Prevents the introduction, control or eradication of alien species that threaten ecosystems, habitats or species;
- Endeavour to establish the conditions necessary to ensure compatibility between current uses and the conservation of biological diversity and the sustainable use of its constituent elements;
- Subject to the provisions of its national legislation, respects, preserves and maintains knowledge, innovations and practices of indigenous and local communities that embody traditional ways of life relevant to the conservation and sustainable use of biological diversity and promote their wider application, with the agreement and participation of the stakeholders of such knowledge, innovations and practices and

encourages the equitable sharing of benefits arising from the use of such knowledge, innovations and practices;

- Formulates or maintains legislation and other regulations necessary to protect endangered species and populations;
- Where a material adverse effect on biological diversity has been determined in accordance with Article 7, regulate or manage the relevant processes and categories of activities;
- Cooperate in the provision of financial and other support for in situ conservation referred to in paragraphs a) to l) above, including to developing countries.

5-Ex situ conservation:

Ex situ conservation is a technique for the conservation of wild fauna and flora that occurs **outside** the natural environment. The objective is to strengthen weakened natural stations, or even reintroduction in kind if the species has disappeared.

This process of protecting a threatened plant or animal species removes part of the population from the threatened habitat and places it in a new environment, which can be a wild area or under human care. Where in situ conservation is insufficient, particularly for a species on the brink of extinction, ex situ conservation ("conservation outside the natural site") is used. It is therefore the last resort to avoid the disappearance of the species. Its use is less desirable compared to in situ conservation.

Usually focused on species, ex situ conservation involves moving a portion of a taxon from its habitat where it is threatened and placing it in a new habitat. Specimens are then taken, in the form of seeds or plants, to be preserved, cultivated, multiplied and maintained as close as

possible to their natural state.Ex situ conservation enables the conservation of endangered species, the recovery and regeneration of threatened species, the management of useful plant genetic resources and the reintroduction of species into their natural habitat.

These are the roles of botanical gardens, arboretums, seed banks and genes.

Objectives:

Ex-situ conservation is not a substitute for in-situ protection; it complements it in the most problematic cases. The objective is to strengthen weakened natural stations, or even reintroduction in kind if the species has disappeared, but not long-term cultivation (which ends up altering populations). The objective of these European breeding programmes is to establish viable populations of 250 to 500 individuals per species by preserving, over 150 years, more than 90% of the genetic diversity of the founding individuals of the population.

5-1-Ex situ conservation sites:

Various organizations are involved in the conservation of species ex situ: Zoos and animal parks specific to terrestrial animal species, Public aquariums, National botanical conservatories, botanical gardens, arboretums for plant species,

5-2-Origin:

Zoos and aquariums have long been places that housed only wildlife for public display. In 1982, under the impetus of the parks of Rotterdam, Amsterdam and Antwerp, European zoological parks set up Breeding Programs to regulate and optimize the reproduction of species kept in captivity. It was only in 1988, when the European Association of Zoos and Aquariums (EAZA) was created, that it supervised the monitoring of the Breeding Programmes and approved the creation of new ones.

The advantage of in situ conservation over ex situ conservation (outside the natural environment) maintain population restoration in the very environment in which their distinctive traits have developed and in which they may continue to evolve with their predators and parasites.

- **What measures can be taken to conserve biodiversity?**

- Support for programs that strengthen in situ protection practices undertaken by rural and tribal families.

- The general principles of species conservation begin with the application of the polluter pays principle. Many actions contribute to the achievement of the envisaged objectives among which we quote: **the prevention** of nuisances avoids a late and often ineffective fight.
- The internationalization of ecological costs calls for international solidarity in order to guarantee a common objective that lies in the preservation of our planet.
- **The National Strategy** is to bridge the gap between development and environmental preservation, which implies the programming of three objectives:

1. ensuring the renewal of resources,
2. establish pollution standards,
3. order sites to be protected.

6-The areas of action concern:

Natural resources (water, pastoral improvement, dune fixation), encouragement of scientific research and construction of gene banks: identification of species and vulnerable

areas, establishing an emergency plan for coastal and marine protection, urban sanitation and adherence to international actions such as the protection of the ozone layer.

- The policy frameworks are institutional and legal. They materialize through the activities of NGOs: awareness, education, research…

- Developing strategies for the sustainable, planned and rational use of biological resources. It would also be desirable to encourage traditional methods of exploitation. The introduction of new species into the environment should be avoided without prior study.

- **What is under threat?**

- Natural resources (water, soil, etc.).

- Living species (animals, plants and micro-organisms) including humans.

- The global environment in general.

- **What are they threatened by?**

- Desertification

- Erosion

- The degradation

- Overexploitation and mismanagement

- Uncontrolled polluting industrialisation;

- Misjudged use of various chemical compounds in agriculture.

- **What can be done for conservation?**

- National parks and reserves

- Spatial planning and land use control;

- Inventory of areas to be protected and objectives of operations

- Preventive and curative interventions

- Research development

- Ecological planning programmes and projects (impact studies);

- Establishment of data banks

- Elimination of sources of nuisance

6-1-Awareness Development and Environmental Education:

- Maintenance of assets

- Use of clean technologies;

- Reduce marine discharges without treatment

- Impact assessment of major projects;

- Proper use of fishing gear with respect for physiological periods.

6-2-Legislative protection:

- Creation of Ministries and Environmental or Coastal Protection Agency.

- Strategies for action at the level of specialised NGOs.

- Creation of regional, national or international boards, groups or committees.

- Advisory, cultural, urban or architectural councils.

- Paris Convention on the Protection of the World Cultural and Natural Heritage adopted in March 1972.

- **Did you know That … ?**

The continental shelf, in the marine environment, is an environment where 2/3 of living marine resources are concentrated, so it is to be monitored.

Knowledge of the level of exploitation of a resource in relation to the potential for regeneration is essential to promote its conservation.

Chapter 06

Management of genetic resources of wild and domesticated populations

Management of genetic resources of wild and domesticated populations

1-Definitions:

For the conservation term, we will use the definition given in the "Global Conservation Strategy" which was prepared by the International Union for the Conservation of Nature and its Resources (IUCN), in collaboration with the United Nations Educational, Scientific and Cultural Organization (UNESCO), the Food and Agriculture Organization of the United Nations (FAO), the United Nations Environment Programme (UNEP) and the World Wildlife Fund (WWF).

Conservation is the management, for human use, of the biosphere, in order to derive the maximum benefit for the present generation, while maintaining its potential, in order to satisfy the needs and aspirations of future generations. Conservation is therefore a positive concept that covers the preservation, maintenance, sustainable use, restoration and improvement of the natural environment.

Preservation itself is the part of conservation that involves isolating a sample of a population of animal genetic strains to maintain it in an environment free from human forces that may cause genetic modification.

This process can be carried *out in situ*, the specimens being then live animals, in their natural environment, or *ex situ*, the samples being preserved for example by cryogenic storage. This concept is much more static than the previous one since it speaks of isolation but it does not exclude valuation actions. Only human actions that can lead to genetic modification are rejected. The problem of evolution according to environmental constraints is not addressed.

At an intermediate stage, conservation by management consists of submitting a sample, or the whole animal population, to a controlled genetic modification for the purpose of maintenance, use, restore or improve animal genetic resources for a specific production. Indeed, the most effective way to conserve genetic resources is to help farmers develop and use their breeds.

1-1-Criteria for improvement:

Are most often quantitative, in the case of Africa where animal productivity remains low. The quality criteria in force in developed countries (composition of milk, shape and state of fattening of carcasses) are of no interest at the moment since no commercial circuit is able to valorize them. On the other hand, certain criteria must be maintained during genetic improvement, otherwise the product will lose all outlets. So it is with the colour of the sheep of Tabaski, chickens for sacrifice. The size of the animals is also important in meat production because it determines the type of culinary preparation.

It is in this context of the Programme for the Conservation and Management of Animal Genetic Resources worldwide that FAO has undertaken to identify and describe the different breeds of recognized domestic animals and to identify the main problems related to the conservation of biodiversity.

Given the significant differences that may exist between environments, climatic conditions, livestock systems, production systems or socio-cultural conditions, the expected objectives were to seek a better possible match between the development of the animal and its maintenance in the ecosystem it values.

To make the whole picture understandable, it was essential to standardize the way in which information on the different races was collected. In this spirit, the Global Information System for Domestic Animal Diversity (GIS-DAD) was created, the visible part of which, in addition to the questionnaires, is represented by the *World Watch List*. This essential document must be permanently updated through a database in direct connection with changes in the environment or knowledge.

In cattle, the extreme fragmentation of breeds gives a concrete example of the interest of a permanent search for a correspondence between the position of man (geographical, social, economic, religious) and his choice for a breed that he transforms and improves.

For sheep, remarkably similar remarks can be made. In Mauritania and Mali, a distinction is made between Moorish sheep with long hair and Moorish sheep with short hair. This corresponds to a particular use of these sheep by breeders (making ropes, tents and blankets). There was selection of a type for hair production,

In goats, the situation is similar to that of sheep. A generic term characterizes the Sahel goat. It takes the name of Moorish goat and Tuareg goat in Mali, Sahel goat voltaica in Burkina Faso and Arab goat in Chad. In this country, it is interesting to note the influence of current research on the characterization of goat breeds that tend to show the great uniformity of breeds in this species

1-2-Farmer models:

Can provide animal products at relatively low prices, since the share of pastures and by-products remains significant in animal feeding, the opportunity cost of labor is low, and many products value livestock. The same is not true of the industrial models, which must remunerate all fodder at market prices, as well as the wage labour, and which value only one

of the livestock products. However, if the urban demand is strong and therefore the prices of products sufficiently high in relation to inputs, then these models, which can be located near cities, can become competitive with the peasant models, especially if their selling prices are constrained by delivery costs. It therefore seems that there will be some room in the future for milk, meat and egg production in industrial workshops on the outskirts of cities. They can be supplied with fodder by domestic peasant production (as non-perishable products, the organization of marketing channels is easier), by the residues of local agricultural industries (ginning of cotton, breweries, mills, etc.) or by imported food. They will develop all the more as the demand (therefore the prices) of animal products will be high, and the price of food will be low

1-3-The choice of genetic material:

The choice of genetic material to be used in these workshops poses serious problems. The material used in developed countries for this breeding model results from several decades of selection. The animals are not adapted to the environmental conditions (climate, pathology, diet), nor to the types of products demanded by African markets. It is therefore important to prepare this development through actions aimed at finding high-performance genetic material from local populations, through selection or crossbreeding. The genetic material defined and developed can possibly be transformed elsewhere. It will then be necessary for a group of breeders to organize themselves to manage the creation, distribution, and exploitation of tested or selected materials.

1-4-Genetic banks (genes and pollen):

Plant species that do not easily produce seeds, or whose seeds do not support freezing, are usually stored in gene banks. The overall objective of these banks is to

preserve phylogenetic material over the long term and make it accessible to research scientists.

DNA conservation is practiced by the approximately 1,750 gene banks existing on all continents (in Africa their number is relatively lower). These banks store nearly 6 million species and varieties of economic, commercial or aesthetic interest. They are essentially useful plants in nurseries (living collections). This includes a wide range of wheat, maize and rice varieties. These genetic resources are
Commonly used for crop improvement, thus contributing to global food and nutrition security. This type of storage can be considered not as a real method of conservation of genetic resources but more as a tool for the study of the genome.

There are three types of collections in the gene banks: *core collection* (long-term germplasm maintained at temperatures below 0 and low humidity), *active collection* (germplasm preserved in the medium term, used for regeneration, multiplication and distribution) and *collection of work* (germplasm whose conservation is not a priority, from an active collection, used by researchers).

The *International Agricultural Research Centres* (CIRA) are the largest gene bank for agriculture, with more than 600,000 samples collected worldwide, accounting for 40% of the germplasm stored worldwide. These collections mainly concern particular cultivated species (so-called species cultivated on mandate) but they also preserve other plants: *wheat, maize, barley, banana, soya, potato, sorghum, cassava,* different *edible legumes, fodder, agro-species silviculture*, etc.

Pollen grains are a real identity card of the plant. They contain half the genetic

heritage of a flowering plant. Thus, no plant is alike.

Pollen banks are created mainly for the conservation and improvement of woody forest and fruit plants. Their objectives are to: preserve genetic material, cross-breed, facilitate artificial pollination, improve fruit or seed production; that of truly participating in biodiversity conservation.

The conservation of plants in the form of pollen has many advantages. Indeed, thanks to the storage in bulbs under a small volume in the laboratory, access to the material and its handling are easy and fast, exchanges and transport are easy. In addition, the process appears to be inexpensive. New methods of pollen preservation include: *refrigeration (pollen powder is stored in glass jars),* freezing (in liquid nitrogen at -196°C), *desiccation (in a desiccant placed in a cold room containing anhydrous calcium chloride) and* freeze-drying (by removing water and obtaining a dry sample). The South-East Asia pollen bank of the CEPAM laboratory «*Centre d'Etude Préhistoire, Antiquité, Moyen-Âge*» already includes more than 2,000 species, mainly concerning the southern flora of Vietnam. This collection is intended for palynologists working in Southeast Asia or in neighboring tropical countries, is a scientific tool that applies to many disciplines such as palaeobotany (characterization of extinct species), medicine (allergology) and feeding (control of products based on flowers such as honey).

CHAPTER 07:

Socio-economic aspects of conservation and management of biological resources

1-The benefits of biodiversity: Values and uses:

1-1-The theme of biodiversity values is growing: For some actors in society, the attribution of values to biodiversity can be used to motivate, support, justify the current and future efforts of biodiversity conservation. But what do you mean by the word "value"? Three main meanings should be mentioned: value as an appreciation of the importance of a thing, value as a quantified measure of the importance or usefulness of a thing, value as a rule or moral reference. With regard to biodiversity, three sets of values can be distinguished, underpinned by different approaches and modes of valuing biodiversity: intrinsic value, heritage value and instrumental value. These three types of values can be described as follows: 1. Intrinsic value refers to the value of biodiversity, some of its elements or processes, in and for themselves, regardless of their possible use [e.g. recognition of rights for non-human living beings, measurement of the value of existence, Nature Protection Act 1976*]. 2. Heritage value refers to the cultural, identity or historical value of biodiversity, which makes biodiversity, or at least some of its elements or processes, a heritage to be conserved (for present or future generations) [e.g. protection of a landscape, an iconic species or a traditional cultivated variety for its cultural importance, measure of heritage value]. 3. And finally, instrumental value (as opposed to intrinsic value) is based on a vision of biodiversity as a provider of resources and services for human societies, to which an economic value can be conferred, through its direct or indirect use [e.g. instrumental value related to genetic resources and other supply services, regulatory services, recreational services]. This set of values includes the option value, which is the conservation value of biodiversity, its elements or processes for potential future use [e.g. discovery of new molecules of interest to the pharmaceutical industry]. We emphasize, however, that these sets are far from exclusive. In addition, the values attributed to biodiversity, its elements or processes, can be considered in

an additional and complementary way. It is also necessary to question the temporality of the values attributed to biodiversity. Will they be endorsed in the same way by future generations?

2-The benefits of biodiversity:

2-1-Genetic resources: The Convention on Biological Diversity defines genetic resources as genetic material of animal, plant or microbial origin, containing functional units of heredity. For animals these are wild populations, standardized breeds, selected lineages or strains. For plants, these are old or modern cultivated varieties, local cultivars, wild or related forms. For microbes, they are strains, isolates, populations and microbial communities.

2-2-Food use of living resources:

Harvesting activities in the natural environment (gathering, fishing) are a very old practice. Wild and semi-wild plants (leaves, roots, tubers, fruits, mushrooms...) contribute to food security and the health of rural populations who live from subsistence agriculture. Some tropical societies consume invertebrates: Caterpillars, molluscs, grasshoppers.... and several species of vertebrates are hunted for their meat (mammals, reptiles, birds). Fishing at sea or in inland waters is the main source of protein in the world.

2-3-Extractivism products:

This term refers to the commercial exploitation of non-timber forest products: fruits, gums, resins, oils, fibers. Cotton, linen, wool, silk and rubber also come from plants and animals. All these products are still used despite competition from synthetic products.

2-4-Wood:

The timber trade is an important activity internationally. Forests represent 3400 million ha of land. Wood is used for domestic uses (firewood), construction and in industry (pulp). The overexploitation of these resources has led to their degradation.

2-5-Industrial perspectives of biotechnology:

Industry is interested in certain elements of biodiversity: microorganisms, genes and molecules. Industrial microbiology uses the enzymatic and metabolic capacities of microorganisms for two types of transformation:⎮ Fermentation: (Brewery, cheese factory)⎮ The production or modification of various molecules (antibiotics, hormones, flavors...). Since 1970, bacteria have been genetically modified to synthesize molecules such as insulin, erythropoietin that stimulates the production of red blood cells, etc.

2-6-Biofuels:

Biofuels (Plant-based fuels to partially replace petroleum-derived fuels that are rapidly depleting reserves) are produced from oilseed plants such as rapeseed or sunflower or alcohol obtained by fermentation of beet sugars.

2-7-Ornamental animals and plants:

Today the number of plant species cultivated for ornamental use and higher than the number of plants for agricultural use. New hybridization species are constantly being innovated and are regularly marketed. On the other hand, the trade in animals is important (for zoos, aquariums, research). Some products such as ivory, turtle scales, snake or crocodile skins, furs, bird feathers have multiple uses: decorative, symbolic, clothing or cultural and whose trade has endangered the survival of several species.

2-8-Ecotourism:

Became a new industry. The valorization of biodiversity through the observation of wild animals is a source of income for some countries that have developed a tourism policy based on the valorization of their natural heritage: Natural parks, however, responsible for certain ecological problems (trampling, fires, fires....).

2-9-Research, education and monitoring:

It is interesting to know the best way to best use biological resources, to know how to maintain the genetic base of harvested biological resources, and how to rehabilitate ecosystems. Natural areas provide excellent living laboratories for such studies, and for other valuable ecological research.

3-Role of Biodiversity:

Biodiversity maintains the integrity of the environment through:

3-1-Biological nitrogen fixation:

Is the most important component of plants after carbon. This supplement comes from the biological fixation of atmospheric diazote (N2) by prokaryotes that allow its introduction into the biosphere. There are two groups of bacteria:⎫ the Rhizobia group associated with legumes (Papilionaceae, Mimosaceae, Césalpiniaceae);⎫ Frankias, sporulant filamentous bacteria (Actinimycetes) associated with trees of the genera Alnus, Casuarina.....

3-2-Organic matter mineralization:

Prokaryotes play a fundamental role in biogeochemical cycles by breaking down organic matter to release inorganic elements that will be used to synthesize new organic molecules.

3-3-Maintain CO2/O2 balance:

It is through biodiversity that this balance (of CO2 and O2 is maintained).

3-4- Absorption and decomposition of pollutants and wastes:

In food webs and food chains where energy flows through production, consumption and decomposition. Without biodiversity, there is no healthy environment for humans because: - It is the first medicinal and food source for humans, - Reduces the risk of pandemics, - Reduces

the risk of natural disasters (Fires, floods, erosions) - Clean water, air and soil. The economy is dependent on biodiversity because: - Primary production is entirely dependent. - Secondary production is highly dependent, many industrial processes require the use of organisms or process products from life. - Tertiary production, like other production, depends on environmental services for energy and environmental purification. Biodiversity is a source of social development - through the direct or indirect employment it generates - through the health care it provides, in particular its healing function.

4-the economic circumstance:

the current economic circumstances of the various countries and the particular geographical situations do not allow for the identification of actors specifically involved in the conservation of the biodiversity of domestic animals. In all countries, either through the questionnaire or at the various meetings of the mission, national structures dealing with biodiversity aspects were highlighted. They never have a specificity in this area. And, as a general rule, where it is possible to isolate them, funding for the functioning of teams working on the conservation of domestic animals comes from outside organizations. The investments made by the country are not negligible since they generally cover a large part of the infrastructure and personnel needs. However, the latter remain difficult to assess because of the non-specific allocation of resources and the multidisciplinary nature of the teams.

5-Protected areas:

Protected areas Protected areas are the primary mode of in situ conservation type and are an essential part of conservation programmes, a. General guidance for protected areas To be effective at conservation:

sites intended to become protected areas must be carefully chosen - Prevention and rapid response have proven to be the most effective and economical way to tackle the problem of

invasive species. - Biodiversity must be taken into account by the agriculture, fisheries and forestry sectors. These sectors have a direct effect on it. - Informing society as a whole about the benefits of biodiversity conservation - Addressing the direct and indirect drivers of biodiversity loss is needed to better protect biodiversity and ecosystem services. - The various possible actions include encouraging the sustainable intensification of agriculture, adapting to climate change and limiting the increase in soil and water nutrient content;

The most important provisions for protected area legislation: - Establishes a system of protected areas or areas where special measures must be taken to conserve biological diversity; - Develops guidelines for the selection, creation and management of protected areas to conserve biological diversity; - Regulates or manages biological resources important for the conservation of biological diversity; - Promotes the protection of ecosystems and natural habitats and the maintenance of viable populations of species in their natural environment;

Promotes sustainable and environmentally sound development in areas adjacent to protected areas; - Establishes or maintains means to regulate, manage or control risks associated with the use and release of living organisms - Prevents the introduction, control or eradication of exotic species that threaten ecosystems, habitats or species; 3. Examples of protected areas in the world, the Mediterranean and Algeria a. Generic terms A number of terms are used interchangeably or with a specific meaning:

Protected areas owned or controlled by the State means conventional protected areas, terrestrial or marine, created and managed by the State. ω Marine protected areas are protected areas located in marine and coastal areas within the jurisdiction of a riparian state. ω The ecosystem or ecosystem approach is an integrated land, water and biological resource management strategy that promotes conservation and sustainable use in an equitable manner.

b. Protected Habitats the World Conservation Union (IUCN) defines a protected area as: Land and(or) a marine expressly dedicated to the protection and maintenance of biological diversity and related natural and cultural resources and developed by legal or other effective means. IUCN has developed an international classification system for protected areas around the world that includes six distinct categories:

Cat. I: Nature reserve: protected area managed primarily for scientific purposes. Cat. II: National park: protected area managed primarily to protect recreational ecosystems. Cat. III: Natural monument: protected area managed mainly for the purpose of preserving specific natural elements. Cat. IV: Habitat or species management area: protected area managed primarily for conservation purposes, with management intervention. Cat. V: Protected landscape or seascape: protected area managed primarily for the conservation of landscapes or seascapes for recreational purposes. Cat. VI: Protected area of managed natural resources: protected area managed primarily for the sustainable use of natural ecosystems.

As of January 2009, the World Protected Areas Database (WDPA) had 122,512 nationally designated terrestrial and marine protected areas in 235 countries and territories. They extend over 21,242,195 km2, or nearly 12.1% of the planet's surface. Of the 122,512 national protected areas listed on the database, 5,674 are marine protected areas, representing about 0.7% of the world's oceans and 2.58 million km2; Lucy Fish). According to the United Nations Environment Programme's (WCMCUNEP) Global Centre for Ongoing Conservation Monitoring:

- in 1962 there were 9214 sites covering 2.4 million km2. - In 1992, 48,388 protected areas covered 12.3 million km2. Thanks to its rich biodiversity, Algeria is one of the most original Mediterranean countries, without equal in terms of bioclimatic, morphological, floristic and faunistic. In order to protect this national heritage, Algeria has established a network of

protected areas that contain unique ecosystems representative of the country's biological diversity, in accordance with Law n°03-10 of 19 July 2003 on environmental protection in the context of sustainable development.

Officially the protected areas created include:♣ 11 national parks with an area of 165,565 Ha;♣ 42 wetlands (2,958,000 Ha) classified as Internationally Significant; ♣ 06 nature reserves; ♣ 04 hunting reserves and 03 hunting centres. ♣ More other parks are being created

Table 3: Protected areas in Algeria.

Coastal Parks	**Parks of the mountain areas**	**Parks of the Steppe areas**	**The Saharian Parks**
El National Park Kala (Wilaya of El Tarf) Gouraya National Park (Wilaya de	Théniet El Had National Park (Wilaya de Tissemsilt) Djurdjura National Park (Wilaya de Tizi Ouzou and Bouira)	• National Park of Djebel Aissa (Wilaya of Naama)	National Park tassili (Wilaya d'Illizi) Ahaggar National Park (Wilaya de
Bejaia) Taza National Park	• Chréa National Park (Wilaya de Blida)		Tamanrasset)

(Wilaya de Jijel)	• Belezma National Park (Wilaya de Batna) • Tlemcen National Park (Wilaya de Tlemcen)		
Nature reserves	Wetlands of International Importance (Ramsar Sites)		
Nature reserve of the Macta (Wilaya de Mostaganem, Oran and Mascara) Mergueb Nature Reserve (Wilaya de M'sila)	Tonga Lake (El Tarf Wilaya) Lake Oubeira (Wilaya of El Tarf) Bird Lake (Wilaya d'El Tarf) Chott Ech Chergui (Wilaya de Saida, Naama and El Bayadh)	Réghaia Lake (Wilaya of Algiers) Black Lake (Wilaya of El Kala) Alder of Ain Khiar (Wilaya of El Kala) Beni Bélaid Lake (Wilaya de Jijel) Ain Ouarka Circus	

	Guerbes (Wilaya de Skikda) Chott El Hodna (Wilaya de M'sila et Batna)	(Wilaya de Naama)	
	• Iherir Valley (Wilaya d'Illizi)	• Fetzara Lake (Annaba Wilaya)	
Beni-salah Nature Reserve (Wilaya de Guelma) Babors Nature Reserve (Wilaya de Sétif) Habibas Islands Marine Nature Reserve (Oran Wilaya)	Issikarassene Gueltates (Tamanrasset Wilaya) Chott Merouarne and Oued Khrouf (Wilaya of El Oued and Biskra) Macta Marsh (Wilaya de Mostaganem, Oran and Mascara) Ouled Said Oasis (Adrar	Sebkhet El Hamiet (Wilaya de Sétif) Sebkhet Bazer (Wilaya de Sétif) Chott El Beidha-Hammam Essoukhna (Wilaya de Sétif) Garaet Annk Djemel-El Merhssel (Wilaya of Oum El Bouaghi)	

	Wilaya) Oran Sebkha (Oran Wilaya) Oasis of Tamentit and Sid Ahmed Timmi (Wilaya d'Adrar)	Garaet Guellif (Wilaya of Oum El Bouaghi) Chott Tinsilt (Wilaya of Oum El Bouaghi)	
	• Oasis of Moghrar and Tiout (Wilaya de Naama) • Zehrez Chergui (Wilaya of Djelfa)	Garaet el Taref (Wilaya d'Oum El Bouaghi)	
	• Zehrez Gharbi (Wilaya of Djelfa)	• Dayet El Ferd (Wilaya de Tlemcen)	
	• Gueltates d'Affilal (Wilaya de	• Oglat Edaira (Wilaya de Naama)	

	Tamanrasset)		
	• Ghar Boumâaza Cave (Wilaya of Tlemcen)	• Arzew Salt Works (Oran Wilaya)	
		•	Tellamine Lake (Oran Wilaya)
	• Mekhada Marsh (Wilaya d'El Tarf) • Chott Melghir (Wilaya of El Oued and Biskra)	Mellah Lake (El Tarf Wilaya) Sebkhet El Meleh (Lake of El Goléa) (Wilaya de Ghardaia) Chott Oum Raneb (Wilaya de Ouargla) Chott Sidi Slimane (Wilaya de Ouargla) Chott Ain El Beida (Wilaya de Ouargla)	

UNESCO-MAB Biosphere Reserves	Barcelona Convention (Specially Protected Areas of Mediterranean Interest)		
• Chréa National Park (Wilaya de Blida) • El Kala National Park (Wilaya d'El Tarf) • Djurdjura National Park (Wilaya de Tizi Ouzou and	• Banc des Kabyles Marine Reserve (Wilaya de Jijel) • Habibas Islands Marine Reserve (Oran Wilaya)		

Bouira) • Tassili National Park (Wilaya d'Illizi) • Gouraya National Park (Wilaya de Béjaia) • Taza National Park (Wilaya de Jijel)			

Protected areas and sustainable development The link with economic policies and sustainable development is an important element for protected areas policies and law. The UN World Commission on Environment and Development (WCSD) has integrated biodiversity conservation as part of sustainable development, which has important impacts on protected areas.

5-1- The difficulties encountered for protected areas:

Many challenges must be overcome:

The main ones are:

a. balancing development needs with the sustainable management and use of natural resources; ω increasing poverty leads to degradation of natural resources;

b. Climate change impacts species greenhouse gas emissions must be reduced while managing ecosystems to increase their resilience;

c. significant gaps in the global network of protected areas, corresponding to irreplaceable and seriously threatened areas, are not given high priority; ω species, habitats and landscapes are affected, as are natural systems and processes and the cultural diversity on which they depend;

d. the flow and quality of fresh water to protected areas is declining due to diversions, runoff from agricultural lands and pollution;

e. The growing popularity of animals, wild plants and their products endangers the survival of rare and endangered species in protected areas;

f. Invasive alien species are increasingly affecting indigenous species;

5-2- estimating the value of biodiversity:

Estimating the economic value of biodiversity is a complex yet crucial task for informing environmental policy and decision-making. Here's an elaboration on how economists approach this challenge and why it's significant:

- ✓ Comparative Analysis and Method Development:
    - Economists develop criteria and methods to compare the benefits and costs associated with biodiversity conservation. This involves assessing the economic value of biodiversity in terms of the services it provides, such as food production, climate regulation, soil fertility, and cultural/spiritual benefits.
    - By quantifying these benefits, economists can evaluate the trade-offs involved in conservation efforts versus other land uses or development activities.
- ✓ Policy Instrumentation:
    - Economists also propose policy instruments aimed at achieving environmental objectives efficiently. This includes mechanisms like market-based instruments (e.g., payments for ecosystem services, carbon pricing) that incentivize conservation and sustainable use of biodiversity.
    - Such instruments are designed to internalize the external costs of biodiversity loss and environmental degradation, thereby promoting conservation practices at a lower overall economic cost.
- ✓ Challenges in Valuing Biodiversity:
    - Biodiversity's value is multifaceted and extends beyond traditional market metrics. It encompasses ecological, social, cultural, and aesthetic dimensions that are challenging to quantify in monetary terms.
    - The non-market values of biodiversity, such as its role in maintaining ecosystem resilience, supporting ecotourism, or providing recreational opportunities, are particularly difficult to measure economically.
    -

- ✓ Economics of Ecosystems and Biodiversity (TEEB):
    - Initiatives like the Economics of Ecosystems and Biodiversity (TEEB) highlight the economic benefits derived from biodiversity and ecosystems. TEEB emphasizes the economic costs associated with biodiversity loss and ecosystem degradation, making a case for investing in biodiversity conservation and sustainable management.
- ✓ Integrated Approaches:
    - Integrated assessment models combine ecological data with economic valuation techniques to provide a more comprehensive understanding of biodiversity's contributions to human well-being.
    - These approaches help policymakers and stakeholders appreciate the full spectrum of benefits that biodiversity provides and support decisions that balance economic development with environmental sustainability.

In conclusion, while estimating the economic value of biodiversity presents challenges, economists play a crucial role in developing methodologies and policy instruments that promote sustainable use and conservation. By recognizing and valuing biodiversity's contributions to various ecosystem services and human welfare, economists contribute to more informed environmental policies that aim to protect biodiversity effectively and efficiently.

Estimating the economic value of ecosystem services, such as soil conservation, climate regulation, water purification, pollination, and local food resources, involves techniques beyond traditional market-based valuation. Here's how these ecosystem services can be assessed and valued:

1. Market Value Approach: For services directly linked to markets (e.g., timber, agricultural products), their economic value is straightforward as it reflects market prices. This can be calculated based on the volume or value of goods produced.
2. Non-Market Valuation Techniques: For ecosystem services without direct market prices, several methods can be employed:
    - Replacement Cost Method: Estimates the cost of replacing the service if it were lost. For example, the cost of building a water treatment plant if water purification by natural ecosystems ceased.
    - Avoided Cost Method: Measures the savings generated by the ecosystem service. For instance, the cost savings in flood control provided by wetlands instead of building flood barriers.
    - Travel Cost Method: Assesses the economic value based on what people are willing to pay to access or use an ecosystem service, such as recreational benefits from parks.
    - Hedonic Pricing Method: Analyzes property values to infer the economic value of nearby ecosystem services like clean air or scenic views.
    - Contingent Valuation Method: Directly asks people how much they would be willing to pay for a particular ecosystem service through surveys and hypothetical scenarios.
3. Ecological-Economic Assessment: Integrates ecological and economic models to quantify the relationships between ecosystem structure/function and human well-being. This approach uses indicators such as biodiversity, habitat quality, and ecosystem productivity to estimate economic impacts.
4. Integrated Assessment Models: Combine multiple valuation techniques to provide a comprehensive estimate of the total economic value of ecosystems and their services.

5. Policy and Decision Support: Once values are estimated, they can inform policy decisions (e.g., land use planning, conservation strategies) and support investments in maintaining or restoring ecosystem services.

To measure the value of ecosystem services accurately, it's crucial to consider local contexts, stakeholder perspectives, and the interconnectedness of natural systems with human economies. This holistic approach helps recognize the full spectrum of benefits that ecosystems provide and ensures informed decision-making for sustainable development.

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