



*Educational material for the training seminar in the framework of the project
EnvironmentYou - Environmental Management Enhancement by Youth-run SMEs*

Educational Thematic

Natural Resources Protection through Business Activities

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Educational Unit 1 "Natural Environment and Natural Resources"

Purpose of the Educational Unit

The purpose of the first educational unit is to help the students of the program to learn more about the natural environment and to gain a global view and knowledge of natural resources with the ultimate goal of developing a sense of their proper use and general rational management. The first educational unit is based on the assumption that raises the issue of knowledge of the subject under management in order for any form of management to be effective.

Expected Results of Educational Unit 1

The first educational unit aims to introduce to the students of the program:

- The natural environment and its elements
- The distinction of natural resources
- The basic types of natural resources
- The concept of Environmental and Natural Resources Management
- The main tasks of the Management of the Environment and Natural Resources
- Approaches to Environmental Management and Natural Resources
- The concept of Sustainable Development
- The concept of Ecosystem Approach
- The most basic tools of Environment and Natural Resources Management

Concepts - Keys of Educational Unit 1

Natural environment, Natural resources, Environment and Natural Resources Management, Sustainable development, Management tools

Subsection 1.1. “Natural Environment”

Natural environment is the set of abiotic (soil, air, water, etc.) and biotic factors (animals, plants, etc.) that affect and determine life. The natural environment is made up of biosystems that are powered by solar energy and include forests, rivers, meadows, lakes, seas and oceans. The natural environment is "self-sustaining" and "self-sufficient" ([Καραμέρης, 2008](#)).

The natural environment consists of four (4) basic spheres: the biosphere, the atmosphere, the hydrosphere and the lithosphere.

1.1.1. Biosphere

The biosphere includes all living things, i.e. plants and animals, but also other categories of organisms and microorganisms (e.g. fungi, bacteria), which grow in the soil (either on the surface or underground), in the water and in the air. The biosphere extends from at least 0.5 km below the surface of the oceans, while traces of it have been identified up to 6.5 km into the troposphere. As a result, its thickness is about 7 km ([Mitterer, 2007](#)).

Living beings, in correlation and interdependence with the environment in which they live and grow, compose ecosystems. Therefore, ecosystems consist of the biotic and abiotic components ([Jones, 2007](#)). Ecosystems are found in all lengths and widths of the Earth ([Golley, 1993](#)).

Each ecosystem is characterized by a specific arrangement of its members, which is based on energy ([Jones, 2007](#)). In the center of this arrangement food relationships can be found (relationships based on food consumption). Energy comes from the sun as solar radiation and is trapped, through photosynthesis, by the plants that form the basis of the food chain. The next food levels include consumers of organic matter (herbivores, carnivores). The food chain ends up in the decomposers, i.e. the organisms that break down the organic compounds of consumer tissues (and food waste) into simpler inorganic compounds, thus recycling their nutrients and energy. ([Waring and Running, 1998](#)).

The elements (e.g. nutrients) that circulate in ecosystems are not created from the beginning, but are preserved and recycled in them. The paths followed by each

element are the result of biological and chemical processes, which depend on each element's chemical properties, the physicochemical properties of the environment and the ways in which it is used by organisms. Known and important biogeochemical cycles are the hydrological cycle, the carbon cycle, the nitrogen cycle and the phosphorus cycle (Waring and Running, 1998).

Ecosystems are determined by their productivity. This, in turn, depends on both the set of biotic and abiotic parameters that affect the ecosystem. In general, the productivity, sustainability and evolution of an ecosystem obey the law of Tolerance (Ντάφης, 1986). According to this law, the productivity, sustainability and evolution of an ecosystem is possible only when the factors that directly or indirectly affect it are kept above a minimum and below a maximum value. Thus in each factor, three key points can be distinguished [Figure 1] (Ντάφης, 1986): the minimum, the best and the maximum price. The minimum and maximum values determine the range of the ecosystem tolerance zone for each factor. Relationships between different factors (elements) can affect the tolerance range of the ecosystem as well as some factors can - within certain limits - be replaced or removed by others (Ντάφης, 1986). An example of this situation is the fact that every living organism is adapted to a specific range of temperature, humidity, oxygen, etc.

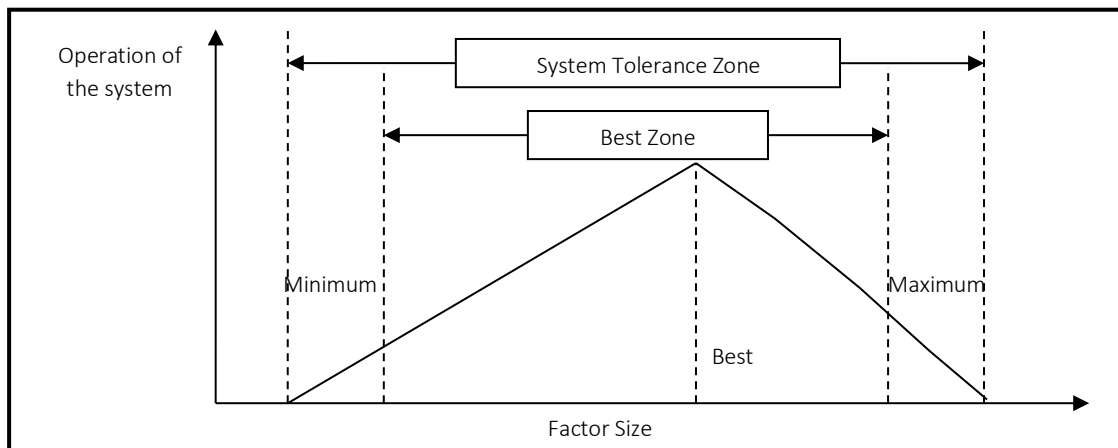


Figure 1. Operation of the System in relation to the size of each factor (Ντάφης, 1986)

1.1.2. Atmosphere

The atmosphere is the gaseous shell of the planet, which starts from its surface and extends to an altitude of more than 10,000 km. The atmosphere hosts life, but also a wide variety of natural phenomena (Lesins, 2007; Lemons, 2009; Χαλδούπης, 2015). The atmosphere, based mainly on the height distribution of temperature, is divided into five basic layers, the troposphere, the stratosphere, the mesosphere, the thermosphere and the exosphere. (Image 1).

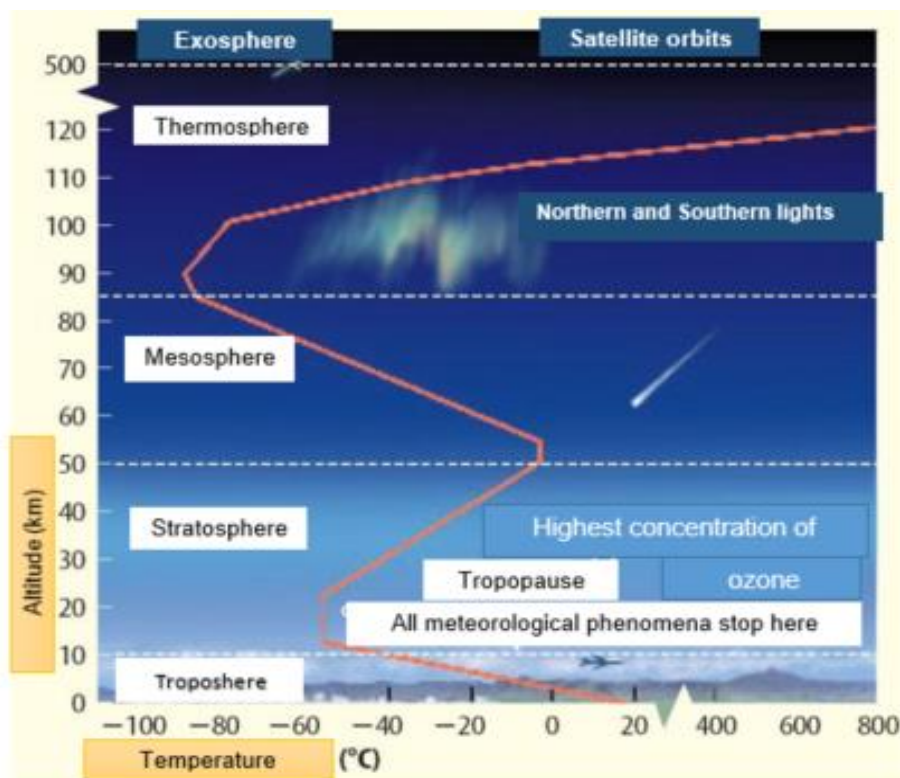


Image 1. The division of the atmosphere based on temperature

In more detail (Wayne, 2000; Houghton, 2002; Wallace and Hobbs, 2006; Χαλδούπης, 2015):

1. The troposphere is the lower layer of the atmosphere. It extends from the ground to a height of about 12 km. The thickness of the troposphere layer depends on the latitude and the time of year. The troposphere collects 75-80% of the total air mass and, essentially, all the humidity of the atmosphere. It is the place where the most and most intense meteorological phenomena are observed as well as the unique layer of the atmosphere in which life is found.

2. The stratosphere extends from the troposphere limit (tropopause) to approximately 50 km. It is characterized by an increase in temperature by altitude, the absence of strong meteorological phenomena, very low moisture content and the absence of clouds. It has relatively high concentrations of ozone (O₃).
3. The mesosphere, the next layer of the atmosphere, reaches a height of about 80 km. It is characterized by a drop in temperature, low air density and the absence of meteorological phenomena.
4. The thermosphere reaches a level that varies widely (approximately 500-1,000 km), depending on solar activity. It is characterized by a gradual increase in temperature (up to 1,500 ° C). However, due to the extremely low density of air, the temperature of the sphere is not perceived by the senses. The non-meteorological phenomena of the northern and southern polar lights are observed in the thermosphere.
5. The exosphere is the outer layer of the atmosphere and extends to the lower limits of space. The ceiling of the exosphere exceeds to 10,000 km. In the exosphere, air has such a low density that it essentially does not act as a gas.

Meteorological phenomena, that is, changes in meteorological conditions perceived by the senses or with the help of specific tools, are "activated" in their entirety by solar radiation. They include precipitation (rain, snow, hailstone, etc.), nebulosity, wind, but also changes in temperature, atmospheric pressure, visibility, etc. ([Wallace and Hobbs, 2006](#)). The air in the atmosphere is in constant circulation, both horizontally and vertically. Many of the meteorological phenomena owe their birth to the general circulation of the atmosphere and the interactions of gaseous masses with different characteristics of temperature and humidity ([Wallace and Hobbs, 2006](#); [Lemons, 2009](#)).

Atmospheric air, in the lower layers of the atmosphere, is composed ([Wayne, 2000](#)) by:

- A mixture of gases in constant proportions, scientifically called "drying air" (nitrogen 78.08%, oxygen 20.95%, argon 0.93%, other gases 0.04%).
- Water vapor, carbon dioxide, ozone and other gases in varying proportions.

- Solid or liquid particles of dust (powder), chemical compounds (e.g. carbon black) or of organic origin (e.g. pollen).

1.1.3. Hydrosphere

The hydrosphere is the total of the water element that surrounds the Earth as liquid (seas, lakes, lagoons, rivers, groundwater), as solid (polar ice, glaciers) and as gas in the atmosphere (water vapor).

The total amount of water on the planet is estimated at about 1.386 million km³. Its largest percentage, 96.5%, is found in the oceans and seas. Fresh water represents only 2.5% (CAP-Net, 2003; Xie, 2006). Of the total amount of fresh water, water in lakes and rivers reaches only 93,120 km³. The rest of the fresh water is found in polar ice and glaciers, on the ground, in the atmosphere and in the tissues of living organisms.

The hydrosphere plays a leading role in the maintenance and evolution of life on the planet (Hanor, 2007). The importance of water has been recognized since the time of the first societies. The absence or abundance of this resource could indicate the ideal area for permanent or temporary installation. In general, it could be said that early human activities were influenced - and in some cases dominated - by access to and use of water: for drinking, cooking, fishing, irrigation, shipping, and later for energy production (Perry, 2013). The progress of civilization can be related to water, especially in climates where the reliable production of food and other goods depends directly on the control of this resource.

Water is a natural resource in continuous recycling through the hydrological cycle, i.e. its phase changes (liquid, solid, gas) along with its position in the environment (Berner and Berner, 1987). At the same time, however, it is a natural resource that requires careful management: although its quantity on Earth is not reduced, its quality is constantly degraded due to pollution (Perry, 2013).

1.1.4. Lithosphere

The lithosphere is the solid layer of the Earth. Its thickness, compared to the overall dimensions of the planet, is very small. At no point does it exceed 40 km, while in the oceans it is often less than 6 km (Karner, 2007).

According to the theory, the lithosphere is not continuous but is divided into large pieces, the lithosphere plates ([Bott, 1982](#)). These plates are small in thickness relative to their surface and slide at different speeds onto the partially igneous asthenosphere, the underlying layer of the earth, which has a higher density and temperature. Today it is believed that many geological phenomena, such as volcanoes, earthquakes, orogeny and the formation of new rocks, are due to the movement of lithospheric plates ([Karner, 2007](#)).

In addition to the movement of lithosphere plates, the lithosphere is constantly changing, due to geological processes such as weathering, erosion and deposition ([Fowler, 1990](#); [Karner, 2007](#)):

- Weathering concerns all actions that contribute to the destruction of geological rocks. It is distinguished in:
 - i. Mechanic, which is caused by various causes, such as temperature changes, frost, the action of the organic world (e.g. plant roots), tectonic movements, and
 - ii. Chemical, which is caused by the effect of chemical agents such as carbon dioxide (CO₂) or sulfur dioxide (SO₂), which is often dissolved in rainwater.
- Erosion concerns the factors that contribute to the detachment and transfer of geological formations to another location. Erosion factors are surface and groundwater, glaciers, sea waves, wind, gravity.
- Deposition, as a geological process, corresponds to the final stage of transport of the weathering and erosion products to new sites.

The lithosphere is composed of rocks. In turn, rocks can be soils, rocks or mixtures of these two categories. Depending on how they are formed, they are divided into the following three categories ([Fowler, 1990](#); [Karner, 2007](#)):

- Magmatic, which are formed by the solidification of fluid and igneous mass (magma), which is released from the interior of the Earth.
- Sedimentary, which are formed from the decomposition and erosion products of other pre-existing rocks.
- Metamorphic, which come from the metamorphosis of certain mineral components of rocks of the other two categories.

Rocks are composed of minerals which usually have a crystalline structure ([Levin, 1988](#)). An example is granite (igneous rock) which consists of quartz, felpars and other minerals. Most minerals contain silicon (such as quartz). Minerals also include

petroleum, mineral coal and various other materials, which, although of organic origin, due to their long stay in the subsoil, have undergone great physicochemical changes in their original organic character.

Subsection 1.2. “Natural Resources”

1.2.1. Distinction of Natural Resources

The term "natural resources" has been interpreted in various ways such as the following:

([Βούτσινος, κ.α. 2016](#)):

- Characteristics of the natural environment able to meet human needs.
- Goods or materials provided by nature.
- Primary and non-human transformed components of nature that can be used to cover basic human needs.
- The primary basic and not man-made goods.
- Anything in nature that man needs for himself or his descendants.

The above interpretations have two common features ([Βούτσινος, κ.α. 2016](#))

- Relate natural resources to the satisfaction of basic human needs.
- They refer to the natural creation and existence of these resources.

Another interpretation of the term is the following ([Βούτσινος, κ.α. 2016](#)):

"Natural resources are essentially the productive forces or the result of the productive forces that exist and act in the natural environment and that, for the present or for the future man, can be used to meet his needs."

Natural resources are categorized according to the criteria considered ([Παπαμανώλης,2015](#)):

- Based on their origin:
 - In abiotic, i.e. those that correspond to non-living elements, such as water, air, ores, etc.
 - In biotic, i.e. those that come from the biosphere, such as crops, forests, animals, fish, etc. (Fossil fuels, such as coal, oil, gas, are often included in living resources, insofar as they were formed from organic fossils during geological time.)

- From an environmental point of view:
 - In finite or non-renewable, i.e. those whose total quantity is finite, and therefore exhaustible (e.g. rocks, metals, fossil fuels).
 - In renewable, i.e. those whose quantities are practically inexhaustible (e.g. sun, wind) or are constantly reproduced by natural processes (e.g. flora, fauna).
 - In potentially renewable, i.e. those whose quantities are potentially inexhaustible but their exploitation takes place at faster and more intensive rates compared to their renewal rate.

For example, contaminating water to such an extent that it cannot be used by humans is essentially depleting a renewable natural resource. The same goes for soil desertification and biodiversity loss.

- In terms of exploitability:
 - In active resources or stocks, i.e. those whose quantities are determined and their exploitation is advantageous given the existing technologies.
 - In potential resources or reserve base, i.e. those that have been identified but, at present, their extraction is not possible, easy or intentional.

1.2.2. Water resources

Water, the most widespread component of the earth, covers about 70% of the planet's surface and is vital for all life forms. (Καραμέρης, 2008). It is also the most important solvent and transporter of ingredients in plants, animals, humans and all natural processes that take place on earth (Jones, 2007).

Water is in constant motion and can be considered to be moving in a closed circuit (hydrological cycle). The hydrological cycle refers to the continuous exchange of water within the hydrosphere, i.e. between the atmosphere, surface water, soil water, groundwater and biosphere (Γιαγκιλίτσηκ.ά, 2013).

The main parts of the hydrological cycle are (NOAA, 2013):

- Filtration: this comes from the movement of precipitation water into the soil. Filtration varies spatially and temporally due to a number of environmental factors. After a rainfall, filtration can cause the soil to saturate in water. This condition does not last long as the water descends and filters deeper under the influence of gravity.

- Precipitations: these can be defined as any aqueous precipitation in liquid or solid form, which develops in a saturated atmospheric environment and generally descends from the clouds. Meteorologists have categorized various types of precipitation such as rain, snow, and hailstone. The fog reflects the saturation of the air near the ground.
- Runoff: is the surface flow of water to areas with lower altitude. On a small scale, runoff can be considered as the result of a series of successive phenomena (difference in precipitation volume, evaporation, transpiration and filtration). On a global or large scale, runoff flows from land masses to the oceans.
- Evaporation and Transpiration: these two processes return water to the atmosphere. Evaporation is caused by the surface of the soil and the free surfaces of water bodies (rivers, lakes, seas, oceans) while evaporation is caused by the vegetation of the area (groundwater that is transported to the foliage through the roots and released as gas through the mouths of leaves). Both of these processes are commonly referred to as evapotranspiration.

Water resources are divided into ([Μπαντάση, 2014](#)):

- Coastal waters: Surface waters one nautical mile from shore. A typical example of coastal waters are the seas and oceans.
- Transitional waters: Surface water systems near estuaries, which are partly saline due to their proximity to coastal waters, but are substantially affected by freshwater currents ([Καραμέρης, 2008](#)). A characteristic category of transitional waters are lagoons and estuaries.
- Inland waters: Systems characterized by the presence of fresh water are called "inland waters" and include the "surface waters" that form the wetlands and the "groundwaters", which are affected but also affect the surface waters.
- Surface waters: Atmospheric precipitation that does not penetrate the soil and does not evaporate together with spring water, is surface water. Surface water occurs either in the form of running water, as flowing water (e.g. rivers), or as stagnant water (e.g. lakes).
- Groundwater: A portion of rainwater penetrates deeper through voids, pores and crevices in rocks, due to the force of gravity forming groundwater ([Βουβαλίδης, 2011](#)).

1.2.3. Soil resources

Soil is one of the most important natural resources, on which depends the conservation of the terrestrial life on the planet but also the economy of the planet locally and globally. It is the upper layer of the Earth's surface and is the dividing layer of the atmosphere from the lithosphere and the lithosphere from the seas, lakes, rivers and oceans.

Soil is formed in a natural way and is a mixture of decomposed surface rocks of the earth, decomposing organic matter, metallic nutrients, moisture, air, oxygen and microorganisms (fungi, bacteria, insects, beetles, earthworms, etc.). Most of them act as decomposers, i.e. they break down dead organic matter (Καραμέρης, 2008).

Although soil is considered a renewable natural resource, it is formed at an extremely slow rate. Indicatively, the formation of one centimeter of soil takes decades (Σφακιανάκη κ.ά, 2008).

The soil is the basis of agricultural and forestry production. About 97% of food consumed by humans comes from the earth, while only the 3% of marine ecosystems (Καραμέρης, 2008).

It is the living space of organisms, the natural filter and protective layer of groundwater reserves, the natural background for the construction of cities and villages, modern infrastructure projects, road networks, etc. and a means of feeding plants with water and minerals. (Σφακιανάκη κ.ά, 2008).

The five main pedological factors are the following (Βούτσινοβκ.ά, 1998; Μπαντιάση, 2014):

- The planting stock: is a relatively loose material that from its gradual physical or chemical decomposition the soil will be formed. The physical (structure and size of the rocks) and the chemical composition of the planting stock, affect the rate of soil evolution, its chemical composition and its ability to retain water.
- Climate: the characteristics of the climate and especially humidity and temperature, affect the evolution of soils but also the type and speed of rock weathering. It also determines the types of vegetation that grow.
- The topographic relief: The altitude and the slope of the soil surface affect the soil formation processes. E.g., areas with a steep slope are characterized by small soil

thickness as the soil horizons do not manage to develop since the soil due to gravity is constantly transported to lower altitudes.

- Time: The age of the soil is considered to be the duration of its formation process and specifically the time that elapses from the moment when the planting stock begins to turn into soil. The older the soil, the more it differs from the planting stock in composition and morphology. Depending on the age, soils are divided into immature, mature and old.
- Living organisms: Plant organisms with their roots contribute to the weathering of rocks while animals affect the soil by decomposing organic matter

1.2.4. Biodiversity

Biodiversity is essential for the preservation of life on Earth, as it is the foundation of the vast range of goods and services provided by ecosystems that contribute significantly to humans' well-being. Human decisions that affect biodiversity affect the well-being of himself and other organisms. In this context, each species has intrinsic value, regardless of its usefulness to humans, other species or the ecosystem to which it belongs (ΥΠΕΚΑ, 2014).

As a term, biodiversity appeared in 1980 and means the diversity of living organisms of all origins, including, inter alia, terrestrial, marine and other aquatic ecosystems and ecological complexes, of which they are a part. It includes diversity within species, between species and between ecosystems.

Biodiversity is usually considered at three levels: genetic diversity (within each species), species diversity, and ecosystem diversity. These three levels correspond to the equal number of fundamental and hierarchically connected levels of organization of life.

The following definitions apply (Marvier, 2007):

- The term genetic diversity refers to the differentiation of genetic material between individuals of the same species and covers the genetic diversity between populations of the same species and / or the genetic diversity between individuals of the same population. An easy way to understand examples of genetic diversity is to observe the differences between people of different races and between people of the same race.

- The second level of biodiversity analysis concerns the diversity of species that characterizes the different regions, habitats, of the Earth. The term habitat refers to the place where a population and its individual characteristics are found, biotic or abiotic. Various studies estimate that the number of species ranges from 5 to 100 million, while the most valid of them estimate the existence of 10 million different species in the Earth's biosphere. However, only about 1.4 million species have been recorded and named so far.
- Examining biodiversity at the level of ecosystem diversity, the different types of ecosystems are described and explored as well as the variety of habitats and ecological processes that characterize each of them.

The real value of biodiversity is incalculable, as it enables all living organisms to survive and adapt to a changing environment. (ΥΠΕΚΑ, 2014).

Indicatively, biodiversity has the following benefits (Heal, 2000; Marvier, 2007):

- Ecological benefits
 - Trees - bushes: capturing CO₂ from the atmosphere, oxygen production, soil formation, providing habitat and food for other plants, animals, fungi and microorganisms.
 - Insects, bats, birds (and other animals): Important for plant fertilization (pollinators).
 - Pests - predators: natural control of populations.
 - Earthworms - bacteria: recycling of soil organic matter, maintenance of soil fertility and productivity.
 - Forests: retention of gaseous pollutants (key factor in reducing global climate change), modification of flood and erosion phenomena, noise suppression, support of food webs, etc.
 - Wetlands: water storage, support of food webs, enrichment of underground aquifers, trapping of sediments and toxic substances, modification of flood phenomena, etc.
- Financial benefits
 - Food: species that are being hunted, caught, collected (eg berries, mushrooms, grasses, snails) from crops or aquacultures.

- Fuels: wood and coal are just two examples of natural resources used for energy production.
 - Housing/Protection: timber and other forest products are used as building and construction materials, fibers (e.g. wool, cotton) and leathers cover clothing-footwear needs.
 - Medicines: natural / traditional or as processed products, they all come from biodiversity, e.g. penicillin is produced from mold, codeine is derived from poppies, aspirin is made from the bark of white willow (*Salix alba* - salicylic acid).
- Social benefits
- Research, education, monitoring: There is still much to be done to find out what and how many species exist, how to make the best use of biological resources, how to preserve the genetic basis of the species, how to restore degraded ecosystems etc. Natural areas are extremely vibrant laboratories for valuable research in various fields of life sciences (ecology, evolution, etc.).
 - Leisure & tourism: Biodiversity is a hub for tourism and leisure activities, which have already expanded rapidly to natural environments and are often the main source of income for the local population. People appreciate these areas for a variety of interests: videotaping, painting, photography, bird watching, ecological field study and other scientific activities.
 - Culture: The conservation of biological diversity is of particular importance for the formation of cultural identity as human cultures evolve together with their environment. It also covers many of the human needs for inspiration, aesthetics, meditation and education, for all the cultures of yesterday, today and tomorrow.

1.2.5. Mineral resources

Mineral resources belong to natural resources and, through their exploitation, conditions are created for employment and economic prosperity. Minerals are divided into the following categories ([Κατσιώτη 2015](#)):

Silicate minerals

Silicate minerals are the main component of rocks. In terms of economic importance, they are of great interest. Building materials such as bricks, gravel, cement, glass, ceramics and porcelain, are either silicate or produced from silicate minerals.

Silicate minerals are divided into six categories:

- Nesosilicates (forsterite, olivine andalusite): These minerals contain independent tetrahedra (SiO_4)⁴⁻, not interconnected and with high hardness.
- Sorosilicates (subsidy): In this formula two tetrahedra (SiO_4)⁴⁻ are connected by a common peak, i.e. by a common oxygen forming pairs (Si_2O_7).
- Cyclosilicates (beryl, cordierite, alinite): Three, four or six tetrahedra (SiO_4)⁴⁻ are interconnected by a common oxygen.
- Fibrosilicates (pyroxenes, wollastonite, diopside): The tetrahedra are connected to each other with common O₂ and form chains: a) single and pyroxenes, b) double and doubtful ones are created.
- Phyllosilicates (muscovite, biotite): When three oxygens from the tetrahedron belong simultaneously to a neighboring tetrahedron, creating tetrahedron leaves.
- Silicate (quartz, plagioclase, zeolites): A three-dimensional network of tetrahedra that each shares all its oxygen. General compound type SiO_2

Non-silicate minerals

- Carbonate minerals: They are minerals that contain the carbonate group as anion. Depending on the way the cations are connected, there are two types of structure, Calcite and Aragonite.
- Sulfate minerals: Includes minerals that have the sulfate root (SO_4)²⁻ as anion. They are as dry as baryte and as hydrated as gypsum.
- Phosphate minerals: The minerals have as anion the phosphate root and the representative mineral is apatite.
- Sulfur minerals: Include compounds with copper (chalcopyrite), iron (iron pyrite), zinc (sphalerite), molybdenum (molybdenite), lead (galena).
- Oxides and hydroxides: Typical examples of this group are: corundum (Al_2O_3), hematite (Fe_2O_3), magnetite (FeOFe_2O_3), titanium (TiO_2), pyrolusite (MnO_2), spinel group (oxides of Mg, Al, Mn, Zn). The main hydroxides of economic importance are $\text{Al}(\text{OH})_3$ and $\text{Fe}(\text{OH})_3$.
- Native elements: More than 30 native elements have been found in the Earth's solid layer. Most of them are metals e.g. Gold, Silver, Iron, Copper, Platinum. Others are non-metals e.g. Sulfur, Coal, some gases: New, Krypton, Helium, and from the liquids Mercury is mentioned.
 - Gold Group: Includes native gold, native silver and native copper.

- Iron - Platinum Group: This group includes the elements iron, nickel, cobalt, rubidium, lead and platinum. The most common of these are native platinum and palladium platinum.
- Sulfur Group: In addition to sulfur, this group includes native selenium and native tellurium.
- Carbon Group: The group includes diamond and graphite minerals. There are other forms of carbon besides crystalline, amorphous carbon and coal (lignite, peat). Coal, oil and natural gas are formed from the organic matter that is buried inside the earth from the earth's surface and under the influence of anaerobic bacteria, high pressures and temperatures give fossil fuels. Another form of carbon is artificial, which occurs in coke, charcoal and soot.

1.2.6. Renewable energy sources

The main characteristics of renewable energy sources are that they are inexhaustible (inexhaustible), abundant, environmentally cleaner. On the other hand, they are sparse forms of energy and so far at least with high costs per unit of energy produced.

They were the first energy sources used by man until the beginning of the last century almost exclusively, when he turned to the intense use of coal and hydrocarbons.

Renewable Energy Sources are defined as the following energy sources ([Kopwvaίός, 2012](#)):

- Solar Energy
- Wind Energy
- Biomass
- Hydroelectric Energy
- Geothermics
- Ocean Energy (tidal waves)

The main renewable energy sources are briefly described below ([Kopwvaίός, 2012](#)):

Solar energy

Solar radiation is used both for the heating of buildings directly or indirectly and with the use of active and / or passive systems, as well as for the production of electricity.

The production of electricity is done in two ways:

- i. By using photovoltaic systems that directly convert solar energy into electricity.

- ii. Solar thermal systems that use solar energy to heat a vapor-producing liquid that powers a turbine and a generator.

Wind energy

Wind energy is a renewable energy source that provides potential for large-scale electricity generation using wind turbines without serious environmental impact. Wind turbines (horizontal or vertical axis) are used both with batteries in small installations and complementary to photovoltaic cells, and are most often connected to the grid.

Biomass

Biomass means the residues of various processes that directly or indirectly come from the plant world and which are used for heating, electricity generation and transportation. These residues can be from municipal waste, from agricultural production (wood, crop residues, animal waste) as well as industrial by-products (from food or organic processing). With proper treatment, biomass is converted into combustible gas. The combustion of this gas produces electricity, with high efficiency but also reduced environmental impact. This technology provides the maximum potential for energy production on European level. However, due to the combustion it cannot be characterized as clean for the environment.

Hydropower

In hydroelectric projects, the energy from the water drop is converted into electricity, with the help of a turbine. Although hydroelectric projects do not produce harmful gases, large dams take into account other environmental parameters, such as flood defenses, water quality, as well as the impact on the life of river organisms and the wider area. Consequently, only small-scale hydroelectric plants (with a capacity of less than 30MW) are considered "green", while large-scale are simply considered "clean".

Geothermics

Geothermal energy is produced by the conversion of hot water or water vapor located deep enough from the earth's surface into electricity. The temperature of the geothermal fluid varies from region to region and can range from 25 ° C to 350 ° C. When the temperature is lower, geothermal energy is used to heat homes and other buildings or facilities, greenhouses, livestock units, fish farms, etc. In cases where the geothermal fluids have a high temperature (above 150 ° C, geothermal energy can be used mainly for the production of electricity, which is currently being used at an increasing rate.

Ocean Energy (tidal waves)

Ocean energy is divided into two categories:

- Wave energy - is the form of energy that results from the kinetic energy of waves. The phenomenon of winds results in the formation of waves, which are exploitable in areas with high winds and on ocean shores.
- Tidal energy - is the form of energy resulting from the gravitational pull of the moon and the earth and which is exploitable when height fluctuations of the surface height of the water level are created - low and rising tide.

Subsection 1.3. "Environmental and Natural Resources Management"

1.3.1. Description of the Concept

Environmental and Natural Resources Management (EM & NRM) includes the development of processes and strategies that focus on:

- The allocation and conservation of resources with the ultimate goal of regulating anthropogenic impacts on the environment (natural or artificial per case) ([Alexander, 2007](#)).
- Taking advantage opportunities, avoiding risks, mitigating problems and preparing people for the inevitable difficulties by increasing the adaptability and durability of the systems under study ([EricksonandKing, 1999](#)).

The main tasks of the management are the following ([Grigg, 1996](#)):

- Planning: It is the process that defines the goals and objectives as well as the creation and recognition of a series of alternative actions, proposals, programs, strategy and policy by the administrator to solve problems in the future.
- Organization: It is a management element that refers to the set of rules and actions with which the factors of production and consumption are harmonized in a specific time and space, in order to achieve the maximum possible efficiency. Essentially, the plan is implemented through organization.
- Administration: It is extremely important for the assignment of tasks and the evaluation of results.
- Audit: It is an integral part of the organization and is necessary to evaluate the overall objectives of the management. This is why it can often be applied by different entities, bodies or organizations.

EM & NRM is essentially a process that deals with human-environment interactions and seeks the recognition of the environmentally desirable outcome taking into account the physical, economic, social and technological constraints and barriers. ([El-Kholy, 2001](#)). Alternatively, EM & NRM deals with the solution of practical problems arising from the coexistence of man and nature ([Alexander, 2007](#)).

It typically consists of a combination of scientific, political, social and economic practices. It deals with the regulation of both socio-economic practices and the effects of human activities on the environment and the effects caused by the environment on humans.

- In the first case, effects such as pollution or the deterioration and degradation of the environment from the construction of certain structures such as dams, roads or other infrastructure and facilities, etc. are included.
- In the second case, situations such as floods, landslides and other natural disasters are included.

In general, EM &NRM has the following characteristics ([Barrow, 2006](#)):

- Often used as a general term
- Supports sustainable development
- It is a dynamic process
- Requires an inter scientific, interdisciplinary or even "holistic" approach
- It must integrate and reconcile different views on development
- It must coordinate science, social needs, policy making and planning.
- It incorporates the principle of prevention.
- It must recognize opportunities and threats and resolve problems
- It emphasizes on management and not exploitation
- The time scale of the process exceeds the short-term limits and the spatial coverage covers a wide range (local - global).
- It deals with the environment that is affected by humans

The scope of its applications covers (but is not limited to) the following topics ([Alexander, 2007](#)):

- Bilateral and multilateral environmental conditions (cross-border ecological management).
- Development of environmental policies and voting (participatory planning and public consultation on environmental programs).
- Assessment, analysis, and management of environmental risks (risk perception and communication studies).
- Development of environmental regulations and rules (for waste disposal, pollutant emissions, resource extraction, control and enforcement and compliance control).
- Impact and management of leisure and tourism (design and implementation of environmentally friendly programs).

- Conservation of natural resources (characterization and management of parks, shelters and other protected areas, characterization and protection of wildlife areas).
- Environmental economics (financial justification for investments in environmental protection).
- Promoting positive environmental values through education, dialogue and dissemination of information.
- Reduction of negative effects on the environment.
- Evaluation and management of resources.
- “Demarcation” and environmental impact investigation (design of policies, rules and procedures for mitigation).
- Strategies, methods and programs for the restoration of ecologically degraded areas.

Therefore, due to the multifaceted and multidimensional nature of EM &NRM as well as its wide range of applications, it is relatively difficult to give a complete definition.

Table 1 presents some of the definitions given to it.

Table 1. Several definitions for EM &NRM ([Barrow, 2006](#))

Definition	Source
An approach that goes beyond the management of natural resources and encompasses the political, social and natural environment. It addresses issues of value and distribution, the nature of regulatory mechanisms and interpersonal and geographical equality as well as generational equality.	----
Formulation of environmentally friendly development strategies	----
The process of allocating natural and man-made resources so that the environment can be optimally used to meet basic human needs to a minimum, and more if possible, on a sustainable basis.	Jolly, 1978
The control of all human activities that have a great impact on the natural environment.	----
The management of the environmental performance of organizations, bodies and companies.	Sharratt, 1995

According to Βούτσινος et. al. 2016, EM &NRM can be understood as the proper utilization and exploitation of wealth-producing resources, which implies the simultaneous protection of the environment

Despite its many definitions, the structure of the whole process can be schematically rendered in a general form. This form is presented in **Figure 2**.

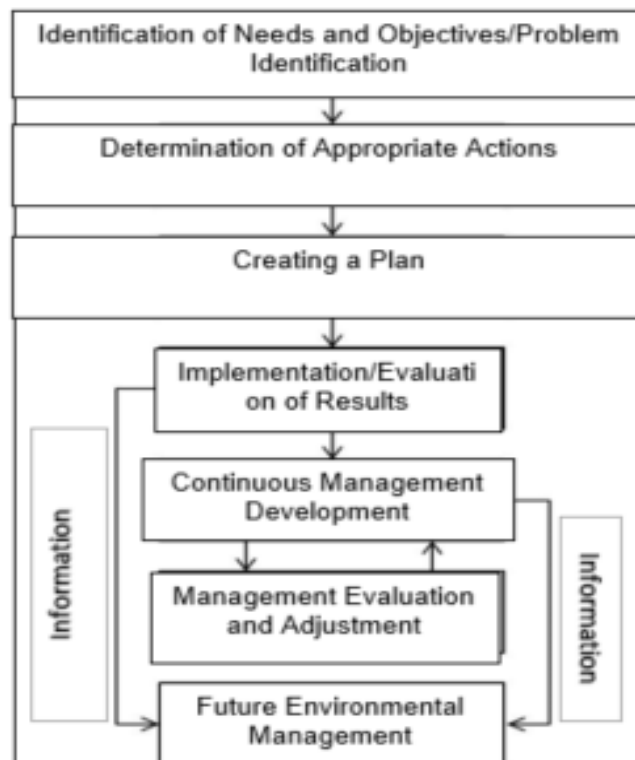


Figure 2. Overview of Environmental Management (Adapted from Barrow, 2006)

In detail:

1. Identification of Needs and Objectives/Problem Identification: The environmental needs and the respective objectives - in the context of the problem in each case - and the necessary information are collected and identifies.
2. Determination of Appropriate Actions: Based on the respective problem and the available information, the most appropriate actions are determined per case.
3. Creating a Plan: Both the set of actions and their accompanying procedures (e.g. financial analysis, cost-benefit analysis, uncertainty analysis, etc.) contribute to the development of the management plan.

4. Implementation/Evaluation of Results: Implementation of the defined actions, monitoring their progress and initial evaluation of the results.
5. Continuous Management Development: Completion of the management plan for dealing with minor problems related to the management of each problem and defining the bases for future management.
6. Management Evaluation and Adjustment: Based on both the initial evaluation of the results of the management plan and the final one, the management plan is adapted and focuses on resolving issues that may have omitted in the initial implementation.
7. Future Environmental Management: This stage is powered by information from previous stages and focuses on identifying problems that may need to be addressed in the near future.

In general, the focus of EM &NRM is more on the implementation, monitoring, control and treatment of real environmental problems (eg change of human habits that affect the environment) than its involvement with theoretical design (Hillary, 1995). The acceptance that economic growth and environmental issues should not be approached in isolation began to widen somewhere between 1972 (United Nations Conference on Human Environment, Stockholm) and 1992 (United Nations Conference on Environment and Development, Rio de Janeiro - "Earth Summit").

1.3.2. The Adoption of the Environmental and Natural Resources Management

EM & NRM responds to problems reactively, and often relies on the application of rapid technological solutions and adopts the "one plan per problem" approach.

In general, before the 1980s, environmental and natural resource managers came from a limited range of specializations with little representation from the sociological and environmental fields. Their approaches were often authoritarian and did not involve public participation. Finally, over the last forty years, interest in natural resources management has declined in favor of environmental management but recently both concepts have emerged and developed more participatory and socially aware approaches.

According to Barrow ([Barrow, 2006](#)), one or more of the following options can lead to the adoption of EM & NRM:

- Realistic reasons - fear or common sense makes people or managers dedicated to avoid a problem.
- Cost-effectiveness - it is better to avoid or deal with problems (potential for extra profit) than their consequences.
- Compliance - individuals, local governments, businesses, states and so on. National or international environmental agreements may be required by law.
- Changing morale - research, media, individuals or groups of activists can trigger new behaviors, agreements or laws.
- Macroeconomics - promoting environmental management can lead to economic growth.

Those involved in environmental issues, after 1970, began to move from recording problems, issuing warnings and defending, to the management of the environment, that is, problem solving, developing practical tools, and formulating rules. ([Dorney, 1989](#)).

A number of developments have contributed to the adoption of environmental management. More specifically ([Barrow, 2006](#); [Alexander, 2007](#)):

- Residents of an ever-increasing number of countries have become environmentally conscious and have expressed a reluctance to entrust environmental protection to governments and companies. This has resulted from the ever-increasing number of environmental accidents, the irrational use of resources and the concern about ecological threats.
- Non-Governmental Organizations (NGOs), various agencies, companies and governments began to pursue environmental management.
- The media began to monitor and broadcast various environmental issues.
- International conferences, meetings, agreements and declarations raised a number of environmental issues and supported environmental management.
- Establishment of the United Nations Environment Program (UNEP) in 1973, and other environmental actors.
- The US National Environmental Policy Act (NEPA - passed in 1970) and the establishment of the US Environmental Protection Agency (EPA) in 1970.
- Publications in North America and Europe [such as Rachel Carson's *Silent Spring* ([Carson, 1962](#))] which raised and communicated environmental concerns in the 1960s

- The development of ecology and green policies since the 1970s.
- Assistance and funding providers in the late 1970s began to require environmental assessment and management before providing support.
- The Brundtland (Brundtland Report) report - World Commission on Environment and Development, 1987 - raises awareness of the need to care for the environment.

Since the early 1990s, the European Union (EU) and the United Kingdom have published Sustainable Development Policy Papers ([Commission of the European Community, 1992](#); [Department of Environment, 1994](#)), Europe has set up an Eco-Management and Audit System (EMAS), international environmental standards have been developed, and most countries require impact assessments before making significant investments.

In general, the basic principles of EM & NRM are prudence and diligence. These are sought through ([Barrow, 2006](#)):

- Policy making and planning,
- Establishing standards and rules, monitoring and control,
- Coordination (adopting an interdisciplinary and holistic approach)
- The functionality of the implementations.

1.3.3. Participation in Environmental Management

The participation of the public in decision making in the context of EM & NRM is considered necessary ([Delmas and Toffel, 2004](#); [Barrow, 2006](#); [Alexander, 2007](#)). More specifically, the following reasons are given:

- ✓ The public may be able to provide advice that would otherwise be omitted.
- ✓ Fears and conflicts in management can be reduced when the public is informed.
- ✓ If people identify with management they can support it.
- ✓ It reduces the risk of communication gap between experts and “locals” or final users/stakeholders.

It should be noted here that the audience usually consists of more than one stakeholder group who may have different, perhaps conflicting, views and goals.

Strong groups tend to dominate the weaker ones who are usually marginalized. Thus, managers must be able to ensure that no team is excluded from the process.

Based on this variation, Alexander ([Alexander 2007](#)) lists the following groups of participants in environmental management:

1. Local, regional, national and international governmental organizations, including global bodies such as the United Nations Environment Program.
2. Research institutes, such as universities, academia, and national laboratories.
3. Enforcement agencies, such as the U.S. Environmental Protection Agency.
4. Businesses of all sizes and multinational companies.
5. International financial institutions, such as the World Bank and the International Monetary Fund.
6. Environmental non-governmental organizations, such as the World Wildlife Fund (WWF).
7. Representatives of environmental users, including tribes, fishermen and hunters.

The main link between these different groups is the need for accountability in the use of nature's wealth. However, although there is a lot of cooperation, relationships are often at odds because of the different goals that each group seeks to achieve.

So far, mainly in developed countries, relevant legislation has been developed since 1970 to ensure the transparency of planning and development. However, there are some countries that prefer not to give a high degree of control to the public. In other countries the public prefers to leave the responsibility of environmental management to the state and finally in some countries, the authorities believe that the public is not ready or able to participate in this process ([Barrow, 2006](#)).

1.3.4. Environmental Management Approaches

EM & NRM includes the implementation of a mixture of objective and subjective approaches. It is a mixture of policy, planning and management, but there is no single and widely adopted framework to shape its implementation, despite the fact that there are guides for policy, procedures, standards and systems [e.g. the widely adopted ISO 14001 ([CronerPublicationsLtd, 1997](#))].

Each situation faced by environmental managers is to some extent unique, and the approach adopted reflects the perceptions and background of those involved, the particular situation, the time, the funds available and many other factors.

The EM & NRM can adopt three distinct positions ([Barrow, 2006](#)):

1. Preventive Management - which aims to eliminate adverse environmental effects
2. Reactive Management - which aims to reduce or control the effects
3. Compensatory Management - which aims to mitigate the effects through compensatory measures

Briefly, there is a wide range of political and philosophical positions that characterize the approach adopted:

1. Specialized Approach: the approach is developed as a reaction to a specific situation.
2. Problem Solving Approach: follows a series of logical steps in order to identify problems and needs and implement solutions.
3. Systems Approach: an approach specifically designed to analyze systems (rather than parts of a system) and solve their problems - Example:
 - Ecosystems (mountain, high latitude, savannah, desert, island, lake and so on - [Dasmannetal, 1973](#); [RuddleandManshard, 1981](#))
 - Agro-ecosystems ([Conway, 1985a and 1985b](#))
4. Regional Approach: mainly ecological zones or biogeophysical units which can sometimes be international. Example:
 - River basin ([Friedman and Weaver, 1979](#); [Barrow, 1998](#))
 - Coastal zone
 - Starting the development of an area (regarding irrigation)
 - Administrative district
 - Sea area (e.g. Mediterranean, Baltic, etc.)
5. Expert approach of many specialties: environmental management in different fields - Example:
 - Air quality management
 - Water quality management
 - Land management
 - Environmental health
 - Urban management
 - Management of marine areas
 - Tourism / ecotourism management

- Management of protected areas
- 6. Approach of the Strategy for the management of the environment and natural resources.
- 7. Voluntary Sector Approach: environmental management that is encouraged and supported by volunteers.
- 8. Commercial approach: environmental management for businesses and public bodies.
- 9. Approach to human ecology.

1.3.5. Sustainable development

EM & NRM is closely linked to the concept of Sustainable Development. Most managers would accept that sustainable development is one of the key goals of EM & NRM. However, providing an internationally accepted definition of sustainable development is a difficult test ([Barrow, 2006](#)). Thus, most users of the term accept that:

"Sustainable development requires maintaining the quality of the environment, and ensuring that the benefits of using resources are shared equally among all existing groups, and that current activities do not limit living choices or degrade the environment of future generations..."

According to the definition in the text of "Our Common Future" resulting from the United Nations World Commission on Environment and Development in 1987, Sustainable Development is the process by which the needs of the present are met, without compromising the ability to meet the needs of the future ([Soubotina, 2004](#); [Carr, 2009](#)).

Thus, in the context of sustainable development, the goal of EM & NRM is to optimally increase goods and services from nature, and to maintain this extension indefinitely, without causing environmental collapse, in order to maximize prosperity, security and human adaptability ([Barrow, 2006](#)). This process requires high quality management of the environment and human organs / bodies, as well as the ability to recognize and mitigate or avoid various risks and finally adapt to socio-economic and physical threats.

As a concept, sustainable development is based on two, often contradictory, traditions: dealing with the limits that nature presents to man and with the potential for ever-

increasing material human development (Redclift, 1987; Barrow, 1995). The interpretation of sustainable development varies accordingly (Barrow, 2006):

- Some see it as a search for harmony between people and their environment.
- Some fail to accept that in a finite world there can be no unlimited demand for resources.
- Some feel that there may be a shift towards less environmentally friendly improvements in the quality of human life.
- Some believe that technology will allow the limits of nature to be extended in a sustainable way.

Due to the complexity of the nature of sustainable development, the proposed practices are usually inapplicable or the term is often misleading. Thus EM & NRM must safeguard the use of the concept and must try to develop applicable strategies without excessive controls.

Currently, the main trends in sustainable development commitments are (Barrow, 2006):

- Maintaining ecological integrity,
- The integration of environmental care and development,
- The adoption of an international position (interdependence between North - South),
- The satisfaction of even the smallest human needs,
- The supervision of equality between the generations, between the members of the different groups and between the species,
- The application of science, technology and environmental knowledge to global development,
- The acceptance of a relevant economic development (without exceeding the environmental limits),
- The adoption of long-term supervision.

The question for sustainable development is whether it will only act as a guiding principle (which in itself is valuable) or whether it can also create applicable strategies that can improve human well-being and prevent environmental degradation.

As a principle and as a way of integrating the various interests, it has already been established, but the development of applicable strategies requires additional efforts.

Based on the definition of sustainable development, presented above, it is designed to meet the existing needs without limiting the ability to meet the needs and expectations of future generations. But here it should be noted that goals of this type raise inherent issues of ethics and values in terms of intragenerational and intergenerational equality (Carr, 2009).

More specifically, intergenerational equality is a very common topic of discussion and reference in the modern literature as, by definition, sustainable development cannot avoid the responsibilities of existing generations to future generations and the satisfaction of their needs. In this case, the following question arises:

"Does sustainable development mean maintaining the basic living conditions of the people in the future or maintaining the current living standards and conditions?" "

The answer to this question essentially dictates the way of life of modern people. Thus, the maintenance of basic living conditions can be achieved even with a relatively "irresponsible" use of available resources by existing generations. On the contrary, maintaining the current standard of living for future generations, unless there are significant changes in the technology used, can be considered impossible (MEA, 2003). Therefore, sustainable development processes must also address the causes that hinder the achievement of the goals set for the livelihoods of future generations.

On the other hand, discussions about the ethical dimensions of intragenerational equality arising from sustainable development practices are less frequent. Thus, for example, some research on the ecological footprint of countries suggests that existing (rich) patterns of resource consumption in the global North are possible only because the global South suffers from similar deprivations (Rees and Wackernagel, 1995). These analyzes highlight the inherent incompatibility between the goals of those who desire and seek the sustainable use of natural resources and those who work to develop consumption patterns in the global South.

Integrating environmental concerns into development thinking and practice remains a work in progress, and one of the most important challenges arising from this effort is the ethical issues surrounding intragenerational and intergenerational equality. On exchanges between the present and the future, the work on sustainable development has provided new possibilities for thinking about the ethical dimensions of

environmental protection and development, as well as the values of systems that allow unsustainable practices to be perpetuated (Carr, 2009).

1.3.6. Ecosystem approach

The concept of ecosystem approach comes from the Convention on Biological Diversity (UN, 1992) and has been described and interpreted in various ways since then (Rice, 2010). According to the literature, the approach has acquired many definitions depending on the needs of each user. Two of them define the ecosystem approach as:

- The integration of scientific knowledge on ecological relations in a complex, socio-political and value framework towards the general goal of long-term protection of the natural integrity of ecosystems (Grumbine, 1994).
- Management's effort to meet human needs through the use of natural resources while maintaining the biological wealth and ecological functions required to maintain the structure and functions of the ecosystems under study (UN, 1992)

It has generally been described as a method, tool, framework or strategy but is essentially a set of principles that can be applied to all policies, plans or programs dealing with the management of natural ecosystems and the environment in general.

These principles are (UN, 1992; Shepherd, 2004):

1. The objectives of land, water and living resources management are a matter of social choice.
2. Management should be decentralized to the lowest and most appropriate level on a case-by-case basis.
3. Ecosystem managers must focus on the impact (actual or potential) of management actions on neighboring and other ecosystems.
4. Recognizing the potential benefits of management, there is usually a need to understand and manage ecosystems in an economical (not particularly costly) context. Thus, any ecosystem management program must:
 - Reduce market impacts that negatively affect biodiversity
 - Align incentives to promote biodiversity conservation and sustainable use
 - Internalize the costs and benefits to the ecosystem under study as far as possible.

5. The maintenance of the structure and operation of ecosystems and the maintenance of ecosystem services must be a priority of the ecosystem approach.
6. Management must take place in the context of ecosystem functionality.
7. The ecosystem approach must evolve at the appropriate spatial and temporal scale.
8. Recognizing the different time scales that characterize ecosystem processes, goals for ecosystem management need to be set in the long run.
9. Management must recognize that change is inevitable.
10. The ecosystem approach must seek to balance and integrate conservation and use of biodiversity.
11. The ecosystem approach should consider all sources of relevant information including scientific, endogenous and local sources.
12. The ecosystem approach must include all relevant areas of society and science.

The process of approaching ecosystems involves the following steps ([Shepherd, 2004](#)):

- **Stage 1:** Defining the main stakeholders, defining the extent of the ecosystem and developing the relationships between them - includes Principles 1, 7, 11 and 12.
- **Stage 2:** Characterization of the structure and operation of the ecosystem under study and definition of management and monitoring actions - includes Principles 2, 5, 6 and 10.
- **Stage 3:** Identification of the most important economic issues affecting the ecosystem and its inhabitants - includes Principle 4.
- **Stage 4:** Determining the impact of the ecosystem under study on neighboring ecosystems - includes Principles 3 and 7.
- **Stage 5:** Defining long-term goals and flexible ways to achieve them - includes Principles 7, 8 and 9.

The main advantage of this process is that it achieves a balance between the use and conservation of biodiversity. This contributes, to a certain extent, to human well-being without compromising natural resources (sustainable use). This ensures in the long run that the natural environment will continue to provide its valuable services. Policies, actions and programs that apply the principles of the ecosystem approach may demonstrate ([Rice, 2010](#)):

- Greater cooperation between stakeholders, integration between sectors as well as linking across geographical boundaries.
- A more holistic approach - rather than just meeting regulatory requirements.

- Better application of both scientific knowledge and the knowledge of stakeholders for decision making.
- Less conflicts between sectors: mutual benefits, and solutions that meet different goals.
- Restoration of ecosystems.

1.3.7. Management tools

A large number of tools have been used within the general framework of EM & NRM. The preference and use of these tools always depends on the desired result, the available resources, the available data, the knowledge and experience of the researcher, the nature of each problem and finally, the general area to which this problem belongs.

1.3.7.1. Environmental Impact Assessment

The adoption of the Environmental Impact Assessment (EIA) began in 1969 through the United States National Environmental Policy Act (NEPA) and quickly spread to other countries such as Canada, Australia, West Germany, France ([Moberg, 1999](#)).

This method was developed to study the environmental aspects of the design of various projects and its purpose is to help support relevant decisions ([Moberg, 1999](#); [FinnvedenandMoberg, 2005](#)). Briefly, the EIA can be defined as a process which:

“Identifies and Manages (recognizes, describes, measures, predicts, communicates) the potential [or actual] effects [direct or indirect, individual or cumulative] of proposed [or existing] human actions (programs, plans, legislation and other activities); and of their alternatives to the environment [physical, chemical, ecological, social, economic, cultural, etc.]” ([Lawrence, 2003](#)).

The United Nations Economic Commission for Europe defines the EIA as "assessing the impact of a planned activity on the environment" ([Glassonetal, 1999](#)).

The EIA, regardless of the above definitions, is commonly used as a kind of study of the impact caused by various policies and legislation on the environment and man rather than as a means of assessing the impact of a project on the environment ([Moberg, 1999](#)).

The process followed each time in the EIA, can take several forms. The following figure (Figure 3) shows the most important stages of this process (Glassonetal, 1999).

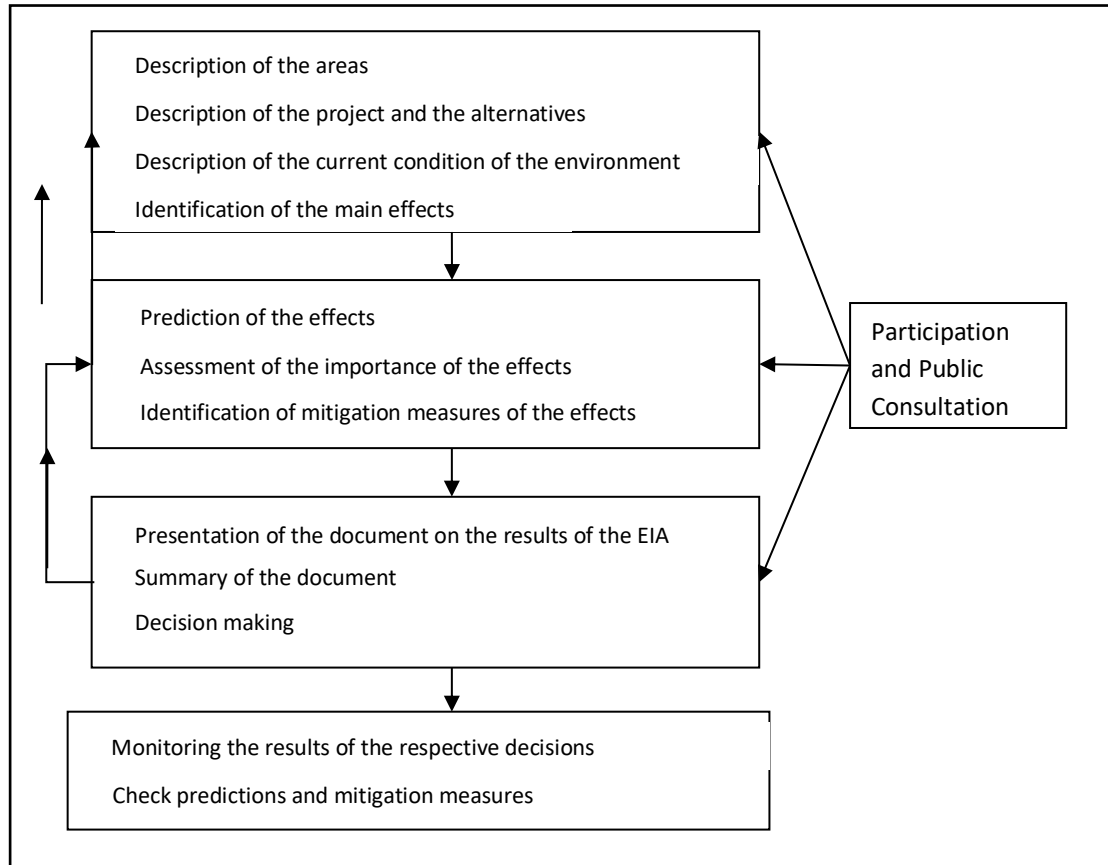


Figure 3. The most important stages of EIA (Adapted from Glassonetal, 1999)

The results of this method, as well as many others, include the opinion of the public on each project, meaning the various stakeholders of independent scope (local, national, international).

The advantages of this tool are the following (Moberg, 1999):

- It introduces to decision makers the environmental aspects of the proposed project.
- The public participates in the process.
- It is quite well known and widely used around the world.

On the contrary, its disadvantages are (Thériveletal, 1992; Moberg, 1999):

- The costs for its implementation are high.
- The usual lack of monitoring of results despite being included in the process.

- Those who apply EIA usually rely on incomplete data from local authorities.

It is appropriate to mention that the EIA is considered a very useful tool as, if the process is carried out correctly, it can provide very useful and important information related to the environment of the area and the views and special needs of the local community.

1.3.7.2. Driving Forces - Pressures - State - Impacts – Responses Framework

This framework organizes information on the environment and is mainly used by internationally renowned organizations such as the European Union Commission on the Environment, and the US Environmental Protection Agency (EPA, 1995; EEA, 1999; Kristensen, 2004).

The acronym for the framework - DPSIR, comes from the initials of the English words Driving Forces, Pressures, State, Impacts, Responses (Figure 4). The idea originally came from social studies and later expanded internationally to organize indicator systems in the context of the environment and then to sustainable development. The final form of the framework was developed in the late 1990s and during its development and evolution it replaced its earlier forms (EEA, 1999; Carretal, 2007).

The PSR (Pressures – State - Responses) framework developed by the Organization for Economic Co-operation and Development (OECD) and the DSR (Drivers – State - Responses) framework proposed by the United Nations Environment Program (UNEP) are two of these earlier forms (OECD, 1993, 1994; UN, 1996). The purpose of the evolution of the framework was to strengthen its descriptive capacity in relation to the relationship between the environment and human activities.

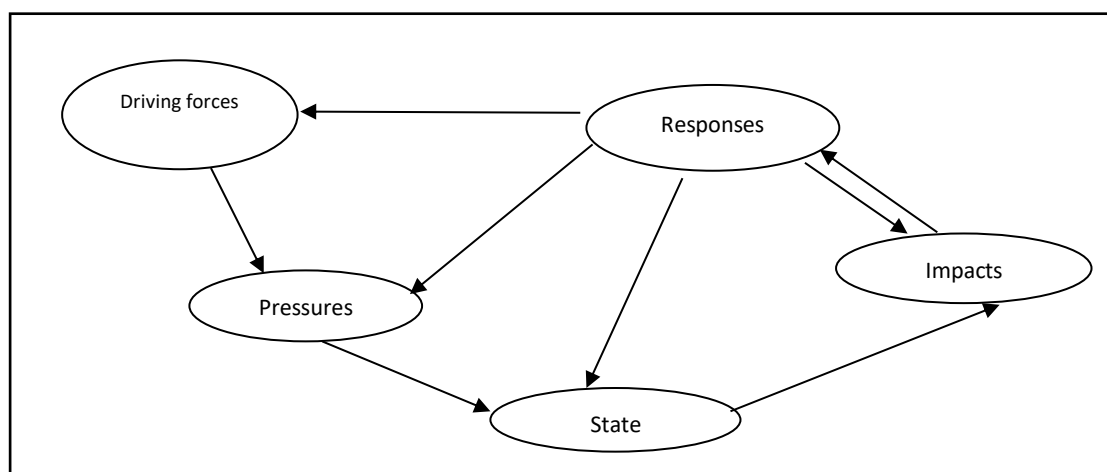


Figure 4. The framework DPSIR (Adapted from [EEA, 1999](#))

The tool consists of the following elements creating a chain within the cause-and-effect relationship ([Giupponi, 2002](#); [Kristensen, 2004](#); [Carretal, 2007](#); [WoodandHalsema, 2008](#); [Tscherningetal, 2012](#)):

➤ Driving Forces:

The driving forces are both human needs and various other natural factors. Examples of main driving forces at the individual level are the needs for food and housing while secondary driving forces are the needs for transportation - movement, entertainment, etc.

➤ Pressures:

The driving forces, lead to human activities that are necessary in order to meet the various needs. These activities exert pressure on the environment and can be divided into three categories ([Kristensen, 2004](#)):

1. Intensive use of natural resources,
2. Land use changes, and
3. Emissions (chemical, waste, radioactivity, noise) to air, soil and water.

Some of the pressures are the following:

- Use of resources.
- Land use change.
- Waste generation.
- Noise generation.
- Emissions of various pollutants (direct and indirect) into the air, soil and water.

➤ State:

The various pressures result in the influence of the current state of the environment such as the quality of the various environmental components (soil, water, air, etc.). The state of the environment is the combination of chemical, physical and biological factors.

Some of the environmental factors that are affected are:

- Air quality.
- Water quality (lakes, rivers, groundwater, seas, etc.).
- Soil quality (natural areas, agricultural areas).
- Ecosystems (biodiversity, vegetation, soil organisms, etc.).

- Human population (health).

➤ Impacts:

Changes in the state of the environment in turn cause some effects on the operation of the systems under study. These effects can be far-reaching as the ability of systems to support life (biodiversity reduction) can be affected, resulting in economic and social problems.

➤ Responses:

Responses are the effort of policy makers and decision makers:

- To correct the problems created by the various pressures
- To prevent and reduce the intensity of pressures
- To reduce the intensity of the effects
- To limit the power of the driving forces

It is worth noting that the use of the framework is so wide that most indicators are designed based on this tool ([EEA, 1999](#)).

It should also be noted that the DPSIR framework is not dynamic. Despite the fact that this does not limit its ability to describe as well as possible the various factors under consideration, it restricts its ability to provide feedback and re-evaluate the results produced at each stage of the method. This can create problems for decision makers, as this approach can not follow the complexity of the nature of the various problems ([Pahl-Wolst, 2007](#)). Thus, it is considered appropriate to gradually replace or improve it.

To date, various efforts have been made in this direction. More specifically, [Pahl-Wolst \(2007\)](#) attempted to combine one of the earlier forms of the framework (PSIR) with the Adaptive Management approach. Despite this considerable effort, the PSIR framework lags behind the DPSIR in terms of the description of the driving forces. Finally, [Niemeijer and DeGroot \(2008\)](#), presented a reinforced DPSIR framework where the causal chain of the original framework was replaced by a complex causal network of indicators and relationships between the various components. This enhanced framework shows increased descriptive capacity but still lacks the element of adjustment.

1.3.7.3. Analysis of Strengths - Weaknesses - Opportunities - Threats

The analysis of Strengths - Weaknesses - Opportunities – Threats is more commonly known with the international term SWOT Analysis, which, comes from the initials of the words Strengths, Weaknesses, Opportunities and Threats. SWOT analysis is a general technique of designing and organizing a coherent decision-making framework, which may concern an institution, a company, a geographical area, etc. In general, this approach captures - photographs - the current state of the system under study.

The conception and application of this analysis began about 50 years ago in the business world, and until today, it has been used in a large number of cases, especially in the field of strategic business planning ([Kheng-Hor and Munro-Smith, 1999](#)).

The purpose of the analysis is to effectively reinforce the elements of the system's internal dynamism, and the opportunities offered by the external environment, while attempting to eliminate or reduce internal weaknesses and address threats from the external environment.

SWOT analysis consists of four key elements taken as part of a broader strategic plan ([Kheng-Hor and Munro-Smith, 1999](#); [Dyson, 2004](#); [Paliwal, 2006](#)):

- Strengths: They are part of the internal environment of a system and refer to the comparative advantages of a system that help to achieve the goals set.
- Weaknesses: They refer to limitations, disadvantages or imperfections of the system that prevent the achievement of goals.
- Opportunities: They are the favorable situations of the external environment of the system.
- Threats: They refer to the external environment of the system and are the various adverse situations that may create risks in the implementation of any action.

According to the European Commission ([EC, 1999](#)), SWOT analysis aims to:

- Reduce uncertainty regarding the implementation of a specific development policy action or program in a geographical area - region - with particular characteristics.
- Identify the dominant and critical determinants (internal and external) that influence the success of a development policy, action or program.
- In the substantiated support of an integrated strategy of connection of the development action both with the endogenous potential of the area in which it is applied, as well as with the external environment.

SWOT analysis should be used and applied in cases where it may be useful and especially in cases of design, evaluation or problem solving where the distinction between external and internal environment is essential.

However, SWOT analysis should in no way be construed as a method without problems and weaknesses. In many cases, the technique is consumed in compiling an extensive list of factors, without documenting their severity or assessing their criticality. In this way the analytical element is limited, while the technique becomes purely descriptive, which results in the impossibility of its creative use in the later stages of decision making or taking specific actions and measures (Balamuralikrishna and Dugger, 1995; Hill and Westbrook, 1997; Βαγιάννη κ.α., 2002).

Efforts to address the above problems led to the development of the Dynamic SWOT Analysis (DSA). The DSA differs from the simple SWOT analysis (Figure 5) as it requires continuous feedback of the content of the various stages, which are not completed until the completion of the overall analytical process. In this way the SWOT analysis acquires a cyclical and reactive character, avoiding staticity and enhancing its validity and reliability (Dealtry, 2001; Βαγιάννη κ.α., 2002).

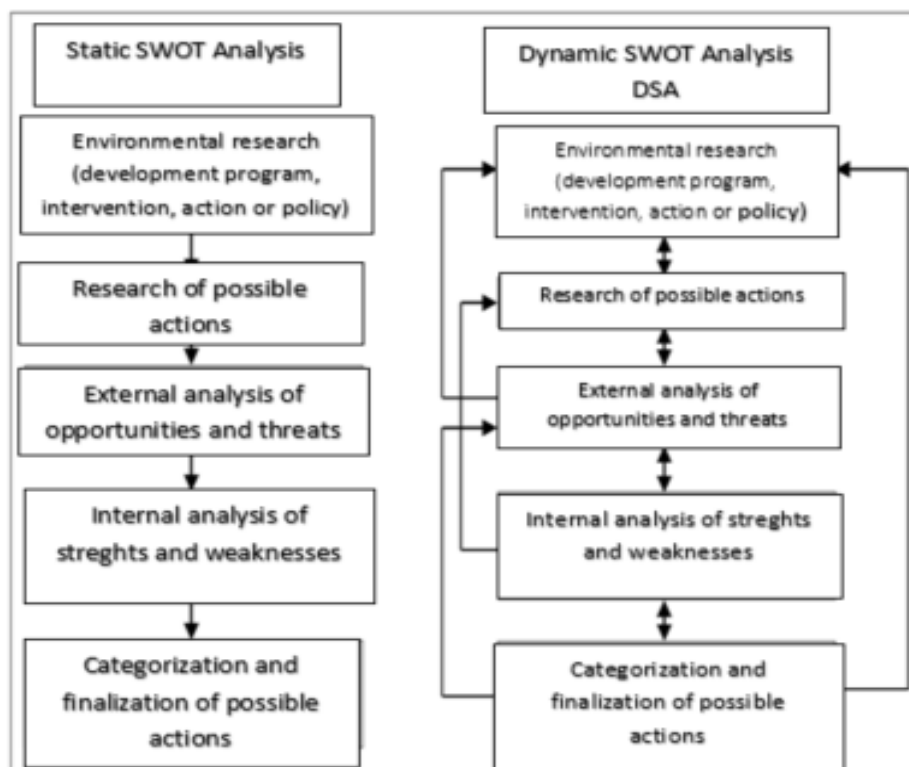


Figure 5. Comparison of static and dynamic SWOT analysis (Βαγιάννη κ.α., 2002)

Based on the above, the SWOT analysis can be considered as part of a learning process, since through the DSA the strategy planning process is examined during its creation. Therefore, useful data and new ideas for the strengths and weaknesses of an area can be provided / produced ([Karppiet.al., 2001](#)).

Although it is widely accepted that SWOT analysis, due to its construction, can produce satisfactory results and that the process is formally correct, there are some points that need special attention ([Karppiet.al., 2001](#)):

- The results must be a logical continuation of the analysis.
- There must be a balance between the internal and external environment.
- Extra attention should be paid to the degree of control. Most SWOT analyses give more weight to external factors.
- All stakeholders must be able to accept the program or action and be ready to commit. This can lead to consistent decision making.

Summarizing the above, SWOT analysis is a simple and popular technique that can be used at all stages of a policy design that includes analysis, planning, evaluation, decision making, implementation, monitoring, post-implementation evaluation and redesign, if necessary.

Educational Unit Summary

Natural environment is the set of factors that affect and determine life on the planet. It is composed of biosystems, which are powered by solar energy and consists of four (4) basic spheres, more specifically: the biosphere, the atmosphere, the hydrosphere and the lithosphere. These spheres include all the natural resources that humans use directly or indirectly for the purpose of survival (primarily) and evolution. It is this element (the use of natural resources by humans) that defines the concept of natural resources. The utilization of natural resources and the environment in general, as well as their parallel protection, is achieved through the principles of management of specific objects. Environment and Natural Resources Management, in addition to a significant set of concepts, implementation frameworks and principles, also includes a significant number of tools with proven value and reliability.

Self-assessment Questions on Educational Unit 1

1. The natural environment consists of four (4) basic spheres:

<input type="checkbox"/>	Biosphere
<input type="checkbox"/>	Stratosphere
<input type="checkbox"/>	Thermosphere
<input type="checkbox"/>	Atmosphere
<input type="checkbox"/>	Mesosphere
<input type="checkbox"/>	Exosphere
<input type="checkbox"/>	Hydrosphere
<input type="checkbox"/>	Lithosphere
<input type="checkbox"/>	Troposphere

2. The atmosphere is divided into five basic layers:

<input type="checkbox"/>	Biosphere
<input type="checkbox"/>	Stratosphere
<input type="checkbox"/>	Thermosphere
<input type="checkbox"/>	Atmosphere
<input type="checkbox"/>	Mesosphere
<input type="checkbox"/>	Exosphere
<input type="checkbox"/>	Hydrosphere
<input type="checkbox"/>	Lithosphere
<input type="checkbox"/>	Troposphere

3. From an environmental point of view, natural resources are divided into:

<input type="checkbox"/>	Abiotic
<input type="checkbox"/>	Finite or non-renewable
<input type="checkbox"/>	Potential
<input type="checkbox"/>	Biotic
<input type="checkbox"/>	Active
<input type="checkbox"/>	Renewable
<input type="checkbox"/>	Potentially renewable

4. Based on their origin, natural resources are divided into:

<input type="checkbox"/>	Abiotic
--------------------------	---------

- | | |
|--------------------------|-------------------------|
| <input type="checkbox"/> | Finite or non-renewable |
| <input type="checkbox"/> | Potential |
| <input type="checkbox"/> | Biotic |
| <input type="checkbox"/> | Active |
| <input type="checkbox"/> | Renewable |
| <input type="checkbox"/> | Potentially renewable |

5. The main soil pedological factors are: planting stock, climate, topographic relief, time and living organisms.

- | | |
|--------------------------|-------|
| <input type="checkbox"/> | True |
| <input type="checkbox"/> | False |

6. List the non-renewable resources in the following list:

- | | |
|--------------------------|-------------|
| <input type="checkbox"/> | Sun |
| <input type="checkbox"/> | Wind |
| <input type="checkbox"/> | Soil |
| <input type="checkbox"/> | Fossil fuel |
| <input type="checkbox"/> | Metals |
| <input type="checkbox"/> | Soil |
| <input type="checkbox"/> | Water |
| <input type="checkbox"/> | Rocks |
| <input type="checkbox"/> | Flora/fauna |

7. According to the Law of Tolerance, the productivity, sustainability and evolution of an ecosystem is possible only when the factors that directly or indirectly affect it are maintained at an average value.

- | | |
|--------------------------|-------|
| <input type="checkbox"/> | True |
| <input type="checkbox"/> | False |

8. Arrange in order the main tasks of the Environmental and Natural Resources Management:

- | | |
|--------------------------|--------------|
| <input type="checkbox"/> | Organization |
| <input type="checkbox"/> | Control |
| <input type="checkbox"/> | Design |
| <input type="checkbox"/> | Management |

9. Note the main trends in sustainable development obligations:

	Satisfaction, even of minimal human needs
	The application of science, technology and environmental knowledge for global development
	Compensatory Management aimed at mitigating the effects through compensatory measures
	Policy making and planning
	The human ecology approach
	The integration of environmental care and development
	Establishing standards and rules, monitoring and control
	The adoption of long-term supervision
	Flora/fauna

10. Note the definition of Environmental and Natural Resources Management:

The effort to meet human needs through the use of natural resources while maintaining the biological wealth and ecological functions required to maintain the structure and functions of the ecosystems under study.

The proper utilization and exploitation of wealth-producing resources, which implies the simultaneous protection of the environment.

Sustainable Development is considered the process in which the needs of the present are met without compromising the ability to meet the needs of the future.

The integration of scientific knowledge on ecological relations in a complex, socio-political and value framework towards the general goal of long-term protection of the natural integrity of ecosystems.

11. Note the definition of Sustainable Development in the United Nations World Commission on Environment and Development:

The effort to meet human needs through the use of natural resources while maintaining the biological wealth and ecological functions required to maintain the structure and functions of the ecosystems under study.

The proper utilization and exploitation of wealth-producing resources, which implies the simultaneous protection of the environment..

Sustainable Development is considered the process in which the needs of the present are met without compromising the ability to meet the needs of the future.

The integration of scientific knowledge on ecological relations in a complex, socio-political and value framework towards the general goal of long-term protection of the natural integrity of ecosystems.

12. Put the stages of the ecosystem approach in the right order:

Recognition of the most important economic issues affecting the ecosystem and its inhabitants.

Determining the impact of the ecosystem under study on neighboring ecosystems.

Defining long-term goals and flexible ways to achieve them.

Defining the main stakeholder groups, defining the extent of the ecosystem and developing the relationships between them.

Characterizing the structure and operation of the ecosystem under study and defining the management and monitoring actions.

Annex – Educational Unit 1

Answers to Self-Assessment Questions on Educational Unit 1

1. The natural environment consists of four (4) basic spheres:

X

Biosphere

Stratosphere

	Thermosphere
X	Atmosphere
	Mesosphere
	Exosphere
X	Hydrosphere
X	Lithosphere
	Troposphere

2. The atmosphere is divided into five basic layers:

	Biosphere
X	Stratosphere
X	Thermosphere
	Atmosphere
X	Mesosphere
X	Exosphere
	Hydrosphere
	Lithosphere
X	Troposphere

3. From an environmental point of view, natural resources are divided into:

	Abiotic
X	Finite or non-renewable
	Potential
	Biotic
	Active
X	Renewable
X	Potentially renewable

4. Based on their origin, natural resources are divided into:

X	Abiotic
	Finite or non-renewable
	Potential
X	Biotic
	Active
	Renewable

Potentially renewable

5. The main soil pedological factors are: planting stock, climate, topographic relief, time and living organisms.

True
 False

6. List the non-renewable resources in the following list:

<input type="checkbox"/>	Sun
<input type="checkbox"/>	Wind
<input type="checkbox"/>	Soil
<input checked="" type="checkbox"/>	Fossil fuel
<input checked="" type="checkbox"/>	Metals
<input type="checkbox"/>	Soil
<input type="checkbox"/>	Water
<input checked="" type="checkbox"/>	Rocks
<input type="checkbox"/>	Flora/Fauna

7. According to this law of Tolerance, the productivity, sustainability and evolution of an ecosystem is possible only when the factors that directly or indirectly affect it are maintained at an average value.

True
 False

True: According to this Law of Tolerance, the productivity, sustainability and evolution of an ecosystem is possible only when the factors that directly or indirectly affect it are kept above a minimum and below a maximum value.

8. Arrange in order the main tasks of the Environmental and Natural Resources Management:

2	Organization
4	Control
1	Design
3	Management

9. Note the main trends in sustainable development obligations:

X	Satisfaction of even the smallest human needs
X	The application of science, technology and environmental knowledge for global development
	Compensatory Management aimed at mitigating the effects through compensatory measures
	Policy making and planning
	The human ecology approach
X	The integration of environmental care and development
	Establishing standards and rules, monitoring and control
X	The adoption of long-term supervision
	Flora/fauna

10. Note the definition of Environmental and Natural Resources Management:

	The effort to meet human needs through the use of natural resources while maintaining the biological wealth and ecological functions required to maintain the structure and functions of the ecosystems under study.
X	The proper utilization and exploitation of wealth-producing resources, which implies the simultaneous protection of the environment.
	Sustainable Development is considered the process in which the needs of the present are met without compromising the ability to meet the needs of the future.
	The integration of scientific knowledge on ecological relations in a complex, socio-political and value framework towards the general goal of long-term protection of the natural integrity of ecosystems.

11. Note the definition of Sustainable Development in the United Nations World Commission on Environment and Development:

	The effort to meet human needs through the use of natural resources while maintaining the biological wealth and ecological functions required to maintain the structure and functions of the ecosystems under study.
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The proper utilization and exploitation of wealth-producing resources, which implies the simultaneous protection of the environment.

Sustainable Development is considered the process in which the needs of the present are met without compromising the ability to meet the needs of the future.

The integration of scientific knowledge on ecological relations in a complex, socio-political and value framework towards the general goal of long-term protection of the natural integrity of ecosystems.

12. Put the stages of ecosystem approach in the right order:

3

Identification of the most important economic issues affecting the ecosystem and its inhabitants.

4

Determining the impact of the ecosystem under study on neighboring ecosystems.

5

Defining long-term goals and flexible ways to achieve them.

1

Defining the main stakeholder groups, defining the extent of the ecosystem and developing the relationships between them.

2

Characterization of the structure and operation of the ecosystem under study and definition of management and monitoring actions.

Educational Unit 2 "Degradation of the Environment and Natural Resources"

Purpose of the Educational Unit

The purpose of the second educational unit is to help the students of the program to know the main causes of degradation of the natural environment and natural resources. Starting with the description of the man-made environment, the educational unit continues with the effects of global population growth and urbanization. From these, as well as from economic development activities, come all the other causes of environmental degradation, most importantly that of biodiversity reduction, pollution, and consequently climate change.

Expected Results of an Educational Unit 2

The second Educational Unit aims to introduce the students of the programs to:

- The anthropogenic environment.
- The problem of global population growth
- The problem of urbanization
- The problem and aspects of pollution
- The causes of degradation arising from the various economic activities
- The problem of biodiversity reduction
- The problem and effects of climate change

Key concepts of Educational Unit 2

Anthropogenic Environment, Global Population, Urbanization, Pollution, Biodiversity Reduction, Climate Change

Subsection 2.1. Anthropogenic Environment

Humans, as a factor of change in the environment, have been functioning for only the last about 5,000 years. Their impact on the environment is not normal, and therefore their results are not predictable. Many of the anthropogenic activities disrupt the complex relationships of organisms, both with each other and with their abiotic environment, and cause damage that is difficult to reverse or irreversible (Βακασίρη, 2016).

The human as a member of the ecosphere participates in the complex system of relationships that shape the environment. He is an integral part of the biosphere, he depends entirely on it, from where he draws the vital components for his survival. Human societies could be considered as a subsystem of the environment. But the humans are radically separated from all other organisms through the culture they have developed (Morin; 1980) and their ability to modify the natural environment (Καραμέρης, 2008).

Anthropogenic or Artificial Environment is defined as the environment that was and is created exclusively by human interventions (Παυλογεωργάτος, 2003; Παπαμανώλης, 2015; Βακασίρη, 2016). At the same time, the Anthropogenic Environment includes agricultural areas, managed and controlled forest areas, artificial lakes, etc. (Βακασίρη, 2016).

However, its most obvious form is the residential environment, ie settlements and cities and various technical projects, such as roads, networks, dams, ports, etc. (Παπαμανώλης, 2015). The residential environment, despite the small part of the Earth's surface that it occupies, gathers many activities that have far-reaching effects on the natural environment. Components of the residential environment are the population, the social and economic activities it hosts, the land usage, the constructions and the transport and infrastructure networks (Παπαμανώλης, 2015).

The Anthropogenic Environment is distinguished in (Καραμέρης, 2008; Σκούλλος, 2012; Βακασίρη, 2016):

- Technological (Artificial or constructed): It refers to know-how, technology, infrastructure, etc. It includes cities, industrial complexes and transportation systems (roads, airports, etc.).

- Social: It refers to the human interaction with other people. As humans adapt and create relationships with other people, thus forming human society, they shape another environment, the social environment. The social environment of humans is delimited by social and economic institutions, laws and social organization, elements that are constantly changing and evolving. The social environment is dynamic and not static, and is determined by beliefs, manners and customs, skills and behaviors. As it is inextricably linked to evolution, it is obvious that the form of the social environment changes over time.
- Spiritual: It refers to the worldview, the relationship with the divine, etc. It includes philosophy, metaphysics, religions and quests on a spiritual level.
- Cultural: It refers to knowledge and culture. Humans, in their effort to understand the world around them, acquire knowledge and develop ideas. These characteristics, in combination with material crafts and social institutions, are inherited and change from generation to generation. They thus constitute another environment, the cultural one, which is neither fixed nor unified, but varies from place to place and from season to season.

Examples of types of anthropogenic environments ([Καραμέρης, 2008](#)):

- Agricultural Holdings

Humans, with the discovery of agriculture, stopped wandering in search of food. They learned to intervene in natural ecosystems and reduce the number of species that made them up, so that they could increase the quantity or yield of the desired species that they would cultivate. Agriculture has shaped most landscapes on the planet. It has contributed over the centuries to the creation and maintenance of a variety of valuable semi-natural habitats but is also responsible, due to inappropriate agricultural techniques used to date, for a number of environmental problems such as soil, water and air pollution, habitat fragmentation and loss of wildlife.

- Industrial Environment

The development of the industry and the evolution of technology have enabled humans to intervene drastically in natural processes and to radically disturb the natural environment. Industrial activities are the most important factors on which the state of the environment and the quality of life depend. One of the most important human effects on the environment is the interruption of the flow of materials, the depletion of non-renewable natural resources and pollution. Industry has contributed the most to these ([Πουσομουςτακάκη, Μ. 2000](#)).

- Artificial Lakes

Artificial lakes (reservoirs) mainly seek to contain all or most of the rainwater, which falls during the rainy season. Retained water is used for various purposes, eg irrigation, water supply, hydroelectric power, etc. In this way control of flood peaks is achieved at the same time. They are mainly offered for the creation of water reserves in areas that suffer from water scarcity in general or at certain times of the year. Most artificial lakes support more or less valuable wetland ecosystems and have acquired other values over time, e.g. organic, fishing, leisure, etc ([Θεοδωρακάκης, 2000](#)).

- Mining areas

Mining is the process of "acquiring" valuable minerals and other geological materials from the soil and subsoil. Mining materials are for example, coal, bauxite, gold, copper, oil, etc. Mines and mining areas have existed since antiquity and since then humans have the ability to transform the landscape and relief. The prosperity of many cultures was marked by the discovery, extraction and use of minerals and metals. The exploitation of mineral wealth seriously disrupts the natural environment. Many of the effects on the natural environment include erosion, deforestation, biodiversity loss, and the pollution of groundwater with hazardous chemicals from the extraction process and its products.

- Structured Environment

The term "structured environment" is used to describe the man-made environment in the strict sense of the term. Structured environment is usually synonymous with the urban environment, but also includes the road network. The city is for all these people the daily living environment. Urban centers show significant problems such as ([Καραγιάννη κ.α. 2014](#)):

- Poor air quality
- Dense road traffic
- High noise pollution
- Moderate quality of structured environment
- Generation of waste and sewage

These problems have an impact on the environment locally and globally, as well as on the health of citizens.

In general, the negative effects of humans on the environment are exerted mainly in two directions (Παπαμανώλης, 2015):

- In the excessive consumption of natural resources (raw materials, water, energy resources)

The depletion of finite natural resources, as a consequence of their excessive consumption, is the nightmarish scenario for the planet that the so-called sustainable development attempts to prevent, ie the development that "ensures the needs (in natural resources) of the present, without jeopardizing the coverage of the needs of the future "(see Educational Module 1).

- In environmental pollution

Pollution is defined as the presence in the environment of any kind of substances, forms of energy or pathogenic microorganisms, in quantity, concentration or duration, which can cause either adverse effects on health, living organisms and ecosystems or material damage, and generally create an environment unsuitable for the desired uses.

Subsection 2.2. "Causes of Degradation of the Environment and Natural Resources"

Difficulties in managing environmental problems caused by human activities have led to their designation as "Unsolved Problems" (Rittel and Webber, 1973; Ludwingetal, 2001). The reason that led to this characterization is the uncertainty that characterizes the reactions of the various environmental systems to the occurrence of problems. Based on the published literature - articles, there are many sources and types of uncertainty (eg. Burgman, 2005; Norton, 2005). In general, however, the management of environmental problems is affected by at least four factors (Williams, 2011):

1. Environmental diversity: It is the most widespread source of uncertainty, and it is largely uncontrollable. It often has a dominant influence on natural resource systems, through various factors such as random climate variability.
2. Partial observation: This refers to the uncertainty about the state of resources. An obvious expression of partial observation is the sampling variation that results in resource monitoring.
3. Partial controllability: This expresses the difference between the actions announced and the actions implemented in practice. This uncertainty usually arises when indirect methods (e.g. regulations) are used to implement an action (eg setting a crop or productivity rate), and can lead to the possible misleading of management interventions and, consequently, to an insufficient accounting of the impact of these actions on the behavior of the systems under management.
4. Structural or procedural factor: This uncertainty refers to the lack of understanding (or lack of agreement) regarding the structure of biological and ecological relationships that promote the dynamics of natural resources.

This section outlines the most important of these problems. Specifically:

- Population growth and urbanization
- Pollution - contamination of the environment
- Reduction of biodiversity

A very important environmental problem, among others (eg acid rain) is also climate change. However, this arises from the structure of the atmosphere in conjunction with its pollution. In other words, it is a derivative problem. This will be described in Subsection 2.3.

2.2.1. Population Growth and Urbanization

2.2.1.1. Global Population Growth

According to the following graph (Figure 2), the world population is expected to reach 9 billion by 2050 (Gandy, 2004).

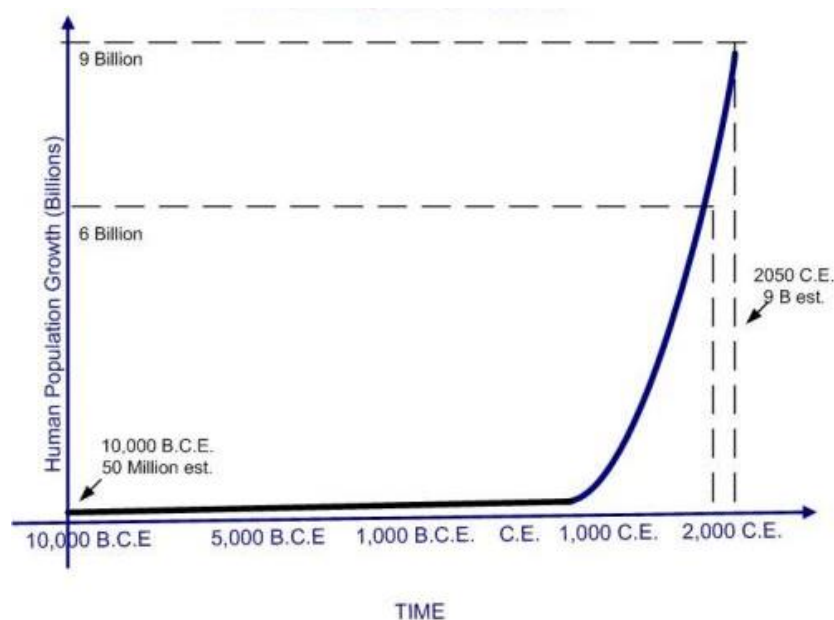


Figure 2. The estimated increase in world population.

The increase in the world's population is the result of many causes that have emerged over time. Examples are the emergence of more effective drugs and vaccines (reduction of child mortality) and the constant struggle of states for development (Baus, 2017).

Specifically, and following the previous example, the tendency of the world population to increase depends on two factors:

- The frequency of births
- The rate of deaths (mortality)

Based on this, the world population is growing when:

- The birth rate remains constant and the death rate decreases.
- The birth rate increases and at the same time the death rate remains constant.

The increase of the world population, through economic activities, causes the parallel increase of the consumption of natural resources and the production of larger amounts of unwanted residues (Harte 2007, Mora and Sale, 2011). An example is the agricultural sector where the need to increase food products has led to an increase in the use of chemical fertilizers and pesticides (Mora and Sale, 2011).

Regarding the need for food, it is worth mentioning that almost 1 billion people are facing hunger (FAO, 2010) and many others live in areas with severe water shortages (FAO, 2011). It is estimated that by 2050, food demand will increase between 70% - 100% compared to today (Godfrayetal. 2010). At the same time, the percentage of the population living in areas with water scarcity will have increased from 3 to 5 times (Gardner-OutlawandEngelman 1997).

Meeting the nutritional needs (including the need for water) of an ever-increasing population is a particular challenge for a variety of causes. Among them are the following:

- Drinking water reserves are finite (Vöösmartyetal. 2000, FAO 2011).
- Human activities threaten more than 65% of the mainland inland waters (Vöösmartyetal. 2010).
- The agricultural sector uses about 70% of the total water earnings.
- Expanding the agricultural sector is not an easy solution as 70% of the land suitable for food cultivation is either already used or can not be used (Foleyetal. 2011).
- There is a tendency to change crops towards the production of biofuels.

The situation in the field of food production and water supply is common to other non-renewable resources such as metals, fuels and minerals. Regarding the latter, it is estimated that 88% of known minerals are now rare in nature as their extraction cannot keep up with the growing global demand (Clugston 2010).

In fact, human activities in combination with modern technology and practices have dramatically increased the exploitation of lands and natural resources. In recent decades, human activities (such as agriculture, mining, etc.) have become so intense that their effects are manifested in the form of uncontrolled growth, degraded

environmental quality, loss of major agricultural lands, destruction of wetlands and loss of wildlife species (Kharel, 2010).

2.2.1.2. Urbanization

Urbanization, in general, is the tendency to increase the concentration of the population of an area as a result of movement and redistribution (GerusonandMcGrath, 1977). The movement of populations usually starts from rural or suburban areas to large urban centers. Alternatively, the term "astyphilia" is used to describe the love for the city and the growing tendency of the centralization of the population.

The increasing rate in the size of cities is more evident in recent years. In particular, the growth rate of the urban population is almost twice that of the total population (Kharel, 2010). The rate of urbanization is higher in developing countries. Indicatively, in some African countries, the annual urbanization rate reaches 10% (Kharel, 2010).

According to the United Nations (UN), in 2010 50% of the world's population lived in urban areas. It is estimated that another two billion people will be added to this population and the global urban population will reach 60% of the total world population by 2030 (The Nature Conservancy, 2008). Finally, it is estimated that this percentage will reach 70% by 2050 (The Nature Conservancy, 2008). This increase in the size of cities can lead to significant damage to various ecosystems and natural resources around the globe. More specifically, increasing the size of cities requires appropriate land and leads to a change in land use. This in turn leads to the creation of environmental problems such as water and air pollution, loss of open spaces and biodiversity, etc. (Kharel, 2010). Mitigating the effects of such environmental problems is costing humanity billions of dollars. Therefore, assuming that urbanization will continue to increase in the coming decades, the cost to humanity will be higher.

The following describes the effects of urbanization on three particularly important resources:

- Soil
- Water
- Biodiversity

A. Impact of Urbanization on Land Resources

According to [Marcotullio et al. \(2008\)](#), urbanization alters the biological, chemical and physical properties of soil. This results in the degradation of its quality to the point that it leads to the loss of vegetation, to reducing its ability to filter water, to the accumulation of heavy metals, to the increase of surface runoff and soil erosion. The latter impact is considered one of the main forms of degradation of soil quality and exposes the soil to the risk of landslides ([Beek et al., 2008](#)). In the United States, landslides cause a damage of \$ 1-2 billion and an average of 25 lives lost each year ([U.S. Geological Survey, 2010](#)).

B. Impact of Urbanization on Water Resources

Global population growth, the intensity of urbanization and changes in land use are affecting water availability to the extent that their reserves can be significantly reduced or rendered unusable due to pollution and contamination ([Smith et al, 2007](#)). This can cause conflicts between different users (water supply, irrigation, industry and activities) for access to this resource. Indicatively, again in the United States, the total wetland area decreased from 890,300 km² before 2004 to 435,600 km² after 2004 ([Dahl, 2006](#)).

C. Impact of Urbanization on Biodiversity

Urbanization, through land use change (with the construction of roads and networks, the removal of vegetation, etc.), leads to the fragmentation of ecosystems and is a major threat to wildlife ([Theobald, 1997, McKinney, 2002, Kharel, 2010](#)). At the same time, urbanization increases the dominance of non-food items in specific areas and changes the existing balances that have developed between food items over time and through adaptation ([Mckinney, 2006](#)). In the United States, more than 10% of edible species are considered endangered ([Stein, 2002](#)). The fragmentation of ecosystems and the expansion of non-food species contribute to this increasingly. These two factors affect 85% and 49% of endangered food species respectively ([Wilcove et al., 1998, Wilcove and Master, 2005, Kharel, 2010](#)).

2.2.2. Pollution and Contamination of the Environment

In general terms (Τσιλιγκιρίδης, 2015):

- Environmental pollution is characterized by the existence of pathogens or indicators that indirectly show the possibility of the presence of such microorganisms or chemicals in elements that can be used by humans causing pathogenic conditions.
- Environmental contamination is the energy and particulate burden the environment that is expressed or perceived as degradation of the biosphere and is calculated qualitatively and quantitatively with the effects and symptoms observed in the flora, fauna, air, soil, water and to the persons.
 - The particulate burden refers to the charge of the environment with substances.
 - The energy burden is related to noise, radiation, heat, etc. emissions.

Environmental pollutants come from a variety of sources. However, there are two general categories of sources (Τσιλιγκιρίδης, 2015; Παπαμανώλης, 2015):

- The point sources of pollution - individually identified sources, such as the chimney of a power plant, the drainage pump of an industrial plant, etc.
- The non-point sources of pollution - scattered and difficult to locate sources such as fertilizers and insecticides from arable land and gardens, flowing into rivers and lakes, and insecticides reaching the atmosphere by spraying or of the wind.

Environmental pollution can be divided into different categories based on specific criteria (Figure 3). The following criteria are generally acceptable (Καραγιάννη κα, 2014; Παπαμανώλης, 2015; Τσιλιγκιρίδης, 2015):

By type of pollution source - the main categories are:

- Natural sources of pollution: Includes those that exist in nature and are not the result of human activity, such as forests and volcanoes.
- Anthropogenic sources of pollution: This category includes all sources of pollution that are the result of human activity. Some of them are industry, urban activities (municipal wastewater, solid waste), traffic (road, air, etc.), central heating, agricultural activities, etc.

By recipient - depending on the recipient (direct and not final) the pollution is divided into:

- Air pollution: The direct recipient is the air, i.e. the atmosphere, for this reason it is alternatively referred to as atmospheric pollution or pollution of the atmosphere.
- Water pollution: The direct recipient in this case is the large surface and groundwater water masses of the planet (rivers, lakes, sea, underground aquifers).
- Soil pollution: With the direct recipient being the solid earth layer.

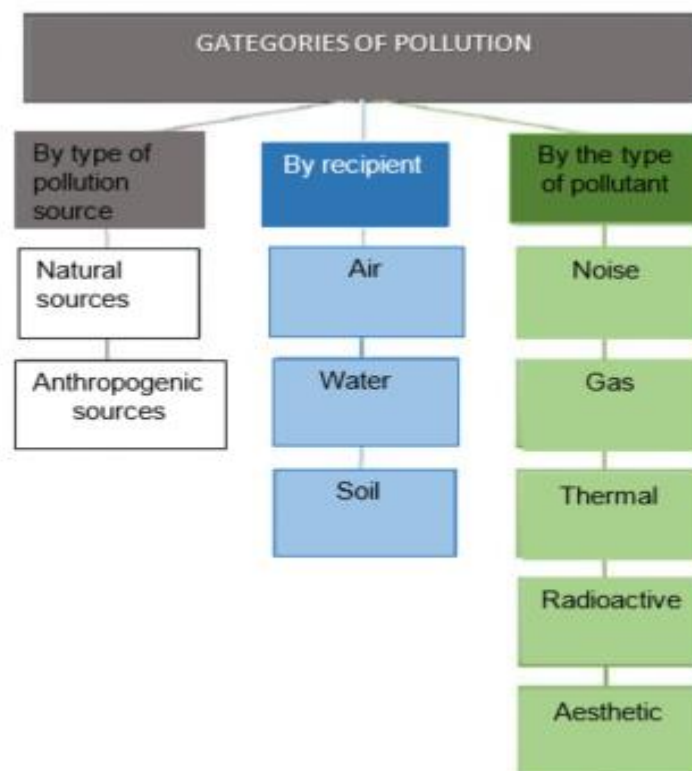


Figure 3. Categories of pollution (Τσιλιγκιριδης, 2015)

According to the type of pollutant, pollution can be divided into:

- Gas pollution: This category includes all forms of pollution due to gaseous chemicals. Pollution caused by solid or liquid particles is also classified in the same category. This is due to the fact that particles, whether solid or liquid, behave largely as gases. With few exceptions, the direct recipient of gaseous pollution is the air. This is another reason why particles fall into the category of gaseous pollutants.
- Noise pollution: This is a form of pollution due to the emission of energy into the atmosphere in the form of sound waves. It is generally one of the less serious

forms of pollution, mainly because it is concentrated in specific areas (industrial facilities, highways, airports, etc.) and therefore it burdens a relatively small number of recipients. The direct recipient of noise pollution is the air.

- Thermal pollution: This is again a relatively minor form of pollution, due to the discharge of thermal energy into the environment. The negative effects that occur are minimal, even when the amounts of energy emitted are large, and are mainly limited to the annoyance of certain species of the animal kingdom, which are usually forced to migrate. The direct recipient of thermal pollution is either the air or the water and in rare cases the soil.
- Radioactive pollution: This is a very serious form of pollution due to the release into the environment of radioactive substances. Its characterization as very serious is due to the fact that its effects can be particularly significant and due to the "lifespan" of these negative effects, which can be up to hundreds of years, depending on the half-life of the discarded radioactive substances. Recipients of radioactive pollution, again depending on the nature of the radioactive substances, can be the air, the water and the soil.
- Aesthetic pollution: It is the most innocent form of pollution that causes only aesthetic discomfort. Establishing rules for protection against aesthetic pollution is practically difficult, due to the subjectivity of the relevant criteria.

The following table ([Table 2](#)) presents the categories and dimensions of environmental pollution ([Τσιλιγκιρίδης, 2015](#)).

Table 2. Categories and dimensions of environmental pollution (Τσιλιγκιρίδης, 2015)

Dimensions of the pollution	Manifestation of phenomena	Effects
Global	<ul style="list-style-type: none"> – Atmospheric ozone depletion – Climate change – Ocean pollution 	<ul style="list-style-type: none"> – Increase of dangerous radiation – Increase in average global temperature – Alteration of large ecosystems
Transnational	<ul style="list-style-type: none"> – Acid rain – Pollution of rivers, lakes, seas 	<ul style="list-style-type: none"> – Destruction of forests and lakes – Alteration of ecosystems
Regional/local	<ul style="list-style-type: none"> – Smoke – Photochemical smog – Pollution of surface and groundwater 	<ul style="list-style-type: none"> – Risks to human health – Destruction of wetlands
Working spaces	<ul style="list-style-type: none"> – Emission of toxic substances 	<ul style="list-style-type: none"> – Diseases in the working spaces
Living spaces	<ul style="list-style-type: none"> – Emission of toxic substances by industrial products 	<ul style="list-style-type: none"> – Long-term effects on human health

In the review of [Καραγιάννη et al. \(2014\)](#) and [Τσιλιγκιρίδη \(2015\)](#), the most important gaseous pollutant emission activities are categorized as follows:

1. Electricity generation, cogeneration and district heating (electricity generation units and heat generation units for local consumption).
2. Combustion for commercial, public service and domestic facilities (combustion units for heat production in households, commercial stores, public buildings, offices, greenhouses, etc.).
3. Industrial combustion (combustion in boilers and gas turbines for the production of heat or mechanical power and combustion in furnaces with or without contact of flame and exhaust gases with products). An example of combustion in furnaces without contact of flame and exhaust gases with products are foundries, steel and iron smelters, cement factories, glass production units, paper industries, primary and secondary metal production units, etc.
4. Industrial processes that do not involve combustion (processes such as wineries, breweries, production units of spirits and bread, chemical industries and special

- processes in refineries, steel, iron and ore industries, non-ferrous metal industries, etc.).
5. Extraction and disposal of fossil fuels (extraction and first treatment of solid, liquid and gaseous fuels, their storage, disposal of liquid fuels and gaseous transmission and distribution networks of gaseous fuels).
 6. Use of solvents (processes in the production of paints, degreasing of metals, dry cleaning, production and processing of chemicals, wood preservation, printing, etc.).
 7. Road transport (vehicle traffic and gasoline fumes from vehicles).
 8. Other moving sources (agricultural, forestry, military and industrial vehicles and machinery, railways, airports and sea traffic).
 9. Waste treatment and disposal (incineration of municipal waste and industrial waste, wastewater treatment, landfills, waste fertilizer production, biogas production, uncontrolled incineration of agricultural by-products, etc.).
 10. Agriculture and Animal Husbandry (various crops with or without the use of fertilizers, reed burning, animal husbandry). As for the latter, animal husbandry is considered a source of air pollutants due to the intestinal fermentation of animals and their secretions.
 11. Nature (forests, forest fires, natural pastures, mires, swamps, lakes, rivers, groundwater, canals, runoff, sea, volcanoes, etc.). Most of the procedures that fall into this category are not controlled by humans.

The next three subsections outline three important problems arising from the pollution of the environment and in particular of the atmosphere.

2.2.2.1. Stratospheric ozone depletion

Ozone is found in two levels of the atmosphere:

- In the stratosphere (around 15-50 km above the ground).
- In the troposphere (the lowest part of the atmosphere up to 15 km above the ground).

Ozone accumulates in the stratosphere as a layer that is like a thick zone around the earth and acts as a filter that prevents solar ultraviolet radiation from reaching the earth. The concentration of this gas is useful, as it protects the earth by absorbing about 80-90% of ultraviolet radiation. Stratospheric ozone depletion is a cause for concern about the effects of radiation on the planet. A 1% reduction in stratospheric ozone leads to a 1-2% increase in ultraviolet radiation ([Τσιλιγκριδης, 2015](#)). An

example of the effects of radiation on the planet, in addition to the effects on human health (increasing the incidence of skin cancers), is its negative effect on microorganisms, such as phytoplankton, which form the basis of all aquatic food tissue. The ecological consequences of this effect can be catastrophic ([Μανιός,2007](#))

Ozone in the stratosphere is destroyed when chlorine and bromine appear in their atomic form (as radicals) or as active minerals. The stratospheric ozone depletion was caused by continuous release of industrial halocarbons (CFC). Planes also cause damage to the O₃ layer since, the higher they fly and the faster they reach their destination, the greater the damage to the O₃ layer from NO_x emissions ([Καραγιάννη κα. 2014](#); [Τσιλιγκρίδης, 2015](#)):

The halocarbons travel up into the atmosphere and under the influence of sunlight are decomposed and a large amount of chlorine is released which easily and quickly destroys the O₃ layer. When the CFCs reach above the O₃ layer, the halogens are released. The ability of halogens to destroy O₃ is a function of the ease with which active radicals can be released from large amounts of gases, such as fluorine and hydrogen fluoride due to the continuous release of CFCs. Photolysis and oxidation in the atmosphere remove large amounts of CFCs. 50% of world consumption of CFCs is used in air conditioning, heat pumps, refrigeration (food preservation) and in the production of certain plastics.

Already, much of the ozone over Antarctica has been lost, creating the famous "ozone hole" with an area of more than 10 million square kilometers, while in other parts of the world the ozone depletion ranges from 2 - 6 %. Measures taken to eliminate pests will gradually pay off during the 21st century. Until then, however, UV radiation will continue to cause harm to human health. ([Μανιός,2007](#); [Καραγιάννη κα. 2014](#))

2.2.2.2. Acid Rain

The term acid rain means rain with a pH lower than normal. The normal pH for clear rain is 5.6, which corresponds to the pH of distilled water that is in equilibrium with CO₂. A similar definition applies to other meteor precipitations (snow, hailstone, fog).

The term was first mentioned about 25 years ago when scientists in Sweden and Norway initially thought that acid rain could cause great ecological damage to the planet. However, by the time they understood the effects of the acid rain, the problem had already become too great.

The acidity of rainwater is mainly due to the presence of strong acids, H_2SO_4 and HNO_3 (Τσιλιγκρίδης, 2015). In some cases other minerals (HCl , H_3PO_4) or organic acids ($HCOOH$, CH_3COOH) coexist, but usually not in significant amounts.

Acid rain has been found to affect almost all components of the biosphere: soil, forests and crops, lakes and aquatic life, various materials, buildings, water pipes and monuments (Figure 4).

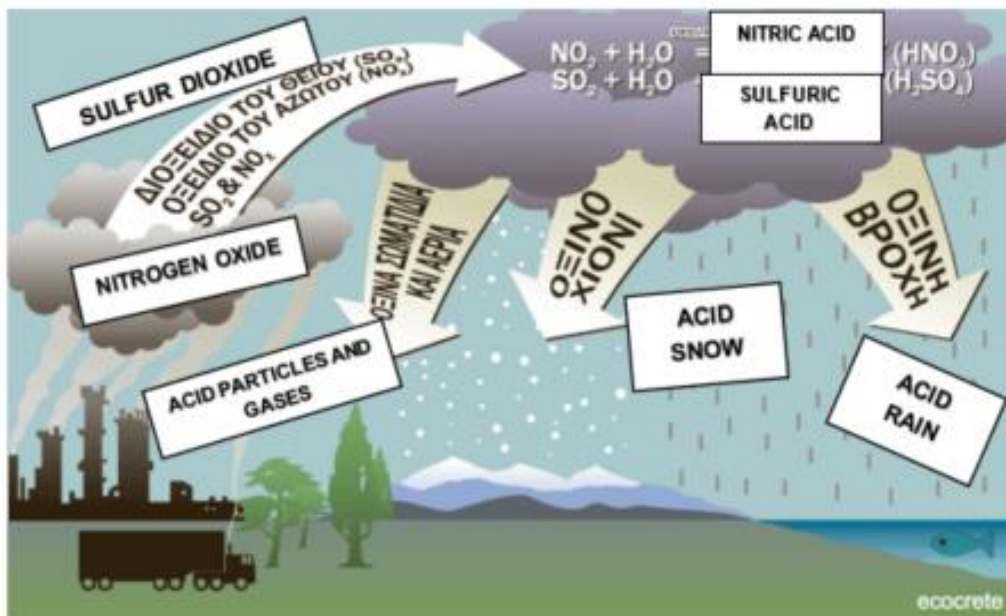


Figure 4. Presentation of the phenomenon of acid rain

An important feature of acid rain is the fact that a large part of the acidic chemicals / pollutants produced in one country can be transported to other countries by winds (cross-border pollution) (Καραγιάννη κα. 2014; Τσιλιγκρίδης, 2015). For example, more than 75% of acid deposits in Norway, Switzerland, Austria, Sweden, the Netherlands and Finland are transported by wind to these countries from the industrial areas of Western and Eastern Europe. Acid deposition is also a major problem in China, Ukraine, Russia, India, Nigeria, Brazil, Venezuela and Colombia.

2.2.2.3. Photochemical smog

The photochemical smog is characterized by the photochemical formation of secondary air pollutants with oxidizing properties, such as O_3 , NO_2 , peroxyacetyl nitrate (PAN) etc. (Τσιλιγκρίδης, 2015).

Tropospheric ozone, unlike the stratospheric ozone mentioned above and which protects the planet from ultraviolet radiation, is a secondary pollutant produced after complex reactions. Ozone is an important component of the smog (photochemical smog) that is created when sunlight affects a mixture of CO, VOC and NO_x. The amount of ozone that is concentrated in the lower layers of the atmosphere is harmful to health, vegetation (eg vegetables), while it can be deadly to plants and animals when it exceeds 200 µg/m³ (Τσιλιγκρίδης, 2015). High concentrations of ozone cause respiratory problems and plant vulnerabilities (yellowing or leaf fall).

In order for a photochemical smog to be created in an area, the following conditions must be met (Τσιλιγκρίδης, 2015):

- Lack of wind and simultaneous temperature reversal.
- Primary pollutants emissions such as VOC, NO_x, etc.
- Solar radiation of high intensity.

This phenomenon has been found to be a common problem in most urban areas. The cause is the NO_x and VOC emissions from cars.

The components of the photochemical smog have adverse effects on human health, vegetation, various materials and the characteristics of the atmosphere (visibility). The extent to which exposure to the photochemical smog affects human health is not exactly known, although many of its components have toxic effects (Τσιλιγκρίδης, 2015).

The components of the smog also adversely affect the various materials. Tire wear from O₃ has long been known and has even been used as a diagnostic of O₃ formation in early photochemical smog studies. Also the formed acids, HNO₃ and especially H₂SO₄ cause corrosion in many materials.

The effects of the photochemical smog on the visibility of the atmosphere are also important, due to the formation of aerosols from the polymerization of smaller molecules produced by the photochemical reactions.

The destructive effects of the photochemical cloud on vegetation are of particular importance (Τσιλιγκρίδης, 2015). More specifically, the destructive effects are due to oxidants, such as O₃, PAN and NO₂. The greatest phytotoxicity is shown by PAN, which infects the young leaves giving them a bronze, glossy surface. Fortunately PAN is usually present in the atmosphere in very low concentrations. NO₂ is found in higher

concentrations, but its phytotoxicity is much lower. Thus, O₃ is the greatest oxidative threat to vegetation.

2.2.3. Biodiversity Reduction

According to many literature sources, the main anthropogenic causes of biodiversity reduction are the fragmentation of ecosystems, the exploitation of natural resources, the pollution and contamination of natural resources (soil, water, air), the introduction of non-food species, climate change, etc. However, many times there can be no distinction between the above causes due to the particular links that connect them.

The following are the main reasons for the reduction of biodiversity according to [Slingenberg et.al. \(2009\)](#).

Changes in land use

Landscape changes from various anthropogenic activities have been identified as the leading causes of biodiversity loss. In order of importance, the main activities are crops, infrastructure development and deforestation. Specifically:

- Expansion of crops by increasing food production in developing countries:
 - Food production and agricultural land development in developing countries are estimated to increase in the coming years.
 - The expansion of the agricultural sector for meat production is estimated to increase in the coming decades and at the same time will increase the intensity of land use changes with the conversion of forests into pastures.
- Expansion of crops from the increase of biofuel production:
 - The recognition of the damage caused to the environment by fossil fuels and the expression of these damages in the increased price of fuel leads to the study and search for alternative, renewable energy sources in many countries around the world. Especially in those countries that are directly dependent on fuel imports (e.g. European Union countries and the United States of America).
 - The contribution of biofuels in reducing the use of fossil fuels is particularly large and leads the global transport sector to alternative energy sources.

- The immediate causes of biodiversity reduction from biofuel production is the immediate change of land use of valuable areas with high conservation value. It contributes to the fragmentation of ecosystems and the loss of services they provide (such as carbon sequestration). At the same time, the use of pesticides and genetically modified crops increase the risk of extinction of sanctuary and biodiversity.
 - There is also the phenomenon of shifting the economic activities of one area to another due to the production of biofuels (e.g. the conversion of a pasture into a biofuel crop). Relocated activities are once again degrading the new areas in which they are settling.
 - The production of biofuels consists of monocultures that change the balances of local biodiversity (replacing many species with one), increase the risk of extinction of certain species of flora and fauna, while at the same time they can introduce edible plant species.
- Infrastructure development
 - Infrastructure development includes the expansion of cities and transmission networks.
 - The impacts of infrastructure development on biodiversity include:
 - The various nuisances caused in the wild.
 - The fragmentation of ecosystems through obstacles.
 - The increasing hunting activity.
 - The development of small settlements in parallel with the course of transport networks (roads).
 - Deforestation:
 - Deforestation is characterized by a wide range of different forms. This varies from selective logging of some trees to total removal of forest species. In general, deforestation is considered to be the reduction of tree canopy to less than 10% of forest cover.
 - Despite efforts to implement specific policies and strategies, 130,000 km² of forest disappear each year ([FAO, 2006](#)).
 - Rainforests are home to almost 50% of the world's biodiversity. Therefore, the preservation of tropical forests is essential for the conservation of the diverse life forms on the planet. Therefore, deforestation is considered a direct cause of biodiversity loss due to the loss of specific ecosystems.

- Deforestation also plays a role in the evolution of climate change through:
 - The release of carbon into the atmosphere due to the fires (biomass combustion).
 - The non-absorption of atmospheric carbon (from the removal of biomass without combustion).
- The driving forces of deforestation are many. These include the use of forest lands for agricultural activity, the prices of agricultural products, the development of infrastructure, the need for timber and other forest products as well as a complex set of institutional factors that may be of particular importance in some societies ([Fearnside, 2006](#)).

Contamination

- Air contamination:
 - Air contamination affects biodiversity on a large scale.
 - The atmosphere, lithosphere and hydrosphere are adversely affected by the type of pollution.
 - Air contamination affects lower life forms more than higher life forms.
 - Plants are more affected than animals in terrestrial ecosystems but not in aquatic ones.
 - Plants receive atmospheric gases on a daily basis to maintain their biological processes.
 - Cars are the most important source of air pollution as they release carbon monoxide (CO). In terms of their importance as sources of pollution, they follow the industrial sources that release sulfur oxides and other pollutants.
- Water contamination:
 - Water contamination comes from various substances that enter water bodies and adversely affect the respective ecosystems, the health of various species (including humans) and related activities (eg swimming, diving, fishing, etc.).
 - Hot water from nuclear power plants and microorganisms from untreated liquid waste are important sources of water contamination.
 - The effects of pollution are extensive and include the contamination of groundwater and surface water reserves, pollution of the oceans and rain (in the form of acid rain).

- In the majority of modern societies, industry is the most important source of pollution, accounting for more than 50% of total water contamination and producing the most deadly pollutants.
 - Thousands of production units around the world use huge amounts of water to dispose of their waste. This polluted and contaminated water ends up in rivers, lakes or oceans. In turn, these water bodies disperse the pollutants.
- Water pollution, among other effects, tends to cause long-term changes in biodiversity.
- Eutrophication is one of the most easily observed effects.
 - This phenomenon occurs in aquatic environments that have minimal fresh water (eg lakes). The constant supply of nutrients (mainly phosphorus and nitrogen), contributes to the appearance of microorganisms (algae). The decomposition of these microorganisms causes intense consumption of oxygen with the result that the species that live in this water body suffocate. The result is an immediate reduction in the species that can host / support the water body.

Irrational use of natural resources

- Fishing/Fish farming
 - Fishing is essential for the survival of around 200 million people (especially in developing countries), with one in five people dependent on fish for their protein intake.
 - According to the relevant UN agencies, fish farming is the fastest growing of any other livestock sector.
 - Despite the growth of fish farming, global fish stocks are at high risk due to the intensive rate of fishing.
 - The problem is not limited to the number of endangered fish species. Through the nutritional relationships between species, changes in the number of fish affect other species in the aquatic ecosystem.
 - The magnitude of the problem of intensive fishing is often overlooked due to other problems such as deforestation, the exploitation of energy resources, and other problems related to biodiversity reduction (e.g. infrastructure development).
 - The rapid increase in demand for fish and their by-products leads to a rapid increase in their price (compared to meat prices). As a result, investment in

the fishing sector seems particularly attractive to companies and governments. In turn, this increases the risk of depletion of fish stocks to a greater extent.

- In the last two decades, in the North Atlantic region, the population of the most commercial fish has decreased by 95%.

○ Mining

- The effects of mining on the environment depend to a large extent on the method used, the soil conditions (quantity and condition of the mineral or ore), the mining area as well as the size and duration of the mining activity.
 - Unlike underground mining, ground mining causes extensive environmental damage.
- Although the mining method is chosen according to specific criteria, the political and social components can be very influential.
- Regardless of the method used, carbon mining (coal) affects the environment in many ways.
- Coal appears locally and is mined, treated and transported before use. These processes affect the environment by increasing:
 - The number of people in an area
 - The demand for public facilities
 - The damage to arable land
 - The disruption of existing ecosystems
 - Deforestation
 - The production of mining waste
 - Groundwater and surface water pollution
 - Air pollution
 - The production of noise and vibration
 - And many more

○ Wood gathering

- Global trade in wood and other related products increased by 6% between 1983 and 2005.
- In terms of its importance in reducing biodiversity, the commercial use of wood has a much greater impact on biodiversity compared to the use of wood as a fuel.
- Wood gathering for use as a fuel for domestic purposes remains a major problem in developing countries.

- E.g. In Africa, wood and charcoal are still used for cooking as no other cheap source of energy is available. Only 7.50% of the rural population has access to electricity.

Invasion of non-food items

Invasion of non-food species is defined as species that bypass geographical or reproductive barriers and threaten ecosystems or food species. This phenomenon has environmental and economic implications. The invasion of non-food species has been considered the second largest threat to biodiversity after land use changes ([Rodríguez-Labajos and Monterrosoa, 2009](#)).

Like other aspects of global environmental change, imports of non-food items are anthropogenic. Many studies have reported the factors of a successful species invasion taking into account the ecological characteristics of the species and / or the respective ecosystems. Ecological differences between non-edible and edible species, flexibility in their behavior or the rate at which they interact with other species are some of these factors.

According to [Kolar](#) and [Lodge\(2001\)](#), about 23 traits have been identified that distinguish a species' ability to invade an area. In contrast, the anthropogenic mechanisms that contribute to the success of an invasion are reported in few studies. Some of these mechanisms are the technical and economic development of the people of an area as well as the cultural choices.

Several components of environmental degradation contribute to the installation of non-food items in an area. Changing coastlines and changing land use are some of them. Others are related to the management of the flora and fauna of an area (eg forestry, crops, fish farming, etc.). These economic activities contribute either to the spread of species or to the modification of ecosystems. Many of them have side effects such as the introduction of "biological pollutants" such as genetically modified organisms (GMOs).

Climate change

The phenomenon of climate change is described in the next subsection (2.3). However, some of the components of the phenomenon that affect biodiversity are presented here.

Biodiversity and climate change are two directly related concepts and one affects the other. In particular, biodiversity is threatened by anthropogenic climate change but at the same time, biodiversity resources can reduce the impact of climate change on ecosystems and the human population.

Until today climate change has produced a large number of changes in the distribution and abundance of species, while at the same time contributing to the extinction of at least one species.

Climate change produces a rapidly increasing pressure on ecosystems and can trigger the effects of other pressures such as ecosystem fragmentation, pollution, resource exploitation, etc. However, the true size of the impact of climate change on biodiversity is still unknown. There is still a great deal of uncertainty as to the extent and speed of the effects of climate change on biodiversity and ecosystem services, as well as on the limits of climate change (above which ecosystems stop functioning in their current form).

Subsection 2.3. "Climate Change / Greenhouse Effect"

According to the Intergovernmental Panel on Climate Change (IPCC, 2007a; 2013), the energy balance of the planet's climate system can be affected by a number of factors. Some of them are changes in the concentration of specific gases in the composition of the atmosphere, fluctuations in solar radiation and changes in land use.

The first factor (the change in the concentration of specific gases in the composition of the atmosphere) is referred to in the literature as the "greenhouse effect".

In fact, this term means the inhibition of infra-red radiation emitted by the earth to radiate into space and its absorption by atmospheric gases. As a result, there is an increase in the temperature of the lower atmosphere and the surface of the earth (Figure 5). The absorption of radiation is mainly due to carbon dioxide (CO₂) but also to other gases.

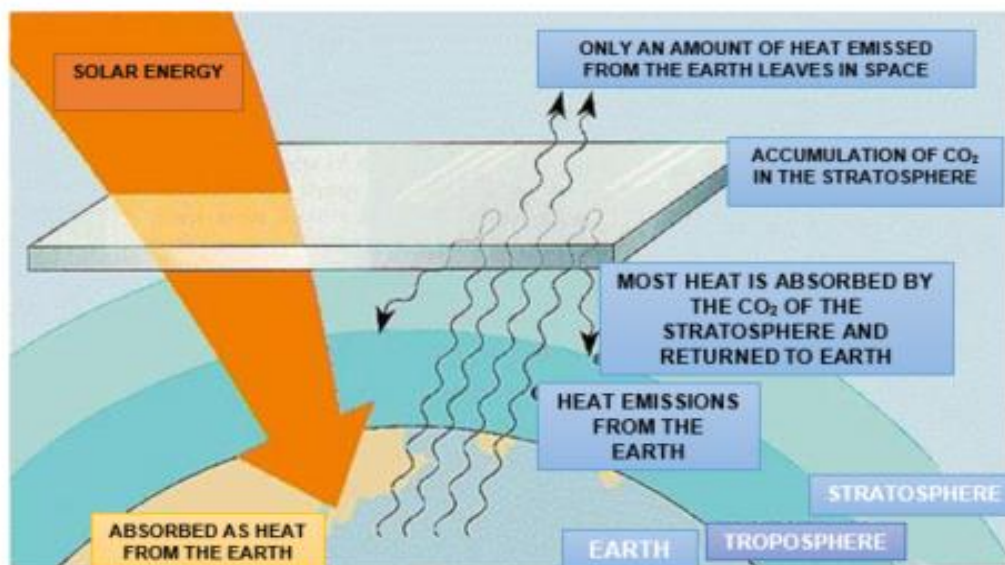


Figure 5. The creation of the greenhouse effect

The greenhouse effect is closely intertwined with the concept of climate change. According to the IPCC (2007a; 2013), the term climate change refers to any change caused by the climate pattern over time and comes from either natural or man-made factors.

The gases that are responsible for the greenhouse effect and, consequently, for climate change, are the following (IPCC, 2007b; Τσιλιγκιρίδης, 2015):

- Carbon dioxide (CO₂) – mainly responsible for 50% of the magnitude of the greenhouse effect and consequently climate change.
- Methane (CH₄) – contributes in about 13% in the creation of the greenhouse effect.
- Atmospheric ozone (O₃) – contribution reaching 7%.
- Nitrous oxide (N₂O) – contribution at 5%.
- Water vapor (H₂O) – contribution at 3%.
- The various forms of chlorofluorocarbons (CFCs), which are also the main cause of stratospheric ozone holes, by 22%.

The main of the above gases are responsible for the greenhouse effect are produced (Τσιλιγκιρίδης, 2015):

- CO₂ is produced during the combustion of all current fuels such as coal, liquid and gaseous hydrocarbons or biomass.
- CH₄ is produced during oil or gas extraction, coal mining, biomass combustion, biogas production, anaerobic fermentation of liquid waste water, the process of physicochemical change in solid waste disposal sites and during evaporation-outgasing from swamps, tundra and rice fields.
- N₂O as a greenhouse gas has as its main source the burning of fossil fuels - oil, the production of nitrogen fertilizers, the "respiration-evaporation" of soil and the evaporation of the oceans.
- Finally, atmospheric O₃, as a factor of the greenhouse effect, comes in a serious percentage from emissions of sulfur compounds, from large fires of tropical forests and mainly volcanic eruptions with planetary effects (eg Pinatubo volcano, Philippines).

It must be emphasized that the involvement of greenhouse gases in global warming is not stable. The contribution of each gas depends mainly on its absorption spectrum, its residence time in the atmosphere, its molecular weight and the duration of its contribution period.

Some of the most important effects of the greenhouse / climate change phenomenon are the following (IPCC, 2007b; 2013;Καραγιάννη κα. 2014; Τσιλιγκιρίδης, 2015):

- Temperature change in different latitudes of the earth means rearranging the balance between climate and microclimate. It is a change that is generally irreversible.

- The relocation, change, reduction or disappearance of certain crop and agricultural production is a serious consequence.
- The melting of the colossal volumes of polar ice in the North, and especially in the South Pole, means an increase of the sea level by 1 - 1.50 m.
- The expansion of ocean seawater - slowly but steadily - further intensifies the process of sea level rise and the flooding of "low altitude" coastal areas of the earth that can exceed 2 meters.
- The disturbance of the hydrological cycle, on a global scale, with rains (and precipitations) of unusual duration and size, with high frequency and intensity, with the creation of "atmospheric" fires and storms of El Ninio type and with catastrophic winds of high speed.

In particular, according to the Intergovernmental Panel on Climate Change ([IPCC, 2007b](#)), the effects of climate change on the individual sectors are the following:

Water resources:

- By the middle of the century, average annual river runoff and water availability may increase from 10% to 40% in large latitudes and some tropical areas. Instead, a reduction of 10% to 30% is expected in some arid areas in the middle latitudes and in arid regions (some of which are already facing water availability problems).
- The number of areas affected by water scarcity may increase. At the same time, the frequency of rainfall will increase, with a large amount of rain creating the risk of increasing floods.
- Over the course of the century, water reserves stored in glaciers may decrease while reducing water availability in areas supplied with water by the melting of seasonal glaciers. It is estimated that 1/6 of the world's population now lives in such areas.

Ecosystems:

- The resilience of many ecosystems may be threatened by an unprecedented combination of effects of climate change (e.g. floods, water shortages, fires, etc.) and other factors (e.g. land use change, pollution, irrational use of resources, etc.).
- Adsorption of atmospheric carbon by terrestrial ecosystems may reach its peak before the middle of the century and then decrease or even reverse, contributing to climate change.

- 20% to 30% of plant and animal species, which have been examined until today, may enter an increased risk of extinction if the average global temperature rises above 1.50 - 2.50 °C.
- With an increase in the average temperature of the planet by more than 1.50 - 2.50 °C and in combination with the corresponding concentrations of carbon dioxide in the atmosphere, the change of the structure, functions and composition of species of many ecosystems may be predicted. This development will have particularly negative effects on biodiversity and the availability of resources and services (eg water and food supply).
- The gradual acidification of the oceans due to the increase of carbon dioxide in the atmosphere is expected to have a negative impact on aquatic ecosystems (eg species loss and relationship changes).

Food and Forest Products:

- Crop production is expected to increase, mainly in medium and large latitudes, for increases in average local temperatures between 1 - 3 ° C depending on the type of crop.
- In lower latitudes, and especially in seasonally arid and tropical regions, crop productivity is projected to decline for even smaller increases in average local temperatures (1-2 ° C). This reduction will increase the risk of food shortage and famine.
- Globally, food production potential is estimated to increase with increases in average local temperatures between 1-3 ° C. However, for larger increases, the potential is predicted to decrease.
- Increases in the frequency of water shortages and floods are predicted to affect local crop productivity. Especially in areas at low latitudes.
- Adaptation strategies (such as crop changes and changes in planting time) can maintain or even increase the average productivity of cereal plantations for small temperature rises.
- Globally, timber production can increase in low- and middle-latitude areas. However, this increase shows large local fluctuations compared to the global trend. This means that depending on the type of forest trees per region, in some areas the increase in production will be greater and in others less than the average predicted increase.
- Local changes in the distribution and production of certain species of fish are predicted to occur due to the increase in temperature. This will have a negative impact on fish farming

Low Altitude Coastal Systems and Areas:

- Coastal systems are predicted to be at greater risk, including erosion due to climate change and rising sea levels. The effects will be much greater if anthropogenic pressures in these areas are taken into account.
- Coral reefs are particularly sensitive to temperature changes and show little adaptability. An increase in sea surface temperature of 1-3 ° C is predicted to cause an extensive increase in coral mortality.
- Coastal wetlands are predicted to be adversely affected by rising sea levels.
- By 2080, many millions of people are predicted to be affected by floods each year. Low-altitude areas that are also densely populated are at particular risk. The number of people affected will be much higher in river delta areas (eg Asia and Africa) and on small islands.
- Adaptation of coastal areas will be particularly difficult in developing countries due to their limited adaptive capacity (lack of financial resources and effort for development).

Industry, Settlements and Society:

- The costs and benefits of climate change vary by location and scale of analysis regarding this sector. Overall, however, the negative impacts are estimated to be greater.
- The most vulnerable cases are generally located in coastal and riverside flood zones. This is because their economies rely on resources with great sensitivity to climate change. The effects will be particularly great in such areas where at the same time there are rapid urbanization trends.
- Less affluent / poor communities are particularly vulnerable, especially when they are located in high-risk areas. This is because of:
 - Their reliance on resources with great sensitivity to changing climatic conditions (e.g. locally available water and food production).
 - The lower adaptability of these communities due to their limited financial resources.
- Economic and social costs increase in areas where the frequency and intensity of extreme weather events increase. However, the effects of climate change may begin to appear in the most vulnerable areas and then, through complex links, extend to other areas less vulnerable to the initial effects.

Climate change can also affect human health. The effects of climate change on health can be divided into the following three categories ([WHO, 2003](#); [EMEKA, 2011](#)):

- Immediate effects caused by extreme weather events (e.g. deaths from heat waves).
- Indirect effects caused by environmental change and ecological disturbances due to climate change (e.g. increased threat of mosquito or rodent transmitted diseases).
- Various other effects caused to populations affected by environmental degradation and economic problems due to climate change (eg nutritional or psychological problems).

Health authorities in the United States of America officially distinguish 11 categories of effects of climate change on health ([CDC, 2009](#); [EMEKA, 2011](#)):

- Asthma, respiratory allergies and diseases due to the atmospheric air
- Tumors
- Cardiorespiratory problems and heart attacks
- Foodborne illnesses and infections
- Morbidity and mortality from heat
- Complications in human development
- Mental health and anxiety disorders
- Neurological disorders
- Diseases caused by carriers
- Diseases caused by water
- Morbidity and mortality from the weather (extreme weather events)

Based on the above, regarding the health sector, the most vulnerable groups due to climate change are the following ([EMEKA, 2011](#)):

- The elderly
- The children
- People with chronic health problems who are under constant medical supervision
- The less affluent with poor nutrition and malnutrition living in low-income areas with difficult access to health services
- The residents in island and mountainous areas where there is a lack of water and difficulty in finding healthy food
- Immigrants who are socially excluded from the labor market, social and health services

Concerns about global climate change have led many governments to study and address the effects that will be caused on the natural balance ([Τσιλιγκιρίδης, 2015](#)).

In this context, an Intergovernmental Panel on Climate Change was set up in 1988 by the World Meteorological Organization and the United Nations Environment Program. This group presented a first evaluation report in 1990, which reflected the views of 400 scientists. According to this report, the problem of rising temperature was real and had to be addressed immediately ([Αλιβιζάτος, 2007](#)).

The conclusions of the Intergovernmental Panel have prompted governments to create the United Nations Framework Convention on Climate Change. Compared to the negotiations for other international agreements, the negotiation of the Convention was relatively short ([Αλιβιζάτος, 2007](#)). It was ready for signature at the United Nations Conference on Environment and Development (better known as the Earth Conservation Summit) in 1992 in Rio de Janeiro.

The United Nations Framework Convention on Climate Change, the first international measure to address the problem, was concluded in May 1992 and entered into force in March 1994. It obliges all Contracting Parties to adopt national programs to reduce greenhouse gas emissions and report regularly, and requires industrialized countries, in contrast to developing countries, to stabilize their greenhouse gas emissions in 1990 levels, until the year 2000. This goal, however, was not binding ([Αλιβιζάτος, 2007](#); [Χατζηκώστας και Σδούγκας, 2013](#)).

The Kyoto Protocol, a follow-up to the United Nations Framework Convention on Climate Change, sets legally binding limiting levels for greenhouse gas emissions for industrialized countries and provides innovative implementation mechanisms based on the operation of market forces, aimed at keeping emission costs low ([Αλιβιζάτος, 2007](#)).

According to the Kyoto Protocol, industrialized countries (listed in Annex B of the Protocol) are required to reduce greenhouse gases by 5.2% to 1990 levels by 2008-12. The 5.2% target is broken down into individual targets for each country or group of countries. The United States listed in Annex B stated at the Bonn Conference that it did not intend to ratify the Protocol. The target for the European Union is a reduction of 8% and the individual targets of the member countries are defined by the "cargo sharing agreement" agreed by the Council of the European Union ([Τσιλιγκιρίδης, 2015](#)).

The Kyoto Protocol provides three flexible mechanisms, which are based on the operation of the market economy (Αλιβιζάτος, 2007; ΥΠΕΚΑ, 2013; Χατζηκώστας και Σδούγκας, 2013; Τσιλιγκιρίδης, 2015):

A. Pollution Trading

In the greenhouse gas emissions trading (pollution trading) the object of the transaction in a market of this kind is air.

Emissions trading involves the creation of a market for transferable greenhouse gas emissions, also called transferable licenses. If, for example, a country anticipates or can achieve an economic reduction in greenhouse gases to levels lower than those set out in the Protocol, it may transfer the emission right to another country. The main advantage of emissions trading is that it enables greenhouse gas emissions to be reduced at a lower cost than if the action was limited to narrow geographical boundaries. A second advantage is that it separates technology funding for emission reduction from the use of technology, favoring cross-border cost sharing and transferring technology to developing countries.

But the most important disadvantage of emissions trading is that it does not reduce the total greenhouse gas emissions, but transports them to another geographical area. At the same time, this may limit the economic development of developing countries to the extent that their rights are not exercised by domestic productive activity but are sold to other interested parties, who continue producing emissions. Finally, a major problem is the fact that emission costs are transferred to the final consumer through integration into the final price of products or through the accounts of power companies.

Emissions trading can be applied not only at the international level but also in the internal market of a country or even at company level.

B. Joint Execution (JE)

Joint Execution allows the joint implementation of projects aimed at reducing greenhouse gases from individual sources or by improving anthropogenic absorption from gas absorption sinks in any sector of the economy provided that they comply with the conditions laid down by the Parties to the United Nations Framework Convention on Climate Change.

In this way, an industrialized country can invest in a project that is expected to reduce greenhouse gas emissions in another industrialized country and thus gain emission reduction units that will measure against its obligations under the Kyoto Protocol. Joint Execution can only take place between developed countries, as mentioned in the Kyoto Protocol.

C. Clean Development Mechanism (CDM)

This Mechanism allows joint implementation, like the JE, but between industrialized and developing countries. The CDM is of great interest to industrialized countries, as it is expected to offer them the opportunity to reduce greenhouse gases at significantly lower costs than if the reduction were to take place domestically. It is also of interest to developing countries, as it will help transfer technology to these countries.

A crucial point for CDM and JE mechanisms is how the reduction of greenhouse gas emissions resulting from the projects will be determined. In order to determine the amount of greenhouse gases avoided by a project and the points gained by the country financing it, an estimate of the greenhouse gases that would be emitted if the project was not carried out must be made. These estimates are often difficult and must be based on common assumptions for all projects in order for the system to work properly. At present the experience of such projects comes from pilot schemes mainly projects to improve energy efficiency (eg upgrading of electricity or district heating units, energy saving lamps) and the promotion of renewable energy sources (eg photovoltaic energy, wind farms).

Educational Unit Summary

Anthropogenic or Artificial Environment is defined as the environment that was and is created exclusively by human interventions. Within this environment humans live, grow and evolve with the parallel implementation of a large number of economic activities. However, these activities are also sources/causes of degradation of the natural environment, on which humans depend for their survival and evolution. Two of the most important components of environmental degradation occur due to the continuous development of the human species: the increase of the world population and urbanization. From these, and in combination with the activities of economic development, come all the other causes of environmental degradation, with the most important one being the reduction of biodiversity, pollution, and consequently climate change, a global aspect of pollution affecting a number of different components of the

natural environment, such as the reduction of plant and animal species, the reduction of services provided by ecosystems, the reduction of water reserves and the degradation of soil.

Self-assessment Questions on Educational Unit 2

1. Humans are distinguished from other organisms by the culture they have developed and their ability to modify the natural environment.

<input type="checkbox"/>	True
<input type="checkbox"/>	False

2. Anthropogenic environment includes rural areas, managed and controlled forest areas, artificial lakes, wetlands and mines.

<input type="checkbox"/>	True
<input type="checkbox"/>	False

Answer: Wetlands are not included in the Anthropogenic Environment

3. Mark anything that applies. The Anthropogenic Environment is divided into:

<input type="checkbox"/>	Cultural
<input type="checkbox"/>	Political
<input type="checkbox"/>	Technological
<input type="checkbox"/>	Religious
<input type="checkbox"/>	Scientific
<input type="checkbox"/>	Social
<input type="checkbox"/>	Spiritual
<input type="checkbox"/>	Institutional

4. Mark anything that applies. Retained waters from reservoirs are used for:

<input type="checkbox"/>	Recreation
<input type="checkbox"/>	The creation of water reserves
<input type="checkbox"/>	Retention of rainwater
<input type="checkbox"/>	Water supply
<input type="checkbox"/>	Irrigation
<input type="checkbox"/>	Electric power production
<input type="checkbox"/>	Flood control

5. The term “structured environment” is usually synonymous to the term “urban environment”.

<input type="checkbox"/>	True
<input type="checkbox"/>	False

6. What is the most common source of uncertainty in the management of environmental problems:

<input type="checkbox"/>	Partial observation
<input type="checkbox"/>	Structural or procedural
<input type="checkbox"/>	Environmental diversity
<input type="checkbox"/>	Partial controllability

7. Structural or procedural uncertainty refers to a lack of understanding (or lack of agreement) about the structure of biological and ecological relationships that promote the dynamics of natural ecosystems.

<input type="checkbox"/>	True
<input type="checkbox"/>	False

Answer: Structural or procedural uncertainty refers to a lack of understanding (or lack of agreement) about the structure of biological and ecological relationships that promote **resource** dynamics.

8. By 2050, the world population is expected to:

<input type="checkbox"/>	Reach 9,00 billion
<input type="checkbox"/>	Reach 9,50 billion
<input type="checkbox"/>	Reach 10.00 billion
<input type="checkbox"/>	Reduce
<input type="checkbox"/>	Remain stable

9. The world population is increasing when:

<input type="checkbox"/>	The birth rates remain stable and the death rates decrease
<input type="checkbox"/>	The birth rates and the death rates remain stable
<input type="checkbox"/>	The birth rates remain stable and the death rates increase
<input type="checkbox"/>	The birth rates decrease and the death rates remain stable
<input type="checkbox"/>	The birth rates increase and at the same time the death rates remain stable

10. The term "astyphilia" is used as an alternative to the term "urbanization":»:

<input type="checkbox"/>	True
<input type="checkbox"/>	False

11. The annual rate of urbanization is _____ in developing countries:

<input type="checkbox"/>	Lower
<input type="checkbox"/>	Stable
<input type="checkbox"/>	Higher

12. Mark anything that applies:

<input type="checkbox"/>	Urbanization alters the biological, chemical and physical properties of soil.
<input type="checkbox"/>	Urbanization affects soil erosion.
<input type="checkbox"/>	Urbanization has little effect on water availability.
<input type="checkbox"/>	Biodiversity is affected by land use change caused by urbanization
<input type="checkbox"/>	Urbanization is adversely affecting biodiversity through the introduction of edible species

13. _____ of the environment is characterized by the presence of pathogens or markers that indirectly indicate the presence of such microorganisms or chemicals in elements that can be used by humans to cause pathogens.

<input type="checkbox"/>	Pollution
<input type="checkbox"/>	Contamination
<input type="checkbox"/>	Climate change

14. Mark the main sources of pollution:

<input type="checkbox"/>	The chimney of a facility
<input type="checkbox"/>	The drainage pump of an industrial facility
<input type="checkbox"/>	Fertilizers and insecticides from arable land
<input type="checkbox"/>	A sewage treatment plant
<input type="checkbox"/>	Car emissions
<input type="checkbox"/>	Disposal of solid and liquid waste from industries

15. According to the type of pollutant - pollution can be distinguished into:

<input type="checkbox"/>	Air pollution
<input type="checkbox"/>	Gaseous pollution
<input type="checkbox"/>	Noise pollution

- Soil pollution
- Thermal pollution
- Radioactive pollution
- Water pollution
- Aesthetic pollution

16. The phenomenon of atmospheric ozone depletion is a global expression of pollution and contributes to global warming.

- True
- False

Response: It contributes to the increase of dangerous radiation.

17. The term acid rain means rain with a pH lower than normal. Normal pH for clear rain is considered when the pH is:

- Around 7,00
- More than 9,00
- Between 6,50 and 9,00
- Between 5,00 and 6,00

18. Tropospheric ozone protects the planet from ultraviolet radiation.

- True
- False

Answer: Stratospheric ozone protects the planet from ultraviolet radiation. Tropospheric ozone is considered a gaseous pollutant.

19. The phenomenon of relocation due to the increase in biofuel cultivation concerns the:

- Relocation of the rural population to new areas and activities
- Relocation of activities to new areas
- Relocation of species affected in new areas

20. According to United Nations agencies, fish farming is the fastest growing of any animal husbandry sector. Therefore, the degree of risk in global fish stocks is now lower.

	True
	False

Answer: The degree of risk faced by global fish stocks remains high. Indicatively, in the last two decades, in the North Atlantic region, the population of the most commercial fish has decreased by 95%.

21. The change in the concentration of specific gases in the composition of the atmosphere is referred to as:

	Climate change
	Photochemical phenomenon
	Grennhouse effect
	Acid rain

22. The greenhouse effect concerns:

	The absorption of radiation emitted by the earth
	The absorption of radiation emitted by the sun
	The emission of radiation into space

23. The most important greenhouse gas is:

	Methane
	Nitrous oxide
	Carbon dioxide
	Chlorofluorocarbons
	Water vapor
	Atmospheric ozone

24. The growing threat of rodent-borne diseases is:

	Indirect impact of climate change on human health
	Direct impact of climate change on human health
	It is not related to the impact of climate change on human health

25. The growing threat of deaths due to heatwave is:

- | | |
|--------------------------|---|
| <input type="checkbox"/> | Indirect impact of climate change on human health |
| <input type="checkbox"/> | Direct impact of climate change on human health |
| <input type="checkbox"/> | It is not related to the impact of climate change on human health |

Annex - Educational Unit 2

Answers to the Self-assessment Questions on Educational Unit 2

1. Humans are distinguished from other organisms by the culture they have developed and their ability to modify the natural environment.

- | | |
|--------------------------|-------|
| X | True |
| <input type="checkbox"/> | False |

2. Anthropogenic environment includes rural areas, managed and controlled forest areas, artificial lakes, wetlands and mines.

- | | |
|--------------------------|-------|
| <input type="checkbox"/> | True |
| X | False |

Answer: Wetlands are not included in the Anthropogenic Environment

3. Mark anything that applies. The Anthropogenic Environment is divided into:

- | | |
|--------------------------|---------------|
| X | Cultural |
| <input type="checkbox"/> | Political |
| X | Technological |
| <input type="checkbox"/> | Religious |
| <input type="checkbox"/> | Scientific |
| X | Social |
| X | Spiritual |
| <input type="checkbox"/> | Institutional |

4. Mark anything that applies. Retained waters from reservoirs are used for:

- | | |
|---|--------------------------------|
| X | Recreation |
| X | The creation of water reserves |

X	Retention of rainwater
X	Water supply
X	Irrigation
X	Electric power production
X	Flood control

5. The term “structured environment” is usually synonymous to the term “urban environment”.

X	True
	False

6. What is the most common source of uncertainty in the management of environmental problems:

	Partial observation
	Structural or procedural
X	Environmental diversity
	Partial controllability

7. Structural or procedural uncertainty refers to a lack of understanding (or lack of agreement) about the structure of biological and ecological relationships that promote the dynamics of natural ecosystems.

	True
X	False

Answer: Structural or procedural uncertainty refers to a lack of understanding (or lack of agreement) about the structure of biological and ecological relationships that promote **resource** dynamics.

8. By 2050, the world population is expected to:

X	Reach 9,00 billion
	Reach 9,50 billion
	Reach 10.00 billion
	Reduce
	Remain stable

9. The world population is increasing when:

X	The birth rates remain stable and the death rates decrease
	The birth rates and the death rates remain stable
	The birth rates remain stable and the death rates increase
	The birth rates decrease and the death rates remain stable
X	The birth rates increase and at the same time the death rates remain stable

10. The term "astiphilia" is used as an alternative to the term "urbanization":»:

X	True
	False

11. The annual rate of urbanization is _____ in developing countries:

	Lower
	Stable
X	Higher

12. Mark anything that applies:

X	Urbanization alters the biological, chemical and physical properties of soil.
X	Urbanization affects soil erosion
	Urbanization has little effect on water availability
X	Biodiversity is affected by land use change caused by urbanization
	Urbanization is adversely affecting biodiversity through the introduction of edible species

13. _____ of the environment is characterized by the presence of pathogens or markers that indirectly indicate the presence of such microorganisms or chemicals in elements that can be used by humans to cause pathogens.

X	Pollution
	Contamination
	Climate change

14. Mark the main sources of pollution:

X	The chimney of a facility
X	The drainage pump of an industrial facility

<input type="checkbox"/>	Fertilizers and insecticides from arable land
<input checked="" type="checkbox"/>	A sewage treatment plant
<input type="checkbox"/>	Car emissions
<input checked="" type="checkbox"/>	Disposal of solid and liquid waste from industries

15. According to the type of pollutant - pollution can be distinguished into:

<input type="checkbox"/>	Air pollution
<input checked="" type="checkbox"/>	Gaseous pollution
<input checked="" type="checkbox"/>	Noise pollution
<input type="checkbox"/>	Soil pollution
<input checked="" type="checkbox"/>	Thermal pollution
<input checked="" type="checkbox"/>	Radioactive pollution
<input type="checkbox"/>	Water pollution
<input checked="" type="checkbox"/>	Aesthetic pollution

16. The phenomenon of atmospheric ozone depletion is a global expression of pollution and contributes to global warming.

<input type="checkbox"/>	True
<input checked="" type="checkbox"/>	False

Response: It contributes to the increase of dangerous radiation.

17. The term acid rain means rain with a pH lower than normal. Normal pH for clear rain is considered when the pH is:

<input type="checkbox"/>	Around 7,00
<input type="checkbox"/>	More than 9,00
<input type="checkbox"/>	Between 6,50 and 9,00
<input checked="" type="checkbox"/>	Between 5,00 and 6,00

18. Tropospheric ozone protects the planet from ultraviolet radiation.

<input type="checkbox"/>	True
<input checked="" type="checkbox"/>	False

Answer: Stratospheric ozone protects the planet from ultraviolet radiation. Tropospheric ozone is considered a gaseous pollutant.

19. The phenomenon of relocation due to the increase in biofuel cultivation concerns the:

- | | |
|--------------------------|--|
| <input type="checkbox"/> | Relocation of the rural population to new areas and activities |
| X | Relocation of activities to new areas |
| <input type="checkbox"/> | Relocation of species affected in new areas |

20. According to United Nations agencies, fish farming is the fastest growing of any animal husbandry sector. Therefore, the degree of risk in global fish stocks is now lower.

- | | |
|--------------------------|-------|
| <input type="checkbox"/> | True |
| X | False |

Answer: The degree of risk faced by global fish stocks remains high. Indicatively, in the last two decades, in the North Atlantic region, the population of the most commercial fish has decreased by 95%.

21. The change in the concentration of specific gases in the composition of the atmosphere is referred to as:

- | | |
|--------------------------|--------------------------|
| <input type="checkbox"/> | Climate change |
| <input type="checkbox"/> | Photochemical phenomenon |
| X | Greenhouse effect |
| <input type="checkbox"/> | Acid rain |

22. The greenhouse effect concerns

- | | |
|--------------------------|--|
| X | The absorption of radiation emitted by the earth |
| <input type="checkbox"/> | The absorption of radiation emitted by the sun |
| <input type="checkbox"/> | The emission of radiation into space |

23. The most important greenhouse gas is:

- | | |
|--------------------------|---------------------|
| <input type="checkbox"/> | Methane |
| <input type="checkbox"/> | Nitrous oxide |
| X | Carbon dioxide |
| <input type="checkbox"/> | Chlorofluorocarbons |
| <input type="checkbox"/> | Water vapor |
| <input type="checkbox"/> | Atmospheric ozone |

24. . The growing threat of rodent-borne diseases is:

- | | |
|-------------------------------------|---|
| <input checked="" type="checkbox"/> | Indirect impact of climate change on human health |
| <input type="checkbox"/> | Direct impact of climate change on human health |
| <input type="checkbox"/> | It is not related to the impact of climate change on human health |

25. The growing threat of deaths due to heatwave is:

- | | |
|-------------------------------------|---|
| <input type="checkbox"/> | Indirect impact of climate change on human health |
| <input checked="" type="checkbox"/> | Direct impact of climate change on human health |
| <input type="checkbox"/> | It is not related to the impact of climate change on human health |

Educational Unit 3 "Environmental and Natural Resources Management Systems"

Purpose of the Educational Unit

The purpose of the third educational unit is to help the students of the program to get acquainted with the Environmental Management Systems (EMS) which are part of the overall management system of an organization or a company. The unit begins with the historical background of the development of EMS and continues with the description of their characteristics, the incentives for their implementation by the business sector, the benefits and costs arising from their implementation, the units that make them up, etc. The educational unit also focuses on the description and summary comparison of the two best known EMS. Specifically of ISO14001 and EMAS.

Expected Results of Educational Unit 3

The third educational unit aims to introduce to the students of the program:

- The concepts of EMS
- The history of EMS in the business sector
- The characteristics of EMS
- The motivations for the implementation and the benefits from the implementation of the EMS
- The costs of EMS
- The sections of the EMS
- The ISO 14001
- The EMAS EMS
- The general differences between the two most important EMS

Key Concepts of the Educational Unit

Environmental Protection, Business Sector, Environmental Management Systems, ISO 14001, EMAS

Subsection 3.1. "Environmental Management Systems"

Environmental Management System (EMS) is defined as the part of the overall management system of an organization that includes the necessary organizational structure, activities, procedures, roles and responsibilities, appropriate practices, processes and resources to address the environmental impact of products, services or functions of this organization ([Αραβώσης, 2000; 2002; MorrowandRondinelli 2002, Μανδάρικα 2004](#)).

Until the mid-1980s, the prevailing perception of business was that environmental protection was only an additional operating cost to the extent that it was effectively protected by law.

The effort to set standards for the development of EMS began in the early 1990s. At the 1st International Industrial Conference on Environmental Management organized in 1984 by the International Chamber of Commerce, it was initially recognized that "environmental management must be an integrated and integral part of economic development".

In the years that followed, the compatibility of industrial development with the environment was recognized by many economic observers, and these views were expressed in the text of the Environmental Directives for Industry, published in 1986 by the International Chamber of Commerce.

In 1991, the International Network for Environmental Management was established, an independent organization of leading companies that proposed the development of international standards for the control of environmental performance (based on the principle of sustainable development).

At the same time, in the same year, the International Chamber of Commerce issued the "Business Charter for Sustainable Development: Business Charter for Sustainable Business Development: Principles for Environmental Management" which includes 16 principles of environmental management ([Argyrazi and Bowman, 2001](#)):

- Business priority
- Integrated management
- Continuous improvement process

- Training of employees
- Environmental impact assessment
- Preventive approach
- Environmentally friendly products and services
- Facilities and processes with the least possible environmental impact
- Information and training of customers, distributors and the public
- Promoting environmental principles and values to suppliers and subcontractors
- Research
- Preparedness for unexpected incidents
- Contribution to technology transfer
- Participation in the joint effort
- Understanding the demands-concerns of employees and society and developing dialogue
- Compliance and disclosure

The creation of tools, which today are the ancestors of modern EMS, was the result of a series of events and developments, such as: the energy crisis, the significant cost of repairing environmental accidents, growing legal requirements, the ecological consciousness of consumers and societies ([Figure 6](#)).

An EMS belongs to the category of tools based on market demands, which push producers and consumers in the responsible use of natural resources and in the minimization or elimination of pollution, and aim at utilizing the ingenuity of companies and directing them to improve the environmental performance of their products and processes in a different way from the traditional “order and control” of environmental legislation.

The success of EMS as a tool is based on the simple assumption that the market will reward companies that are the first to incorporate the requirements of an EMS into their operations and therefore market pressures will encourage more and more companies to follow.

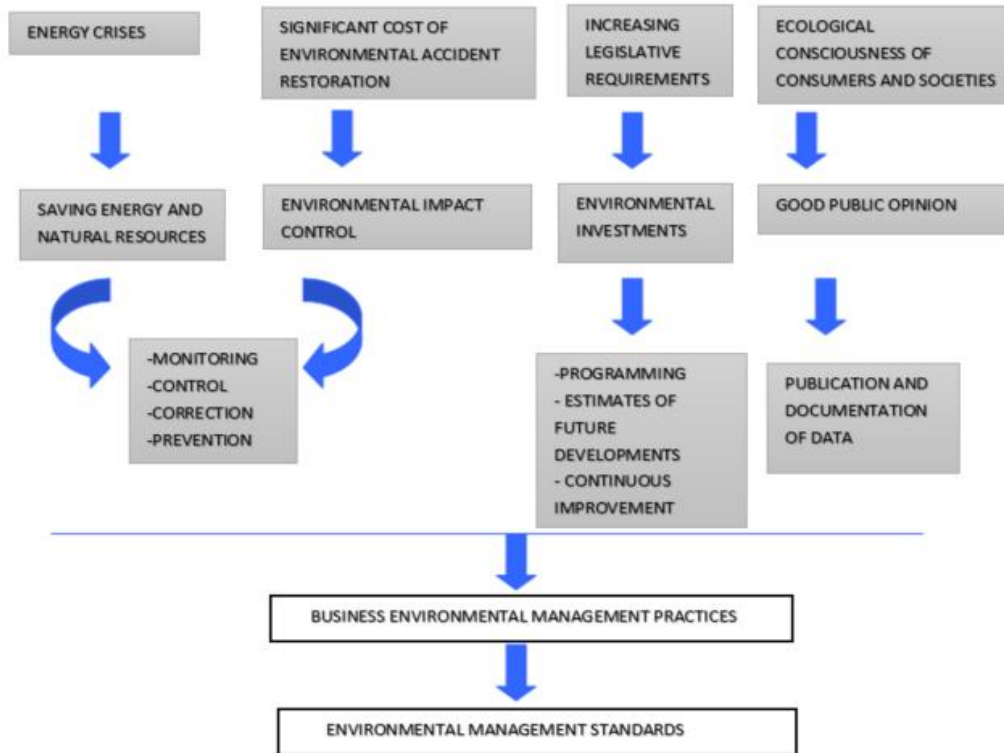


Figure 6. The creation of Environmental Management Systems

An efficient environmental management is considered to be a factor sustainability of organizations in the near future because (EMSI, 1999):

- The environmental awareness of customers, suppliers, consumers and associates is increasing, as are authorities, banks and insurance companies.
- Consumption is more focused on products made in environmentally friendly ways.
- Businesses and organizations with environmental orientation gain grants and loan subsidies.
- Techniques for the production of environmentally friendly products affect their life cycle.
- Environmental legislation is becoming stricter, its implementation increasingly harsh and with personal responsibilities for business managers.
- Environmental contributions and taxes are constantly increasing.
- Information on the environmental impact of productive activities must be made public to the authorities and the public.
- The environmental market is now important.
- Prices of energy and raw materials will continue to rise.

In general, an EMS includes the following (HillaryandThornes, 1994):

- Initial environmental analysis.
- Defining environmental policy and objectives.
- Defining goals and creation of its implementation program.
- Organization, communication, training and documentation.
- Control of business activities that have an impact on the environment.
- Monitoring and measurement procedures.
- Structural and preventive actions, records and internal audits.
- Reviewing objectives according to the results and conclusions of the audit for continuous improvement.

An effective EMS is based on the ideas of Total Quality Management and is essentially an extension of the existing management system in a company, through which environmental issues are introduced in the management operation of the company. The first step is to identify the problems and the cause. The correction of these malfunctions leads to the improvement of the environmental and in general of the overall operation of the organism.

In terms of Total Quality Management, it is worth mentioning that it is a way of managing an organization that is focused on quality, based on the participation of all its members (staff of all departments at all levels of the organizational structure) and aims at long-term success through customer satisfaction and the provision of benefits to all members of the organization and society. The values on which the implementation of Total Quality Management is based are: responsiveness, cooperation and participation

3.1.1. EMS Characteristics

An EMS must be:

Complete:

- It focuses not only on organizational issues, but also on processes, products and services.
- It refers to all parts of an organization / business.
- All employees have environmental responsibilities and are aware of them.

Understandable:

- Well-defined duties and responsibilities for all employees.

- Well-defined environmental goals and objectives for its implementation and maintenance.
- Adequate and appropriate training of staff to understand environmental issues and the system in general.
- Appropriate control and review procedures with the aim of continuous improvement.

Open:

- Encourages cooperation and internal communication.
- Appropriate, cyclical process of continuous improvement of the operations of the organization/business and, consequently, of its environmental performance.

3.1.2. Benefits of the EMS

In general, there are many areas in which there are benefits to implementing an EMS, for an organization or business, in accordance with the EMAS Regulation or ISO 14001 ([Speddingetal, 1993](#); [Αραβώσης, 2000;2002](#)).

Specifically:

- In the insurance sector, there is the possibility of securing lower insurance premiums, due to the implementation of precautionary measures.
- In the production sector, there is the possibility of reducing costs, due to the rational management of resources and energy savings.
- Public opinion and customers acquire a positive image of the organization or business.
- Avoidance of criminal and civil consequences, since there is a documentation of the observance of the institutionalized standards regarding the environmental discharges.
- Better relationship of trust between the organization and local authorities, which helps in faster processes of approving requests of the organization.

According to [Αραβώση \(2000; 2002\)](#) and [Μανδαράκα and Γεωργακόπουλο \(2006\)](#), motivations can be divided into two categories, external and internal:

External motivations:

- Improving the public image of the company

- The pressures of the local community
- Entering international markets
- Gaining a competitive advantage
- Requirement of certification by customers
- Compliance with legislation

Internal motivations:

- Cost reduction due to waste reduction and protection of stocks.
- Improving environmental performance.
- Improving the internal operation and organization of the business.
- Better management of environmental issues.
- Increasing productivity.
- Optimal use of resources and energy savings.
- The development of human resources.
- Government support through subsidies ([Rondinelli, et al., 2000](#); [Morrow and Rondinelli, 2002](#); [Raines, 2002](#); [Poksinska et al., 2003](#)).

However, [Petroni \(2001\)](#), lists three categories of motivations instead of two:

1. Financial

- Reduction of environmental management costs
- Savings on material cost
- Reduction of other operating expenses

2. Operational

- Good business practices
- Human resources development
- Improving the efficiency of operations and processes
- Improving the organization and operation of the business

3. External

- Compliance with legislation
- Improving customer satisfaction
- Increasing investments
- Reduction of insurance premiums
- Gaining a competitive advantage
- Increasing market share

- Improving the public image and reputation of the company
- Environmental protection ([Alberti 2000](#), [Petroni 2001](#))

From international bibliography ([Delmas, 2002](#); [Βλάχος, 2003](#); [Poksinskaet.al, 2003](#); [Zeng, 2004](#)) it is observed that the motivations that are mentioned as the most important for the certification of companies are the improvement of the business image, the continuous improvement of the environmental performance, the improvement of internal operation and organization of the business, gaining a competitive advantage, complying with legislation and requiring certification from customers and other stakeholders.

3.1.3. EMS Costs

The potential costs of implementing an EMS by an organization or business are ([Αραβώσης, 2002](#)):

- Investment and infrastructure costs
- Costs of external consultants - hiring specialized staff who will do the "preparation" for the implementation
- Staff training costs
- Costs of the person in charge of environmental management of the organization (internal inspector)
- Study costs
- Low cost of publication
- Higher workload - extra hours

It is obvious that the total cost is not the same for every organization or company. This depends on the size of the organization/company (employees - infrastructure), as well as on the pre-existing experience that may exist on the application of EMS ([KurtandGleckman, 1998](#); [Αραβώσης, 2000;2002](#)).

Experience in northern European countries shows that there is no rule. The financial resources for the development of an EMS including external fees for consultants and related communication as well as certification costs are on average (excluding public assistance):

- 10,000 euros for very small companies (<10 employees)
- 20,000 euros for small companies (<50 employees)

- 35,000 euros for medium-sized companies (50-250 employees)
- 50,000 euros for large companies (> 250 employees).

3.1.4. EMS Sections

According to Ζουμπλούλης κ.α. (2015), a complete environmental management system usually consists of the following seven sections/subsystems (Figure 7):

- Section 1: Corporate strategy and the environment
- Section 2: Performance and management practices: Initial overview
- Section 3: Environmental policy design
- Section 4: Implementation of environmental policy
- Section 5: System monitoring
- Section 6: Monitoring and evaluation
- Section 7: Communication environmental policy

Section 1: Corporate strategy and the environment

The organization / business strategy in relation to the environment should clarify:

- The basic argumentation and logic that governs the effort to install the EMS.
- The general objectives of the organization/company in relation to the general environmental issues:
 - The commitment of full compliance with the applicable regulations regarding the emissions of pollutants, as well as any other environmental disturbances caused by the organization/company.
 - The commitment to launch specific procedures for the continuous improvement of the relevant environmental performance.

The strategy is the main document of the EMS, ie the basis on which the specific policy will be formulated, the respective programs will be designed and the relevant objectives will be set.

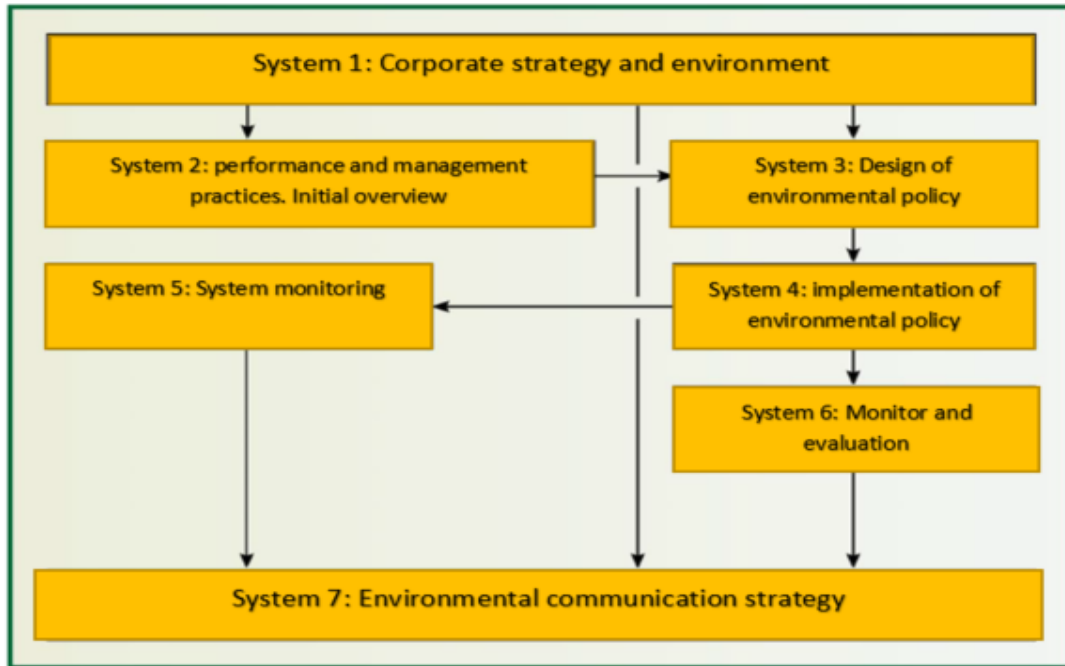


Figure 7. Functional communication between the individual sections of an EMS

Section 2: Performance and management practices: Initial Overview

Prior to the policy design it is necessary to conduct a brief but complete overview of the broader relationship of the organization/business operation with the environment. The initial overview is a first analysis of the current situation. In this way the company approaches its strengths and weaknesses both in terms of operations and in terms of management.

This first overview, in combination with the basic strategic direction of the company, are the key points on the basis of which the appropriate environmental policy will be designed.

Section 3: Environmental policy design

The design of a coherent environmental policy starts with the identification of all possible interactions of the organization/business with the environment. Although the previous phase has provided the possibility to codify this relationship in detail, it is possible that the potential effects will exceed those detected in the analysis of the present situation. That is because some of these interactions may need to be predicted as possible in the future, even if they have not yet occurred. The second pre-work is the complete picture of the legal and other institutional obligations of the

organization/company. Respect for the current institutional framework is the starting point, the basic and most obvious goal of any environmental management system.

Finally, the policy under development is specified in the form of specific management plans, for each of which the following should be specified in an extremely clear manner:

- General and specific objectives,
- Schedule of implementation of the objectives,
- Necessary roles (in general) for the implementation of the objectives,
- Means required in addition to human resources to achieve the objectives,
- Risk during implementation and alternative plans.

Section 4: Implementation of environmental policy

Implementing the policies adopted in the previous step is the most difficult and time consuming stage of the whole project. The implementation includes the following components:

- Assignment of the roles, which were deemed necessary (in a previous phase) to specific individuals, executives of the company and determination of the person responsible for monitoring and maintenance of the system. This person in charge must have the approval of the administration, to which he will refer directly. - Answer to the question "Who?"
- Verification that the competent (appointed in the previous phase) staff will have a good and practical understanding of the organization / business policy in matters of environmental management, as well as the impact that the implementation of this company policy is expected to have on the environment. At this point, the possibility of training / retraining of staff in the relevant technical and management issues should be considered. Also, the detailed flow of information and work procedures of the competent staff should be made. - Answer to the question "How?"
- Detailed documentation of the EMS so that it is possible to audit it internally and externally and to determine its satisfactory adaptation or not to one of the applicable standards. The documentation takes the form of a complete file, which describes the various parts of the system and there are references to accompanying material. All documents have clear production and expiration / revision dates. - Answer to the question "What?"
- Notification to suppliers, subcontractors and other collaborators of any claims imposed on them by the specific organization / company due to the application of the EMS.

Section 5: System monitoring

A particularly important question is the suggestion of a method for the effective monitoring and evaluation of the adaptation of reality, in relation to the goals set by the business environment management policy.

This method is based on the correlation of the contents of three tables:

- The first table contains quantitative measurements related to the actual impact of the business on the environment.
- The second table contains the environmental policy targets adopted in the previous step.
- The third table includes the corresponding figures provided by the current legislative and institutional framework.

By comparing the sizes of these three tables, it is found whether the organization/company is consistent in its commitment to be within the limits set by the relevant legislation and whether there is a dimension of continuous improvement in the relevant (environmentally friendly) operation of the organization.

Section 6: Control and evaluation

The control of the environmental management system is done both by the company itself and by appropriate certified external partners. The audit aims to review, improve and adapt any component of the system (e.g. strategy, policy, objectives, management, tools and monitoring tools, etc.) to take into account:

- The subjective disposition of the organization's management for "harder" or "looser" strategic or policy goals.
- Changes in the activities of the organization or in its individual functions.
- Changes in the technology used.
- Changes in the legal framework.
- Findings per audit (internal or external) and auditors' recommendations.

The external audit is performed by experts accredited for this purpose and aims to determine the complete and correct structure and operation of the EMS.

In order for this control to be feasible, it is essential that the documentation of the EMS is complete. In addition to the general description of the system, detailed analytical figures and records should be included regarding the following:

- Measurements of the parameters provided by the system and their evaluation, so that the legal compliance of the system and its continuous improvement can be clearly seen.
- Staff training, in order to obtain continuous support with the necessary human skills for the operation of the system.
- Internal audit acts, in order to determine the leading role of the administration in the strategic adaptation of the system, when necessary.
- Results of external audits, so that it is possible to monitor the compliance of the organization with the comments of external auditors.

Section 7: Communication environmental policy

The requirement for informing the general public of the activities of the organization/company regarding its environmental performance and the relevant objectives it sets, is a fundamental feature of the EMS.

A mature communication system requires:

- Indication of the responsible person by the staff of the company, who will receive the relevant questions regarding the environmental management system.
- Existence of a transparent procedure for the company to process and manage the inquiries received by the external auditors.
- Processing and preparing appropriate material addressed to the general public (e.g. public relations department) and customers (eg sales department).
- The organization's strategy for the environment and the corresponding policies, in which it has specialized.
- The detailed description of the other components of the system (objectives, specific staff, measurements, controls, communication policy, etc.), including all three basic tables, described in the previous Section 5 "System Monitoring".
- The evaluation of the system, as perceived by:
 - The society in general,
 - The shareholders,
 - The creditors of the organization.

The environmental management system must prove not only its positive impact on the environment but also its long-term sustainability by applying pure economic criteria.

3.1.5. Comparison between the two most famous EMSs

The two world-leading Environmental Management Systems are the ISO 14001 (International Organization for Standardization) and the EMAS regulation (Eco-Management and Audit Scheme).

Regarding the comparison of these two, [Βασιλόπουλος \(1998\)](#), [Rivera-Camino \(2001\)](#), [Αραβώσης \(2002\)](#), [Delmas \(2002\)](#), [Hillary \(2004\)](#) and [Γεωργακόπουλος \(2005\)](#), mention the following

ISO is an international standard with global recognition, applied in all organizations and services. On the other hand, EMAS is only recognized in the European Union. The adoption of both is voluntary and their differences are presented in [Table 3](#).

Table 3. The differences between ISO and EMAS ([Αραβώσης, 2002](#))

ISO	EMAS
Global recognition	Recognition only in the EU
It does not require registering in a list of environmental impacts and business-related legislation	Requires registering in a list of environmental impacts and business-related legislation
Official compliance control of the Environmental Management System	Determining the audit period by the environmental inspectors, at least every 3 years
It does not require environmental statement	It requires environmental statement
The environmental policy of the organization / company is communicated to the public	Environmental policy must be published, inter alia, in the context of an environmental statement
Less requirements	More requirements, more complete

The purpose of the EMAS system is to promote continuous improvement of environmental performance. This can be done through the development and implementation of environmental policies by companies, the systematic, objective and periodic evaluation of the performance of informing the public about the environmental

impact and active participation of employees in the organization/company, as well as appropriate training and ongoing education.

The European Union, as a motivation to participate in EMAS, offers grants that can reach up to 60% of the budget for the implementation of the environmental management system in manufacturing companies. It also funds pilot programs to promote the participation of small and medium-sized enterprises in EMAS.

The basic steps, in terms of methodological approach, that a company can follow to implement a standard or regulation, given the decision and commitment of the management in this direction, is the analysis of the current state of operation of the company, the comparison of this operating status with the requirements of the selected model, the identification of adaptation needs, the initial planning of required interventions, the definition and planning of the necessary actions - interventions, the launch of an implementation program and its continuous monitoring and evaluation ([Αραβώσης, 2002](#)).

In general, ISO 14001 is more popular than EMAS. This is mainly due to the international recognition of ISO 14001, while EMAS is recognized only in the European Union. But also among countries of the European Union, ISO 14001 clearly has the lead over EMAS, since, in most countries, the number of companies registered according to ISO 14001 is much higher than the corresponding number of companies registered according to EMAS.

In a small number of countries (Norway, Belgium, Luxembourg) there are approximately equal numbers of business registrations in ISO 14001 and EMAS. Finally, in two EU countries, Germany and Austria, EMAS entries far exceed the corresponding entries according to ISO 14001. This is probably due to the successful EMAS promotion policy pursued by these two countries and which should be an example to the other countries.

Another reason for which ISO 14001 is more popular than EMAS, is the fact that ISO 14001 refers only to the implementation of Environmental Management System, while EMAS has higher requirements, as mentioned above (e.g. compliance with legislation, disclosure of environmental statement), and is considered more strict. These requirements of course, which in a way make EMAS less attractive to companies, should in fact be an advantage of EMAS, as, by properly covering them, the company

ensures better relations with the authorities and the public and consequently environmental protection is more effective.

A third reason why ISO 14001 is more widespread than EMAS is the many common requirements of the standard with the standards for ISO 9000 quality systems. Thus, for companies that already implement a Quality Management System according to ISO 9000, it is easier and more economical to apply EMS according to ISO 14001.

Subsection 3.2. "ISO 14001 Environmental Management System"

The ISO International Standardization Organization is a global federation consisting of respective national standardization bodies in more than 130 countries.

Specifically:

- In Greece it is represented by ELOT (Hellenic Standardization Organization)
- In Germany by DIN
- In the US by ASTM

ISO was founded in the 1970s in Geneva, Switzerland to promote the development of safe standardization and similar activities. The most widely known of the ISO series standards is ISO 9000 (and its derivatives), which has been adopted by many companies around the world, in order to show customers and other stakeholders that their business has been submitted in a complete analysis of its organizational structure, which (at least in theoretical level) guarantees quality assurance.

An ISO certified company has not simply adopted the ISO series standards, but has received its certification from an independent and approved body (e.g. TUV, etc.).

Following the successful introduction of the ISO 9000 series of standards, mainly for construction companies and service companies, a team of expert environmental consultants was established to assess the need for corresponding environmental management standards and to propose the best and most functional options for the development of these models ([Ζουμπούλης κ.α., 2015](#)).

During the 1990s this group proposed the development of an international environmental management standard, known as the ISO 14000 series of standards. The general purpose of these standards is to help various organizations and businesses develop their own systems, which, however, will take into account environmental protection issues and allow their future evaluation with safe environmental practices.

The first group includes the ISO 14001 and ISO 14004 standards, which have as an objective the definition of specific instructions and principles for the management of environmental issues by companies through the installation and operation of EMS.

The second group, which includes the ISO 14010, 14011 and 14012 standards, are environmental inspection guidelines. These standards are designed to help businesses develop and implement an administrative process and assess the effectiveness of their actions, their products and their overall environmental behavior.

All standards, except ISO 14001, are general guidelines. This means that their content has no predefined requirements, except for ISO 14001 which is the main model of environmental management.

The standards of the ISO 14000 series can be divided into sub-categories, depending on what they focus on. Thus, they can be divided into two general categories::

- Business or procedure standards - Environmental Systems, Management, Environmental audits, Environmental Performance Evaluations.
- Specific product standards - e.g. Life Cycle Assessment, Ecological Labeling, Environmental Considerations in Product Production, etc.

The ISO 14000 family of standards includes the following standards ([Αραβώσης, 2002; Ζουμπούλης κ.α., 2015](#))

ISO 14001: Environmental Management Systems - Specifications with instructions for their use.

It is a general EMS, developed through an international consensus process. ISO 14001 is a standard management system and not a product or performance standard. It represents the change in business management in relation to the concepts of complete management and employee involvement.

It is a fairly broad framework, containing both the basic principles of managing a company's processes and the activities to identify environmental issues, which specifically concern the operation of that company. This standard requires a company to state what it does in environmental management and then to do what it says. When a company is certified according to ISO 14001, it means that it has a documented environmental management system fully developed, supported and monitored, while what is certified is the management system that takes place during the production of a product or service and not the product itself.

ISO 14004: EMS - General guidelines for principles, systems and supporting structures.

This standard provides practical help in adapting an EMS to the needs and requirements of a particular company. It is an internal directive and:

- It helps to determine the principles that managers will use to implement the EMS.
- It highlights the benefits of an EMS.
- It provides the necessary details needed for the implementation of the EMS.
- It assists in the design processes of the EMS by offering guidance in identifying environmental aspects, in impact assessment, in defining procedures for meeting (possibly) legal and regulatory requirements, in setting internal performance priorities and in setting goals and objectives.
- It proposes an implementation plan, ensuring the availability of resources. It aligns the EMS with other management systems applied by the company, and assigns responsibilities and duties to the staff, ensuring with relevant training and information that the staff has the necessary knowledge to implement the EMS. Lastly it ensures the existence of procedures for responding to emergencies.
- It suggests a way to measure, monitor and evaluate performance in relation to its objectives, while defining a system for the implementation of corresponding corrective and preventive actions.
- It suggests ways in which the company manages the process of continuous improvement to achieve "Overall Quality" and improvement in its environmental behavior.

ISO 14010: Guidelines for environmental inspection - General principles

It guides businesses, inspectors and their clients on the general principles of environmental inspections.

ISO 14011: Guidelines for conducting environmental inspection – inspection procedures - conducting inspection of environmental management systems.

It defines the inspection procedures for planning and conducting an EMS inspection. The purpose of the inspection is to determine whether the EMS meets the criteria set.

ISO 14012: Guidelines for conducting the environmental inspection - Suitability assessment criteria for environmental inspectors.

It determines the required qualifications of inspectors and chief auditors.

ISO 14015: Environmental assessments of organizations and sites.

ISO 14020: Environmental labels and statements - General principles.

It provides general principles that guide the development of specific environmental requirements. The basic principles are:

- Labels and statements must be accurate, verifiable, relevant and non-misleading.
- Environmental features must be available to buyers.
- Labeling and statements must be based on a rigorous scientific methodology.
- Criteria for labeling and environmental statements should be available to all stakeholders.
- Labeling and environmental statement must take into account the life cycle of the product or service.
- Administrative work should be limited to verifying compliance with the criteria set.
- Labeling procedures and environmental criteria should not create restrictions on trade.
- Labeling and environmental statement should not inhibit innovation.
- Criteria, as well as environmental labeling and statement, must be developed by common consent.

ISO 14021: Environmental labels and statements - Self-declaration claims: terminology, symbols, controls and verifications

The purpose of this standard is to encourage the reduction of environmental burdens and effects of the products or services consumed and the harmonization of the corresponding environmental requirements.

ISO 14024: Environmental labels and statements - Environmental Label Type I

This standard provides criteria for the evaluation of products and the award of environmental labels.

ISO 14025: Environmental labels and statements – Environmental Label Type II

It is a labeling program. In this standard, the label does not distinguish the preferred products but provides the necessary information about their environmental effects to potential buyers.

ISO 14031: Environmental performance assessments

It is the standard, which aims to determine and delimit the environmental performance assessment of companies' environmental management systems. The assessment of the environmental performance within the framework of the EMS can function as a system of measurement-assessment but also as a system of determining the

environmental strategy of the company. This process is different from inspection, because environmental performance assessment is an ongoing process, performed by the company's staff involved in the production process.

ISO 14032: Environmental performance assessments - Case studies

ISO 14040: Life cycle assessments - Principles and guidelines.

It is a standard aimed at encouraging the public and private companies to approach environmental issues in a systematic way, taking into account the environmental impact under a wider range of views, i.e. from their initial production and use until their final disposal in the environment.

ISO 14041: Life cycle assessments – Life cycle analysis.

It is a standard that aims to give those involved in the product life cycle specific instructions and requirements that will help them formulate a more complete life cycle. This standard focuses on life cycle study and the process of analyzing life cycle data.

ISO 14042: Life cycle assessments - Environmental impact assessments.

It is a standard that proposes three categories of influence, which must be taken into account in each component of the life cycle, namely (a) Classification, (b) Characterization, and (c) Evaluation.

ISO 14043: Life cycle assessment - Interpretation.

ISO 14049: Environmental Management - Life Cycle Assessment - Examples of the application of ISO 14041 to define the objectives, scope of implementation and analysis.

ISO 14050: Vocabulary of environmental management.

ISO 14061: Information and reference material for the application of ISO 14001 and the use of ISO 14004 especially by forest organizations.

Guide 64:

A guide to incorporating environmental aspects into product standards. It sets out factors to consider when developing product specifications to reduce environmental impact and achieve specific performance. The guide emphasizes on provisions that

may affect the environment during the product life cycle stages. It also provides a summary of all scientific methodologies for identifying and assessing the environmental impact of the various provisions of a product standard.

3.2.1. ISO 14001

The ISO 14001 standard was first published in 1996 and mainly includes the requirements of an environmental management system. It applies to those environmental aspects that the organization has control over and in which it is expected to have an impact. On November 15, 2004, the revised version of this ISO was published, i.e. ISO 14001: 2004. This revised standard appears to be quite improved compared to the previous one in terms of ease of understanding, emphasis on compliance and compatibility with the ISO 9000: 2000 quality management standard.

ISO 14001 is often cited as the cornerstone of the ISO 14000 series of standards. Not only because it is the most well-known and widespread but also because it is the only standard through which an organization or business can be certified by an external certification body. By declaring the certification, the organization/company does not initially declare any specific environmental performance criteria. The success of the standard depends on the commitment at all levels and, above all, at the level of the top management of the organization. Such a standard enables an organization/business/company to establish procedures for defining its environmental policy and environmental objectives and to evaluate their effectiveness, to achieve compliance with them and to demonstrate to other stakeholders this compliance. The overall goal of ISO 14001 is to generally support environmental protection and pollution prevention equally with other socio-economic needs.

It should be noted that this international standard does not establish absolute requirements for environmental performance, other than a commitment to the company's policy and compliance with applicable law and other regulations aimed at continuously improving its performance. Therefore, two organizations/companies that carry out similar activities, but have different environmental performance, can both comply with the requirements of the standard. In addition, the mere adoption of this standard alone does not guarantee excellent environmental results. In order to achieve the environmental objectives, the EMS should encourage companies/organizations to consider the application of the best available technology, where this is feasible and

economically viable. Finally, this standard does not include workplace health and safety requirements but does not prevent or discourage companies from incorporating such elements into their systems.

The main reason why many people perceive ISO 14001 differently is the misunderstanding of what this standard really is and which its real goals are. With the series of ISO 14000 standards, the international organization ISO once again moves in the area of management, this time to establish the basis for an international certification process for EMS.

ISO 14001 is often incorrectly referred to as an environmental standard. Its purpose is not to measure the environmental impact or to ensure that it is minimized. ISO 14001 should only be considered as a reference framework, in order to properly identify and manage the various performance criteria set by each organization-company that applies this standard. It is a process, which aims at the best possible management of the company's activities, which can potentially have a negative impact on the environment. Organizations should follow a process of reviewing these activities in order to manage them effectively.

The important environmental aspects that have been identified are the core of the EMS and become the content of the company's environmental policy and the relevant objectives set out in it. By itself an EMS will not improve the environmental performance of the organization/company but a proper standard will be able to give the organization the ability to measure and control the environmental aspects of its operations.

3.2.2. ISO 14001 Requirements

ISO 14001 provides guidance on the requirements of an EMS, which are based on the "Design - Implementation - Control - Improvement" framework. ([Ζουμπούλης, 2015](#)).

I. Design:

The design data of the EMS take into account existing legal regulations, requirements and data from stakeholders, technological and organizational elements and data (eg

best practices, standards, production technology, infrastructure, etc.), as well as environmental requirements. The basic stages of design are:

- Recording of the current situation.
- Identification of legal and other requirements.
- Collection of data from stakeholders.
- Evaluation of technologies and infrastructure.
- Assessment of the environmental aspects of the organization.
- Identification, evaluation and prioritization of Environmental Impacts.
- Decision on specific actions to manage the environmental impact in accordance with the previous prioritization.

More specifically, the recording of the present situation includes:

- Carrying out environmental inspection of the facilities:
 - Operation
 - Environmental Licenses
- Locating:
 - The problems
 - The main operational characteristics of the company that are expected to affect the environment
 - The possibility of intervention in order to avoid or reduce adverse environmental effects
- Writing a detailed "Environmental Inspection Report".

In terms of compliance with the legislation, initially an investigation of the current legislation, Greek and European, is carried out. Information on general environmental legislation is found as well as the specific legislation on the activities of the organization/company (if any), whether special permits are required, what are the other requirements, internal regulations (if any), codes, detailed instructions and specifications, etc., and then, the more specific requirements, concerning the operation of the specific company, are identified. The following is a comparison with the results of the environmental inspection and evaluation of the level of compliance. The final stage includes identifying the possibilities and ways to improve compliance.

The identification of environmental aspects is done throughout the scope of the EMS and includes:

- The activities of the organization/company.

- Incoming and outgoing activities.
- The products.
- Business processes at all organizational levels (production, sales, procurement, etc.).
- Infrastructure (facilities, equipment, etc.).
- Normal and abnormal (emergency) operating conditions.

Changes in the environment, positive or negative, resulting from environmental aspects, constitute the environmental impact.

The identification of environmental aspects is completed in four steps:

- Step 1: Select the activity/process.
- Step 2: Determine the environmental aspects: normal operating conditions, potential emergency situations.
- Step 3: Identification/description of the respective environmental impacts.
- Step 4: Assessment and prioritization of environmental impacts.

The identification of environmental impact/aspects can be done, e.g. through the examination of inputs and outputs in each individual production process of the company, such as:

- Discharges into water,
- Raw materials and natural resources,
- Liquid waste generated,
- Solid by-products produced,
- Noise generated.

Another proposed method of identifying environmental aspects is to consider the following procedures as a whole, without analysis of inputs and outputs:

- Operation and production,
- Maintenance,
- Emergency situations.

Once the recording is complete, the effects are evaluated and prioritized by applying certain criteria (e.g. legal requirements, internal requirements or business regulations, damage to the natural or human environment, size and severity of impact, frequency and probability of occurrence, cost to business, possibility of intervention, social interest, contribution to climate change, depletion of natural resources, stakeholders,

etc.) and, finally, the appropriate decisions are made for the management of the Environmental Impact.

II. Implementation:

In the implementation of an EMS, using the environmental impact assessment/management algorithm, decisions are made for the management of the Environmental Impact and their implementation includes some permanent actions of continuous management, as well as specific actions of improvement of the environmental impact, while at the same time requiring more comprehensive coordination.

The implementation is done through the application of specific procedures, ie through the documented description of how some tasks should be performed, and contain the following:

- Scope (in which activities of the company the process is applied).
- Purpose (what we seek to achieve by implementing it).
- Responsibilities (who is involved and what responsibilities they have).
- Actions that are implemented and how to implement procedures.
- Time series of actions.
- Records kept.

Procedures for improving environmental parameters include:

1. the preparation and monitoring of environmental management programs,
2. targeting, monitoring and elaboration of appropriate environmental indicators,
3. the process of corrective and preventive actions.

Design procedures include:

1. environmental goals and objectives,
2. review by the management,
3. communication with third parties,
4. investigation of legislative requirements, and
5. assessment of environmental aspects and requirements.

System control procedures include:

1. Carrying out environmental internal inspections, and
2. Maintenance of devices, measurements and controls.

Finally, environmental impact management procedures refer to the management of:

1. solid waste,
2. liquid waste,
3. gaseous pollutants,
4. energy consumption,
5. water consumption, and
6. production of hazardous waste and special handling waste.

III. Control:

It includes the establishment of a control system and the corresponding corrective actions, which will include monitoring and measurement, in case of non-compliance, as well as taking corrective and preventive actions. These will be complied with in accordance with the requirements of the environmental management and inspections of the EMS.

IV. Improvement:

It includes a review process by the management, through which senior management re-evaluates the suitability, effectiveness and adequacy of the EMS at appropriate intervals, in order to ensure the continuous improvement of the system.

3.2.3. Scope of application

The international standard ISO 14001 is applicable to all types and sizes of corporate organizations and can be adapted to different geographical, cultural and social conditions. Specifically, it can be applied to (Ζουμπούλης, 2015):

- The whole company, including the central administration and the factories – international facilities.
- A business unit within a business. This unit may consist of components in different locations.
- A factory - facility of a business, which includes one or more business units.
- A government agency, including all its managements and functions or a single management, such as e.g. is waste management.
- A specific processing procedure of a factory, such as e.g. a plating line.

ISO 14001 can be applied to any organization/business/company, which wishes to (Ζουμπούλης, 2015):

- Implement, maintain and improve an EMS,
- Prove its compliance with the environmental policy stated,
- Demonstrate and prove its compliance to others,
- Ensure compliance with applicable environmental laws and regulations,
- Seek the certification of the environmental management system provided by an appropriate external body,
- Make a self-declaration of conformity.

Subsection 3.3. “Community Eco-management and Audit Scheme (EMAS)”

The European Union Eco-Management and Audit Scheme (EMAS) is an administrative tool for businesses and other organizations that aims to improve their environmental performance. Companies have been participating in EMAS since 1995 (Regulation No. 1836/93, date of voting by the European Council 29/6/93). Initially, only companies from the industrial sector could participate. From 2001, however, and after its revision (Regulation No. 761/2001, date of voting 19/3/01), EMAS is available for implementation to all organizations in all sectors and industries, including public and private services. In addition, EMAS has been strengthened by the implementation of ISO 14001 as the standard environmental management system required by it. EMAS, however, unlike ISO 14001, is accompanied by an attractive logo, with which the organizations that apply it, show their certification in non-EU countries (Figure 8). Participation is voluntary and applies to any public or private sector organization committed to improving its environmental performance.



Figure 8. EMAS logo

The purpose of EMAS is to promote the continuous environmental performance of organizations (Regulation 761/2001) through the (Αραβώσης 2002):

- Development and implementation of environmental management systems by organizations
- Systematic, objective and periodic evaluation of the performance of these systems

- Information on environmental performance, and open dialogue with the public and other stakeholders
- Active participation of employees in the organization, as well as appropriate training and in-service training which facilitate active cooperation in their duties.

EMAS is a voluntary process, and any organization (according to the new Regulation) that wants to improve its overall environmental performance has the right to participate. To this end, it must adopt an environmental policy that will include commitments aimed at continuous environmental improvement. The process begins with an initial environmental analysis of the site. Next, an environmental program and an environmental management system must be introduced in order to meet the obligations contained in the organization's environmental policy.

The effectiveness of the system must be monitored, so the organization carries out or outsources environmental audits. The EMAS Regulation goes a little further and requires a validated environmental statement, which the organization forwards to the competent body of the Member State, and if approved, made public and eligible for EMAS.

EMAS allows the registration of individual units, which allows organizations to implement EMAS in a single location. In the United Kingdom, public bodies have been given the opportunity to apply for service-level registration, allowing even more system flexibility.

3.3.1. EMAS Implementation Steps

See is a brief presentation of the implementation steps, which an organization needs to apply to participate in EMAS, below ([Αραβώσης, 2002](#)).

I. Environmental Policy

The EMAS regulation requires the organization to prepare and draft its environmental policy. This policy constitutes a written statement of the general objectives and principles of action of the company in environmental matters.

Environmental policy provides the initial direction for the environmental management system. With the policy, the organization is committed to continuous environmental

improvements, to its compliance with the relevant environmental legislation and to ensuring environmentally responsible behavior by all of its staff.

The policy is a commitment to which promises must be kept. It should reflect the organization's strategy, visions and goals, and provide a framework for environmental objectives and the management system. The policy should target its activities, products and services and be the basis for the future integration of the EMS into it.

Environmental policy must be:

- Written
- Adopted by the highest administrative level
- Reviewed periodically and possibly reviewed by the management (based on the results of the audits).
- Available to the public

II. Environmental Analysis.

Environmental analysis is the basis of environmental work. The initial analysis is performed once, when the organization prepares an initial mapping of all its environmental impacts.

The analysis provides an overall picture of the organization's resource consumption, its dischargers into water, its air emissions, and waste generation. The primary objective is to ensure that the organization is fully aware of its environmental status before embarking on the environmental impact hierarchy, the creation of improvement programs and the planning of the implementation of the EMS.

In the process of identifying and recording all the environmental impacts associated with the activities of the activity area, both the direct and indirect aspects of the activities, products and services of each organization must be recorded.

The EMAS regulation requires an analysis to produce two results:

- Environmental impact registration,
- Registration of legislative, regulatory and other requirements included in the policy.

The analysis requires the creation of a file with the registration, analysis and evaluation of all environmental parameters that govern the area of activity and the creation of a file with all relevant regulations and legislations that cover all its activities.

The advantage of conducting an analysis is that it provides the company with a useful overview of environmental conditions, a picture it may not have had before. It also usually provides new ideas on where and how improvements and savings can be made.

III. Environmental Objectives and Program

It is a requirement of the EMAS Regulation that all stakeholders prepare, based on the results of the analysis, an environmental program that describes how environmental policy should be implemented.

The environmental program is the 'action plan' that guides environmental improvements. Through the program, the organization sets the environmental goals and activities that need to be done to improve environmental performance and achieve the specific objectives. The program also identifies those responsible for the timely implementation of these activities.

The environmental program has an independent and dynamic form. The organization itself decides on how to meet the objectives and the timeline. The program should be reviewed at regular intervals and ensure a continuous environmental improvement.

IV. Environmental Management System.

The environmental management system distributes responsibilities and duties and describes the day-to-day environmental tasks. The procedures and instructions contained in the management system describe who is responsible and for which tasks, related to the environmental efforts of the organization, and give a clear description of how those tasks will be performed.

The overall goal of designing and introducing such a system is to ensure that the organization's environmental efforts will be an integral part of its overall activities and day-to-day administrative procedures, and that these efforts will take place on a daily basis.

The advantage of having such a system is that all the responsibilities of each employee are defined. Therefore, all staff will be aware of their daily individual responsibilities and in addition new employees can be easily introduced to the environmental tasks of the organization.

V. Environmental Audit.

It is a requirement of EMAS, for each company to review at regular intervals their environmental management system in order to check the adequate operation of the system, i.e. to carry out an environmental audit. This audit will cover the activities for a period of at least one year.

The environmental audit checks whether the management system applied works as a whole. Auditors (who may be external or internal) examine whether the objectives set are being achieved. That means that they check whether the operational tasks that are implemented are on the right track and completed, as well as whether the management tasks, which have been assigned to different administrative levels, and the responsibilities function as provided.

The audit process, in accordance with the requirements of EMAS, is carried out through audits of records, written procedures and other relevant written data, with inspections of working conditions and equipment, and with discussions with the personnel employed in the specific field of activity.

Environmental audit is therefore a tool by which the organization is able to obtain an overall picture of its position, in relation to the environmental concerns and environmental issues that govern it.

VI. Environmental Statement.

Another requirement of the EMAS Regulation is for the organizations to prepare a public environmental statement relating to its environmental work, including policy, objectives and management system.

The statement is a means of informing the public about the environmental progress made in relation to the processes that have taken place, and at the same time a commitment to continuously improve environmental performance. The environmental statement must be prepared after the end of each environmental audit, ie every year as a minimum requirement.

The advantage of an environmental statement is that the organization creates a universal and reliable document for the environmental conditions and activities that affect it, which can be distributed to customers and other stakeholders, and used in general advertising efforts.

With the statement, the organization wants to improve its image among its 'neighbors' and the public in general, and to emphasize on the environmental responsibility that governs it. Some of the relevant stakeholders in this process concern its customers, investors, insurance companies, suppliers, environmental non-governmental organizations, SMEs, etc.

The environmental statement must include the following:

- Description of the activities of the company in the specific area where the EMS is applied.
- Evaluation of all important environmental issues related to the specific activities.
- Summary of numerical data on all its environmental aspects.
- Other factors related to environmental impact.
- Presentation of the organization's policy, program and management system for the environment regarding a specific area of activity.
- The deadline for submitting the next statement.
- The name of the accredited environmental inspector.

VII. Environmental Verification and Registration

The EMAS regulation includes the external verification of the environmental declaration and the management system by an accredited environmental inspector that will lead to the registration of the organization in accordance with the Regulation.

The inspector effectively examines and approves the compliance of the site with all the requirements of the Regulation, the reliability of the data and information contained in the environmental statement and if the statement adequately covers all environmental issues related to the specific site.

The organization, after the verification, has the right to use the environmental logo of EMAS, which essentially constitutes approval that the company has complied with all the requirements of the regulation.

The EMAS logo can only be used in the following cases:

- In verified environmental statements
- In documents of the registered organizations
- In information material that shows the participation of an organization in EMAS

The logo may also be used by organizations in conjunction with environmental information, such as brochures related to activities, products and services, provided that the information and references are included in the environmental statement and have been verified by the inspector, and that the logo is accompanied by the words "verified information".

The logo may not be used in the following cases:

- In products or in their packaging
- In combination with comparative claims regarding products, activities and services
- In ads for products, activities and services

3.3.2. EMAS Main Points

In the EU member states Environmental tools (eg regulations, directives, etc.) are the basis for most of their current environmental legislation. However, despite the directives and regulations issued by the EU and the international and national action, the quality of the environment is still not improving as fast as some would have hoped. On the other hand, for many corporations, simple compliance with legal requirements is only the first step towards sustainable development. Reactive management strategies, such as the restoration of the environment, since it has already been destroyed and the payment of criminal sanctions for violating the law, burden the finances of companies and undermine their profits. Therefore, the benefits of voluntary management systems, such as EMAS, are becoming increasingly apparent. The following three main features are the key to the successful implementation of the Community Eco-Management and Audit Scheme:

I. Performance:

EMAS is a voluntary environmental management system, based on a common system throughout the European Union, with the aim of improving the environmental performance of companies/organizations, which are committed to assessing and reducing their environmental impact.

II. Transparency:

Published information on the environmental performance of a company/organization is an important aspect of the EMAS goal. It is achieved through the environmental statement, which provides information to the public about the environmental impact and environmental performance of the organization, and within the organization itself, through the active participation of employees in the implementation of the management system. The EMAS logo, which can be displayed on the headings of all documents, environmental statements, product advertisements, various activities and services, is an attractive visual tool that shows the organization's commitment to improving its environmental performance and the credibility of the information provided.

III. Credibility:

The process of registration and certification according to EMAS by an external and independent body (competent bodies and certification auditors under the control of EU Member States) ensures the public credibility but also the general credibility of the system, including the environmental management and information of the company/organization to the public (with the environmental statement).

Educational Unit Summary

Environmental Management System (EMS) is defined as the part of the overall management system of an organization that includes the necessary organizational structure, activities, procedures, roles and responsibilities, appropriate practices, processes and resources to address the environmental impact of products, services or functions of that specific organization. The development of EMS started as a result of a series of events and developments such as the energy crisis, the cost of reaction to environmental accidents, the growing legal requirements, the ecological consciousness of consumers and societies, etc., EMS belong to the category of tools that are based on market demands and encourage producers and consumers for the responsible use of natural resources and the minimization or elimination of pollution, while aiming to make use of the ingenuity of companies and direct them to improve the environmental performance of products and procedures in a different way from the traditional “order and control” of environmental legislation. Today, the two most well-known EMS are ISO 14001 and EMAS. The first is a system of global reach while the second is recognized only in Europe.

Self-assessment Questions on Educational Unit 3

1. By definition: Environmental Management System (EMS) is the management system of an organization that includes the necessary organizational structure, activities, processes, roles and responsibilities, appropriate practices, processes and resources to address the environmental impact of products, services or functions of that organization.

<input type="checkbox"/>	True
<input type="checkbox"/>	False

2. At the 1st International Conference on Environmental Management organized in 1984 by the International Chamber of Commerce:

<input type="checkbox"/>	The International Network for Environmental Management was established.
<input type="checkbox"/>	The International Chamber of Commerce issued the "Business Charter for Sustainable Development".
<input type="checkbox"/>	It was recognized that "environmental management must be an integrated and integral part of economic development".
<input type="checkbox"/>	Environmental guidelines for the industry have been published.

3. The following are included in the Business Charter of Sustainable Development of the International Chamber of Commerce:

- Business priority
- Training of employees
- Preparedness for unexpected incidents
- Integrated management

<input type="checkbox"/>	True
<input type="checkbox"/>	False

4. The following are included in the Business Charter of Sustainable Development of the International Chamber of Commerce:

- Continuous improvement process
- Training of employees
- Environmentally friendly products and services
- Environmental impact assessment

<input type="checkbox"/>	True
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False

5. The creation of tools, which today are the ancestors of modern EMS, was the result of a series of events and developments, such as: the energy crisis, the cost of repairing environmental accidents, the growing legal requirements, the ecological consciousness of consumers and societies, etc.

True
 False

6. Note which of the following are correct: An EMS belongs to the category of tools that:

- Push producers and consumers to minimize or eliminate pollution
- Are based on market demands
- Aim to take advantage of business ingenuity
- Push producers and consumers to use natural resources responsibly
- Aim to improve the environmental performance of products and processes

7. Note which of the following are correct: An EMS must:

- Offer adequate and appropriate training of staff for the understanding of environmental issues and the system in general
- Refer to the production departments of an organization / company
- Focus only on processes, products and services
- Encourage cooperation and internal communication
- Have the appropriate inspection and review procedures in order to continuously improve

8. Mark the external incentives for implementing the EMS:

- Improving the public image of the company
- Optimal use of resources and energy savings
- Reduction of environmental management costs
- Requirement for certification by customers

- | | |
|--|--|
| | Good business practices |
| | Improving environmental performance |
| | Improving the organization and operation of the business |
| | Saving material costs |

9. Mark the internal incentives for implementing the EMS:

- | | |
|--|--|
| | Improving the public image of the company |
| | Optimal use of resources and energy savings |
| | Reduction of environmental management costs |
| | Requirement for certification by customers |
| | Good business practices |
| | Improving environmental performance |
| | Improving the organization and operation of the business |
| | Saving material costs |

10. Mark the operational incentives for implementing the EMS:

- | | |
|--|--|
| | Improving the public image of the company |
| | Optimal use of resources and energy savings |
| | Reduction of environmental management costs |
| | Requirement for certification by customers |
| | Good business practices |
| | Improving environmental performance |
| | Improving the organization and operation of the business |
| | Saving material costs |

11. Mark the financial incentives for implementing the EMS:

- | | |
|--|---|
| | Improving the public image of the company |
| | Optimal use of resources and energy savings |
| | Reduction of environmental management costs |

	Requirement for certification by customers
	Good business practices
	Improving environmental performance
	Improving the organization and operation of the business
	Saving material costs

12. In order of importance, the improvement of the image of the company is considered one of the most important motivations for the implementation of the EMS compared to the improvement of the internal operation and organization of the company.

	True
	False

13. Put the sections of the EMS in the correct order:

	Implementation of environmental policy
	System monitoring
	Corporate strategy and the environment
	Environmental policy design
	Monitoring and evaluation
	Performance and management practices: Initial overview
	Communication environmental policy

14. Section 1 of the EMS (Corporate Strategy and the Environment), inter alia, aims to:

	The detailed documentation of the EMS so that its internal and external audit is possible
	Communicating to the general public the activities of the organization-organization regarding its environmental performance
	Designing a coherent environmental policy
	The development of the basic argumentation and logic, which governs the effort to install the EMS
	The control of the environmental management system that is done both by the company itself and by appropriate certified external partners

- The preparation of tables for the monitoring of the EMS in relation to the objectives set by the business environment management policy
- The complete overview of the wider relationship of the operation of the organization / company with the environment

15. Section 2 of the EMS (Performance and Management Practices. Initial Overview), inter alia, aims to:

- The detailed documentation of the EMS so that its internal and external audit is possible
- Communicating to the general public the activities of the organization-organization regarding its environmental performance
- Designing a coherent environmental policy
- The development of the basic argumentation and logic, which governs the effort to install the EMS
- The control of the environmental management system that is done both by the company itself and by appropriate certified external partners
- The preparation of tables for the monitoring of the EMS in relation to the objectives set by the business environment management policy
- The complete overview of the wider relationship of the operation of the organization / company with the environment

16. Section 3 of the EMS (Environmental Policy Design), inter alia, aims to:

- The detailed documentation of the EMS so that its internal and external audit is possible
- Communicating to the general public the activities of the organization-organization regarding its environmental performance
- Designing a coherent environmental policy
- The development of the basic argumentation and logic, which governs the effort to install the EMS
- The control of the environmental management system that is done both by the company itself and by appropriate certified external partners
- The preparation of tables for the monitoring of the EMS in relation to the objectives set by the business environment management policy

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The complete overview of the wider relationship of the operation of the organization / company with the environment

17. Section 4 of the EMS (Environmental Policy Implementation), inter alia, aims to:

The detailed documentation of the EMS so that its internal and external audit is possible

Communicating to the general public the activities of the organization-organization regarding its environmental performance

Designing a coherent environmental policy

The development of the basic argumentation and logic, which governs the effort to install the EMS

The control of the environmental management system that is done both by the company itself and by appropriate certified external partners

The preparation of tables for the monitoring of the EMS in relation to the objectives set by the business environment management policy

The complete overview of the wider relationship of the operation of the organization / company with the environment

18. Section 5 of the EMS (System Monitoring), inter alia, aims at:

The detailed documentation of the EMS so that its internal and external audit is possible

Communicating to the general public the activities of the organization-organization regarding its environmental performance

Designing a coherent environmental policy

The development of the basic argumentation and logic, which governs the effort to install the EMS

The control of the environmental management system that is done both by the company itself and by appropriate certified external partners

The preparation of tables for the monitoring of the EMS in relation to the objectives set by the business environment management policy

The complete overview of the wider relationship of the operation of the organization / company with the environment

19. Section 6 of the EMS (Audit and Evaluation), inter alia, aims at:

	The detailed documentation of the EMS so that its internal and external audit is possible
	Communicating to the general public the activities of the organization-organization regarding its environmental performance
	Designing a coherent environmental policy
	The development of the basic argumentation and logic, which governs the effort to install the EMS
	The control of the environmental management system that is done both by the company itself and by appropriate certified external partners
	The preparation of tables for the monitoring of the EMS in relation to the objectives set by the business environment management policy
	The complete overview of the wider relationship of the operation of the organization / company with the environment

20. Section 7 of the EMS (Communication Environmental Policy), inter alia, aims at:

	The detailed documentation of the EMS so that its internal and external audit is possible
	Communicating to the general public the activities of the organization-organization regarding its environmental performance
	Designing a coherent environmental policy
	The development of the basic argumentation and logic, which governs the effort to install the EMS
	The control of the environmental management system that is done both by the company itself and by appropriate certified external partners
	The preparation of tables for the monitoring of the EMS in relation to the objectives set by the business environment management policy
	The complete overview of the wider relationship of the operation of the organization / company with the environment

21. Note which of the following are correct: ISO characteristics are:

	Global recognition
	It requires an environmental statement
	More requirements, more complete

- Less requirements
- Recognition only in the EU
- It does not require an environmental statement

22. Note which of the following are correct: EMAS characteristics are:

- Global recognition
- It requires an environmental statement
- More requirements, more complete
- Less requirements
- Recognition only in the EU
- It does not require an environmental statement

23. EMAS does not require a listing of environmental impacts and business-related legislation.

- True
- False

24. ISO does not require a listing of environmental impacts and business-related legislation.

- True
- False

25. In general, ISO 14001 is more popular than EMAS.

- True
- False

26. In Greece ISO is represented by ELOT.

- True
- False

27. All ISO 14000 series standards are general guidelines. This means that their content has no predefined requirements.

- True

False

28. ISO 14001 is based on the framework:

Design - Implementation - Monitoring - Improvement

Design - Implementation - Control - Improvement - Re-control

Design - Implementation - Control - Improvement

Design - Implementation - Control - Improvement - Publication

29. EMAS logo can be used:

In information material that shows the participation of an organization in EMAS

In products of each company or in their packaging

In combination with comparative claims regarding products, activities and services

In ads for products, activities and services

In the documents of registered organizations

In verified environmental statements

30. EMAS logo cannot be used:

In information material that shows the participation of an organization in EMAS

In products of each company or in their packaging

In combination with comparative claims regarding products, activities and services

In ads for products, activities and services

In the documents of registered organizations

In verified environmental statements

31. EMAS, unlike ISO 14001, is accompanied by an attractive logo, with which the organizations that apply it, show their certification in non-EU countries.

True

False

Annex – Educational Unit 3

Answers to Self-Assessment Questions on Educational Unit 3

1. By definition: Environmental Management System (EMS) is the management system of an organization that includes the necessary organizational structure, activities, processes, roles and responsibilities, appropriate practices, processes and resources to address the environmental impact of products, services or functions of that organization.

<input type="checkbox"/>	True
<input checked="" type="checkbox"/>	False

Answer: Environmental Management System (EMS) is defined as the part of the overall management system of an organization that includes the necessary organizational structure, activities, procedures, roles and responsibilities, appropriate practices, processes and resources to address the environmental impact of products, services or functions of that organization.

2. At the 1st International Conference on Environmental Management organized in 1984 by the International Chamber of Commerce:

<input type="checkbox"/>	The International Network for Environmental Management was established.
<input type="checkbox"/>	The International Chamber of Commerce issued the “Business Charter for Sustainable Development”
<input checked="" type="checkbox"/>	It was recognized that "environmental management must be an integrated and integral part of economic development".
<input type="checkbox"/>	Environmental guidelines for the industry have been published.

3. The following are included in the Business Charter of Sustainable Development of the International Chamber of Commerce:

- Business priority
- Training of employees
- Preparedness for unexpected incidents
- Integrated management

<input checked="" type="checkbox"/>	True
<input type="checkbox"/>	False

4. The following are included in the Business Charter of Sustainable Development of the International Chamber of Commerce:

- Continuous improvement process
- Training of employees
- Environmentally friendly products and services
- Environmental impact assessment

X	True
	False

5. The creation of tools, which today are the ancestors of modern EMS, was the result of a series of events and developments, such as: the energy crisis, the cost of repairing environmental accidents, the growing legal requirements, the ecological consciousness of consumers and societies, etc.

X	True
	False

6. Note which of the following are correct: An EMS belongs to the category of tools that:

X	Push producers and consumers to minimize or eliminate pollution
X	Are based on market demands
X	Aim to take advantage of business ingenuity
X	Push producers and consumers to use natural resources responsibly
X	Aim to improve the environmental performance of products and processes

7. Note which of the following are correct: An EMS must:

x	Offer adequate and appropriate training of staff for the understanding of environmental issues and the system in general
	Refer to the production departments of an organization / company
	Focus only on processes, products and services
x	Encourage cooperation and internal communication
x	Have the appropriate inspection and review procedures in order to continuously improve

8. Mark the external incentives for implementing the EMS:

X	Improving the public image of the company
	Optimal use of resources and energy savings
	Reduction of environmental management costs
X	Requirement for certification by customers
	Good business practices
	Improving environmental performance
	Improving the organization and operation of the business
	Saving material costs

9. Mark the internal incentives for implementing the EMS:

	Improving the public image of the company
X	Optimal use of resources and energy savings
	Reduction of environmental management costs
	Requirement for certification by customers
	Good business practices
X	Improving environmental performance
	Improving the organization and operation of the business
	Saving material costs

10. Mark the operational incentives for implementing the EMS:

	Improving the public image of the company
	Optimal use of resources and energy savings
	Reduction of environmental management costs
	Requirement for certification by customers
X	Good business practices
	Improving environmental performance
X	Improving the organization and operation of the business
	Saving material costs

11. Mark the financial incentives for implementing the EMS

	Improving the public image of the company
	Optimal use of resources and energy savings
X	Reduction of environmental management costs
	Requirement for certification by customers
	Good business practices
	Improving environmental performance
	Improving the organization and operation of the business
X	Saving material costs

12. In order of importance, the improvement of the image of the company is considered one of the most important motivations for the implementation of the EMS compared to the improvement of the internal operation and organization of the company.

X	True
	False

13. Put the sections of the EMS in the correct order:

4	Implementation of environmental policy
5	System monitoring
1	Corporate strategy and the environment
3	Environmental policy design
6	Monitoring and evaluation
2	Performance and management practices: Initial overview
7	Communication environmental policy

14. Section 1 of the EMS (Corporate Strategy and Environment), inter alia, aims to:

	The detailed documentation of the EMS so that its internal and external audit is possible
	Communicating to the general public the activities of the organization-organization regarding its environmental performance

	Designing a coherent environmental policy
X	The development of the basic argumentation and logic, which governs the effort to install the EMS
	The control of the environmental management system that is done both by the company itself and by appropriate certified external partners
	The preparation of tables for the monitoring of the EMS in relation to the objectives set by the business environment management policy
	The complete overview of the wider relationship of the operation of the organization / company with the environment

15. Section 2 of the EMS (Performance and Management Practices. Initial Overview), inter alia, aims to:

	The detailed documentation of the EMS so that its internal and external audit is possible
	Communicating to the general public the activities of the organization-organization regarding its environmental performance
	Designing a coherent environmental policy
	The development of the basic argumentation and logic, which governs the effort to install the EMS
	The control of the environmental management system that is done both by the company itself and by appropriate certified external partners
	The preparation of tables for the monitoring of the EMS in relation to the objectives set by the business environment management policy
X	The complete overview of the wider relationship of the operation of the organization / company with the environment

16. Section 3 of the EMS (Environmental Policy Design), inter alia, aims to:

	The detailed documentation of the EMS so that its internal and external audit is possible
	Communicating to the general public the activities of the organization-organization regarding its environmental performance
X	Designing a coherent environmental policy
	The development of the basic argumentation and logic, which governs the effort to install the EMS

	The control of the environmental management system that is done both by the company itself and by appropriate certified external partners
	The preparation of tables for the monitoring of the EMS in relation to the objectives set by the business environment management policy
	The complete overview of the wider relationship of the operation of the organization / company with the environment

17. Section 4 of the EMS (Environmental Policy Implementation), inter alia, aims to:

X	The detailed documentation of the EMS so that its internal and external audit is possible
	Communicating to the general public the activities of the organization-organization regarding its environmental performance
	Designing a coherent environmental policy
	The development of the basic argumentation and logic, which governs the effort to install the EMS
	The control of the environmental management system that is done both by the company itself and by appropriate certified external partners
	The preparation of tables for the monitoring of the EMS in relation to the objectives set by the business environment management policy
	The complete overview of the wider relationship of the operation of the organization / company with the environment

18. Section 5 of the EMS (System Monitoring), inter alia, aims at:

	The detailed documentation of the EMS so that its internal and external audit is possible
	Communicating to the general public the activities of the organization-organization regarding its environmental performance
	Designing a coherent environmental policy
	The development of the basic argumentation and logic, which governs the effort to install the EMS
	The control of the environmental management system that is done both by the company itself and by appropriate certified external partners
X	The preparation of tables for the monitoring of the EMS in relation to the objectives set by the business environment management policy

The complete overview of the wider relationship of the operation of the organization / company with the environment

19. Section 6 of the EMS (Audit and Evaluation), inter alia, aims at

X

The detailed documentation of the EMS so that its internal and external audit is possible

Communicating to the general public the activities of the organization-organization regarding its environmental performance

Designing a coherent environmental policy

The development of the basic argumentation and logic, which governs the effort to install the EMS

The control of the environmental management system that is done both by the company itself and by appropriate certified external partners

The preparation of tables for the monitoring of the EMS in relation to the objectives set by the business environment management policy

The complete overview of the wider relationship of the operation of the organization / company with the environment

20. Section 7 of the EMS (Communication Environmental Policy), inter alia, aims at:

X

The detailed documentation of the EMS so that its internal and external audit is possible

Communicating to the general public the activities of the organization-organization regarding its environmental performance

Designing a coherent environmental policy

The development of the basic argumentation and logic, which governs the effort to install the EMS

The control of the environmental management system that is done both by the company itself and by appropriate certified external partners

The preparation of tables for the monitoring of the EMS in relation to the objectives set by the business environment management policy

The complete overview of the wider relationship of the operation of the organization / company with the environment

21. Note which of the following are correct: ISO characteristics are:

X	Global recognition
	It requires an environmental statement
	More requirements, more complete
X	Less requirements
	Recognition only in the EU
X	It does not require an environmental statement

22. Note which of the following are correct: EMAS characteristics are:

	Global recognition
X	It requires an environmental statement
X	More requirements, more complete
	Less requirements
X	Recognition only in the EU
	It does not require an environmental statement

23. EMAS does not require a listing of environmental impacts and business-related legislation.

	True
X	False

Answer: To EMAS requires listing in environmental impact and business related legislation

24. ISO does not require a listing of environmental impacts and business-related legislation.

X	True
	False

Answer: ISO does not require listing in environmental impact and business related legislation.

25. In general, ISO 14001 is more popular than EMAS.

X	True
	False

26. In Greece ISO is represented by ELOT.

X	True
	False

27. All ISO 14000 series standards are general guidelines. This means that their content has no predefined requirements.

	True
X	False

Answer: All ISO 14000 standard series, except 14001, are general guidelines. ISO 14001 is the main standard of environmental management.

28. ISO 14001 is based on the framework:

	Design - Implementation - Monitoring - Improvement
	Design - Implementation - Control - Improvement - Re-control
X	Design - Implementation - Control - Improvement
	Design - Implementation - Control - Improvement - Publication

29. EMAS logo can be used

X	In information material that shows the participation of an organization in EMAS
	In products of each company or in their packaging
	In combination with comparative claims regarding products, activities and services
	In ads for products, activities and services
X	In the documents of registered organizations
X	In verified environmental statements

30. EMAS logo cannot be used:

	In information material that shows the participation of an organization in EMAS
X	In products of each company or in their packaging
X	In combination with comparative claims regarding products, activities and services
X	In ads for products, activities and services
	In the documents of registered organizations
	In verified environmental statements

31. EMAS, unlike ISO 14001, is accompanied by an attractive logo, with which the organizations that apply it, show their certification in non-EU countries.

X	True
	False

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Presentations

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Natural Environment

Natural Resources Protection through Business Activities

Educational Unit 1 "Natural Environment and Natural Resources"

Educational Unit 1 "Natural Environment and Natural Resources"

The purpose of the First Educational Unit, with the title "Natural Environment and Natural Resources", is to help the students of the program to learn about the natural environment and gain a global perspective and knowledge of natural resources with the ultimate goal of developing a sense of proper use and rational management of natural resources in general. Therefore, the First Educational Unit is based on the assumption that raises the issue of acquiring relevant knowledge about the subject under management in order for any form of management to be effective.

Introduction

Introduction

Natural environment is the set of abiotic (soil, air, water, etc.) and biotic factors (animals, plants, etc.) that affect and determine life.

The natural environment consists of four (4) basic spheres.
In particular:

Click

Click on the images below and discover the four (4) key spheres.

Subsection 1.1. “Natural Environment”

Natural Environment

“Biodiversity means the diversity of living organisms of all origins, including, inter alia, terrestrial, marine and other aquatic ecosystems and ecological complexes of which they are a part. It also includes diversity within species, between species and ecosystems.” In a few words, biodiversity is defined as the diversity of life in all its forms (plants, animals, fungi, etc.) and at all levels of its organization (genes, organisms, ecosystems).

The concept of biodiversity therefore embraces all life on Earth. It includes the way of expressing or appreciating the diversity that exists at the various levels of life organization. It reflects the number, variety and variability of living organisms and the systems that they compose.

Lithosphere

Hydrosphere

Atmosphere

Biosphere

Biosphere (1)

- The biosphere includes all living things.
- Its thickness is about 7 km.
- The abiotic and biotic elements of the biosphere compose the ecosystems.
- Ecosystems can be found across the Earth.

Biosphere 1

The biosphere includes all living things, ie plants and animals, but also other categories of organisms and microorganisms (eg fungi, bacteria), which grow in the soil (either on the surface or underground), in the water or the air. The biosphere extends from at least 0.5 km below the surface of the oceans, while traces of it have been identified up to 6.5 km inside the troposphere. As a result, its thickness is about 7 km. Living things, in correlation and interdependence with the environment in which they live and develop, compose ecosystems. Therefore, ecosystems consist of the biotic and the abiotic component. Ecosystems, can be found all across the Earth.

- Every ecosystem is characterized by a specific organization of its members.

- Food relations are at the heart of this organization.
- Plants are the basis of the food chain.
- The food chain ends up in the decomposers.
- The materials that circulate in ecosystems and which are preserved and recycled in them.

Bioshpere (2)

Biosphere 2

Each ecosystem is characterized by a specific organization of its members, which has an energy base. Food relations are at the heart of this organization. That is, relationships based on food consumption. Energy comes from the sun as solar radiation and is trapped, through photosynthesis, by the plants that form the basis of the food chain. The next food levels include consumers of organic matter (herbivores, carnivores). The food chain ends up in the decomposers, ie the organisms that break down the composite organic matter of consumer tissues (and food waste) into simpler inorganic compounds, thus recycling their nutrients and energy.

Materials or, in other words, the nutrients that move in ecosystems are not created from the beginning, but are preserved and recycled in them. The paths followed by each element are the result of biological and chemical processes, which depend on its chemical properties, the physicochemical properties of the environment and the ways in which it is used by organisms. Known and important biogeochemical cycles are the hydrological cycle, the carbon cycle, the nitrogen cycle and the phosphorus cycle.

- Ecosystems are determined by their productivity.
- Productivity depends on the set biotic and abiotic parameters that affect the respective ecosystem.
- In general, productivity, sustainability and evolution of an ecosystem obey the Law of Tolerance.

Biosphere (3)

Biosphere 3

Ecosystems are determined by their productivity. This, in turn, depends both on the set of biotic and abiotic parameters that affect the respective ecosystem. In general, productivity, sustainability and evolution of an ecosystem obey the Law of Tolerance. According to this law, productivity, sustainability and evolution of an ecosystem are only possible when the factors that directly or indirectly affect it are kept above a minimum and below a maximum value.

Maximum

Optimum

Minimum

Factor Size

Optimum Zone

Tolerance Zone of the System

System Operation

Operation of the System in relation to the size of each factor

Biosphere (4)

Biosphere 4

Thus, in each factor, there are three main points: the minimum, the best and the maximum value. The minimum and maximum values determine the range of the ecosystem tolerance zone for each factor. The relationships between the various factors (elements) can affect the tolerance range of the ecosystem as well as some factors can - within certain limits - be replaced or removed by others. An example of this situation is the fact that every living organism is adapted to a specific range of temperature, humidity, oxygen, etc.

- The atmosphere is the gaseous envelope of the planet.
- It starts from the surface of the Earth and extends to an altitude higher than 10,000 km.
- The atmosphere hosts life, but also a great variety of natural phenomena.

Atmosphere (1)

Atmosphere 1

The atmosphere is the gaseous envelope of the planet, which starts from its surface and extends to an altitude of more than 10,000 km. The atmosphere hosts life, but also a wide variety of natural phenomena.

Based mainly on the height distribution of the temperature, it can be divided into five (5) basic layers:

- Troposphere
- Stratosphere
- Mesosphere
- Thermosphere
- Exosphere

Atmosphere (2)

Atmosphere 2

The atmosphere, based mainly on the height distribution of temperature, is divided into five basic layers, the troposphere, the stratosphere, the mesosphere, the thermosphere and the exosphere.

The division of the atmosphere based on temperature

Atmosphere (3)

Atmosphere 3

It displays the facts mentioned in Slide 11 and Slides 13 - 17.

- The troposphere is the lower layer of the atmosphere.
- It is about 12 km thick.
- It concentrates 75-80% of the total mass of air and humidity.
- It is the place where the most and most intense meteorological phenomena can be observed.
- The only layer of the atmosphere that hosts life.

Atmosphere (4) - Troposphere

Atmosphere 4

The troposphere is the lower layer of the atmosphere. It extends from the ground to an altitude of about 12 km. The thickness of the troposphere layer depends on the latitude and the time of year. The troposphere concentrates 75-80% of the total air mass and, essentially,

all the humidity of the atmosphere. It is the place where the most and most intense meteorological phenomena are observed as well as the unique layer of the atmosphere in which life is found.

- It extends from the troposphere limit (tropopause) to an altitude of about 50 km.
- It is characterized by an increase in temperature proportionally to altitude.
- There is an absence of meteorological phenomena.
- It has a very low moisture content and relatively high concentrations of ozone (O₃).

Atmosphere (5) – Stratosphere

Atmosphere 5

The stratosphere extends from the troposphere limit (tropopause) to an altitude of about 50 km. It is characterized by an increase in temperature proportionally to altitude, the absence of strong meteorological phenomena, very low moisture content and the absence of clouds. It has relatively high concentrations of ozone (O₃).

- It reaches an altitude of 80 km.
- It is characterized by a drop in temperature proportionally to altitude.
- Low air density and absence of meteorological phenomena.

Atmosphere (6) – Mesosphere

Atmosphere 6

The mesosphere, the next layer of the atmosphere, reaches an altitude of about 80 km. It is characterized by a drop in temperature, low air density and the absence of meteorological phenomena.

- Layer thickness that varies widely (approximately 500-1,000 km).
- It is characterized by a gradual increase in temperature (up to 1,500 ° C).
- The non-meteorological phenomena of the northern and southern polar lights are observed.

Atmosphere (7) – Thermosphere

Atmosphere 7

The temperature reaches an altitude that varies widely (about 500-1,000 km), depending on solar activity. It is characterized by a gradual increase in temperature (up to 1,500 ° C). However, due to the extremely low density of air, the temperature of the layer is not perceived by the senses. The non-meteorological phenomena of the northern and southern polar lights are observed in the thermosphere.

- The outer layer of the atmosphere.
- The upper limit of the exosphere exceeds 10,000 km.
- Air does not behave like gas because of its low density.

Atmosphere (8) – Exosphere

Atmosphere 8

The exosphere is the outer layer of the atmosphere and extends to the thresholds of space. The upper limit of the exosphere exceeds 10,000 km. In the exosphere, air has such a low density that it does not actually behave as a gas.

The atmospheric air, in the lower layers of the atmosphere, consists of:

- A mixture of gases in stable proportions, called "dry air" (nitrogen 78.08%, oxygen 20.95%, argon 0.93%, other gases 0.04%).
- Water vapor, carbon dioxide, ozone and other gases in variable proportions.
- Solid or liquid particles of dust (powder), chemical compounds (eg soot) or of organic origin (eg pollen).

Atmosphere (9)

Atmosphere 9

The air in the atmosphere is in constant circulation, both horizontally and vertically. Many of the meteorological phenomena, ie changes in meteorological conditions perceived by our senses or with the assistance of instruments, owe their birth to solar radiation (mainly) and to the general circulation of the atmosphere and the interactions of gas masses with different temperature and humidity characteristics.

Atmospheric air, in the lower layers of the atmosphere, consists of:

- A mixture of gases in stable proportions, scientifically called "dry air" (nitrogen 78.08%, oxygen 20.95%, argon 0.93%, other gases 0.04%).
- Water vapor, carbon dioxide, ozone and other gases in variable proportions.

- Solid or liquid particles of dust (powder), chemical compounds (eg soot) or of organic origin (eg pollen).

- The hydrosphere is the total amount of the water element surrounding the Earth.
- It has a leading role in the maintenance and development of the life on the planet.
- The first human activities were affected – and in some cases dominated – by access and use of water.
- The progress of civilization can be related to water, and especially in climates where the reliable production of food and other goods is directly dependent on control of this resource.

Hydrosphere (1)

Hydrosphere 1

The hydrosphere is the total amount of the water element surrounding the Earth as liquid (seas, lakes, lagoons, rivers, groundwater), as a solid (polar ice, glaciers) and as a gas in the atmosphere (water vapor).

The hydrosphere plays a leading role in the maintenance and evolution of life on the planet. The importance of water has been recognized since the time of the first societies. The absence or abundance of this resource could indicate the ideal area for permanent or temporary settlement. In general, it could be said that the first human activities were influenced - and in some cases dominated - by the access to and the use of water: for drinking, cooking, fishing, irrigation, shipping, and later for energy production. The progress of civilization can be related to water, and especially in climates where the reliable production of food and other goods depends directly on the control of this resource.

- Water is a natural resource in continuous recycling.
- The total amount of water on the planet is estimated at about 1,386 million km³.
- Fresh water represents only 2.5%.
- Water requires careful management as, even though its quantity on Earth does not decrease, its quality is constantly degrading due to pollution.

Hydrosphere (2)

Hydrosphere 2

Water is a natural resource in continuous recycling through the hydrological cycle, ie its phase transitions (liquid, solid, gas) and its position in the environment. The total amount of water on the planet is estimated at about 1.386 million km³. Its largest percentage, 96.5%, is found in the oceans and seas. Fresh water represents only 2.5%. Of the total amount of fresh water, water in lakes and rivers reaches only 93,120 km³. The rest of the fresh water is found in polar ice and glaciers, on the ground, in the atmosphere and in the tissues of living organisms. At the same time, it is a natural resource that requires careful management: although its quantity on Earth does not decrease, its quality is constantly degrading due to pollution.

- The lithosphere is the solid crust of the Earth.
- At no point does its thickness exceed 40 km (while

in the oceans is often less than 6 km).

- The lithosphere is not continuous but is divided into large pieces, the lithospheric plates.
- Many geological phenomena, such as volcanoes, earthquakes, orogeny and the formation of new rocks are due to the movements of lithospheric plates..

Lithosphere (1)

Lithosphere 1

The lithosphere is the solid crust of the Earth. Its thickness, compared to the overall dimensions of the planet, is very small. At no point does it exceed 40 km, while in the oceans it is often less than 6 km.

According to the theory, the lithosphere is not continuous but is divided into large pieces, the lithospheric plates. These plates are thin, in relation to their surface, and slide at different speeds onto the partially glowing asthenosphere, the underlying layer of the earth, which has a higher density and temperature. Today it is believed that many geological phenomena, such as volcanoes, earthquakes, orogeny and the formation of new rocks, are due to the movement of lithospheric plates.

The lithosphere is constantly changing, due to the geological processes, such as:

- Weathering
 - Mechanical
 - Chemical

- Erosion
- Deposition

Lithosphere (2)

Lithosphere 2

In addition to the movement of lithospheric plates, the lithosphere is constantly changing, due to geological processes such as weathering, erosion and deposition:

- Weathering refers to all actions that contribute to the destruction of geological rocks. It is distinguished in:
 - i. Mechanical, which is caused by various causes, such as temperature changes, frost, the action of the organic world (eg plant roots), tectonic movements, and
 - ii. Chemical, caused by chemical agents such as carbon dioxide (CO₂) or sulfur dioxide (SO₂), which is often dissolved in rainwater.
- Erosion concerns the factors that contribute to the detachment and transfer of geological formations to another location. Erosion factors are surface water and groundwater, glaciers, sea waves, wind, gravity.
- Deposition, as a geological process, corresponds to the final stage of transport of weathering and erosion products to new sites.

- The lithosphere consists of rocks.
- Rocks are divided into the following three categories:

- Igneous
- Sedimentary
- Metamorphic
- Rocks are composed of minerals which usually have a crystal structure.
- Minerals also include oils and mineral coals.

Lithosphere (3)

Lithosphere 3

The lithosphere consists of rocks. These rocks can be soils, rocks or mixtures of these two categories. Depending on how they are formed, they are divided into the following three categories:

- Igneous, formed by the solidification of a fluid and glowing mass (magma) released from the Earth's interior.
- Sedimentary, formed from the weathering and erosion products of other pre-existing rocks.
- Metamorphic, which come from the transformation of certain mineral components of rocks of the other two categories.

Rocks are composed of minerals which usually have a crystal structure. An example is granite (igneous rock) which consists of quartz, feldspars and other minerals. Most minerals contain silicon (such as quartz). Minerals also include petroleum, mineral coals and various other materials, which, although of organic origin, due to their long stay in the subsoil, have undergone major physicochemical changes in their original organic character.

Natural Resources

The term "natural resources" has been interpreted in various ways:

interpretation 1

Interpretation 3

Characteristics of the natural environment able to meet human needs

interpretation 2

Interpretation 4

Goods or materials provided by nature

The primary, and non-transformed by humans, components of nature that can be used to cover basic human goods.

The productive forces or the result of the productive forces that exist and act in the natural environment and that for the present man, or for the future man, can be used to meet his needs..

Subesection 1.2. "Natural Resources"

Subsection 1.2. "Natural Resources"

"Biodiversity means the diversity of living organisms of all origins, including, inter alia, terrestrial, marine and other aquatic ecosystems and ecological complexes of which they are a part. It also includes diversity within species, between species and ecosystems." In a few words, biodiversity is defined as the diversity of life in all its forms (plants, animals, fungi, etc.) and at all levels of its organization (genes, organisms, ecosystems).

The concept of biodiversity therefore embraces all life on Earth. It includes the way of expressing or appreciating the diversity that exists at the various levels of life organization. It reflects the number, variety and variability of living organisms and the systems that they compose.

Natural resources, according to the criteria considered, are categorized:

Based on their origin

Based on exploitability

Distinction of Natural Resources (1)

Distinction of Natural Resources (1)

In active resources or stocks

In potential resources or reserve basis

abiotic

biotic

Natural resources, according to the criteria considered, are categorized:

From an environmental point of view

Distinction of Natural Resources (2)

Distinction of Natural Resources (2)

In finite or non-renewable

In renewable

In potentially renewable

- Water covers approximately 70% of the planet's surface.
- It is the most important solvent and transporter of ingredients in plants, animals, humans and all natural procedures.
- Water is in constant motion and can be considered to circulate in a closed circuit (hydrological cycle).
- The hydrological cycle refers to the continuous exchange of water between the atmosphere, surface water, soil water, groundwater and biosphere.

Water Resources (1)

Water Resources 1

Water, the most widespread component of the earth, covers approximately 70% of the planet's surface and is vital for every form of life. It is also the most important solvent and transporter of ingredients in plants, animals, humans and all natural processes that take place on earth. Water is in constant motion and can be considered to be moving in a closed circuit (hydrological cycle). The hydrological cycle refers to the continuous exchange of water between the hydrosphere, ie between the atmosphere, surface water, solid water, groundwater and biosphere.

The main parts of the hydrological cycle are:

- Filtration - movement of precipitation water into the ground.
- Precipitation - any aqueous precipitation in liquid or solid form.
- Runoff - the surface flow of water to areas of lower altitude.
- Evaporation and perspiration - return water to the atmosphere.

Water Resources(2)

Water Resources 2

The main parts of the hydrological cycle are (NOAA, 2013):

- Filtration: this comes from the movement of precipitation water into the soil. Filtration varies spatially and temporally due to a number of environmental factors. After a rainfall, filtration can cause the soil to saturate with water. This condition does not last long as the water descends and filters deeper under the influence of gravity.
- Precipitation: these can be defined as any aqueous precipitation in liquid or solid form, which develops in a saturated atmosphere and generally descends from the clouds. Meteorologists have categorized various types of precipitation as rain, snow, and hail. Fog reflects the saturation of the air close the ground.
- Runoff: is the surface flow of water to areas of lower altitude. On a small scale, runoff can be considered as the result of a series of successive phenomena (difference in precipitation volume, evaporation, perspiration and filtration). On a global or large scale, runoff flows from land masses to the oceans.
- Evaporation and Perspiration: these two processes return water to the atmosphere. Evaporation is caused on the surface of the soil and the free surfaces of water bodies (rivers, lakes, seas, oceans), while perspiration is caused by the vegetation of the area (groundwater that is transported to the foliage through the roots and released as gas through the mouths of leaves). These two processes are commonly referred to as evapotranspiration.

Water resources are divided into:

- Coastal waters - surface waters that are more than a nautical mile away from the coast.
- Transitional waters - surface waters near river mouths.
- Inland waters - are characterized by the presence of

fresh water.

- Surface waters - form wetlands
- Groundwater – affected, but also affect surface waters.

Water Resources(3)

Water Resources 3

Water Resources are divided into:

- Coastal waters: Surface waters that are more than a nautical mile away from the coast. A typical example of coastal waters are seas and oceans.
 - Transitional waters: Surface water systems near river mouths, which are partly saline due to their proximity to coastal waters, but which are also substantially affected by freshwater currents. A typical category of transitional waters are lagoons and estuaries.
 - Inland waters: Systems characterized by the presence of fresh water are called "inland waters" and include "surface waters" that form wetlands, and "groundwater", which is affected, but also affect surface waters.
 - Surface waters: Atmospheric precipitation that does not penetrate the ground and does not evaporate, along with spring water, is surface water. Surface water occurs either in the form of running water, flowing water (eg rivers), or stagnant water (eg lakes).
 - Groundwater: Part of the rainwater penetrates deeper through the voids, pores and crevices of the rocks, due to the force of gravity forming groundwater.
- Factors that are dependent on the soil:
 - The preservation of terrestrial life on the planet

- The world economy on a local and a global level
- It is the upper layer of the Earth's surface
- It consists of a mixture of:
 - Decomposed surface rocks
 - Organic matter
 - Mineral nutrients
 - Humidity
 - Air / oxygen
 - Microorganisms

Soil Resources(1)

Soil Resources 1

The soil is one of the most important natural resources, on which the conservation of the terrestrial life on the planet and the world economy, on a local and a global level, are dependent. It is the upper layer of the Earth's surface and is the dividing layer between the atmosphere and the lithosphere and between the lithosphere and the seas, lakes, rivers and oceans.

The soil is formed in a natural way and is a mixture of decomposed surface rocks of the earth, decomposing organic matter, mineral nutrients, moisture, air, oxygen and microorganisms (fungi, bacteria, insects, beetles, earthworms, etc.), most of which act as decomposers, breaking down dead organic matter.

- Soil is considered a renewable natural resource.
- It is formed at an extremely slow pace.
- The soil is the basis of agricultural and forestry production.
- Among other things, the soil is:
 - The living space of organisms.
 - The natural filter of groundwater reserves.
 - The natural background for construction.
 - The medium for plant nutrition with water and minerals.

Soil Resources(2)

Soil Resources 2

Although soil is considered a renewable natural resource, it is formed at an extremely slow rate. Indicatively, the formation of one centimeter of soil takes decades.

The soil is the basis of agricultural and forestry production. About 97% of food consumed by humans come from the earth, while only 3% come from marine ecosystems.

It is the living space of organisms, the natural filter and protective layer of groundwater reserves, the natural background for the construction of cities and villages, modern infrastructure projects, road networks, etc. and a medium for feeding plants with water and minerals.

The five main soil forming factors are:

- The planting stock - material that comes from the gradual physical or chemical weathering of rocks.
- The climate - the characteristics of the climate and especially humidity and temperature.
- The topographic relief - The altitude and the inclination of soil surface affect the processes of soil formation.
- The time - the time since the planting stock begins to turn into soil.
- Living organisms - plant and animal organisms

Soil Resources(3)

Soil Resources 3

The five main soil forming factors are:

- The planting stock: is a relatively loose material that from its gradual physical or chemical weathering soil will be formed. The physical (structure and size of the rocks) and the chemical composition of the planting stock, affect the rate of soil evolution, its chemical composition and its ability to retain water.

- The climate: the characteristics of the climate, especially humidity and temperature, affect the evolution of the soils but also the type and speed of weathering of the rocks. It also determines the types of vegetation that grow.
- The topographic relief: The altitude and the inclination of the soil surface affect the soil formation processes. E.g. areas with a steep inclination are characterized by small soil thickness as the soil horizons do not manage to develop since the soil, due to gravity, is constantly transported to lower altitudes.
- The time: The age of the soil is considered to be the duration of its formation process and specifically the time that elapses from the moment the planting stock begins to turn into soil. The older the soil, the more it differs from the planting stock in terms of its composition and morphology. Depending on the age, the soils are divided into immature, mature and old.
- Living organisms: Plant organisms with their roots contribute to the weathering of rocks while animal organisms affect the soil by decomposing organic matter.

Find out more

Biodiversity (1)

Biodiversity (1)

It is the foundation of the vast range of goods and services that ecosystems provide.

It contributes decisively to human well-being.

Each species has an intrinsic value, independent of its usefulness to humans.

As a term, it appeared in 1980 and it means the variety of living organisms of any origin.

Biodiversity is usually considered at three levels:

Genetic diversity

Species diversity

Ecosystem diversity

Biodiversity (2)

Biodiversity (2)

Genetic diversity (within each species) - refers to the differentiation of genetic material between individuals of the same species.

Ecosystem diversity - describes and explores different types of ecosystems.

Species diversity - diversity of species that characterizes different regions.

The true value of biodiversity is immeasurable:

Ecological benefits (indicatively):

Click

Click on the images below and discover the ecological benefits of biodiversity.

Biodiversity (3)

Biodiversity (3)

"Biodiversity means the diversity of living organisms of all origins, including, inter alia, terrestrial, marine and other aquatic ecosystems and ecological complexes of which they are a part. It also includes diversity within species, between species and ecosystems." In a few words, biodiversity is defined as the diversity of life in all its forms (plants, animals, fungi, etc.) and at all levels of its organization (genes, organisms, ecosystems).

Therefore, the concept of biodiversity embraces all life on Earth. It includes the way of expressing or appreciating the diversity that exists at the various levels of life organization. It reflects the number, variety and variability of living organisms and the systems that make them up.

Wetlands - e.g. water storage, enrichment of underground aquifers, sediment trapping, modification of flood phenomena, etc.

Forests - e.g. retention of gaseous pollutants, modification of flood and corrosion phenomena, support of food webs, etc.

Parasites / predators – control of the population

Trees / shrubs - e.g. CO2 capture from the atmosphere, oxygen production, food supply, etc.

Click

Click on the images below and discover the economic benefits of biodiversity.

Biodiversity (4)

The true value of biodiversity is immeasurable:

Ecological benefits (indicatively):

Biodiversity (4)

“Biodiversity means the diversity of living organisms of all origins, including, inter alia, terrestrial, marine and other aquatic

ecosystems and ecological complexes of which they are a part. It also includes diversity within species, between species and ecosystems." In a few words, biodiversity is defined as the diversity of life in all its forms (plants, animals, fungi, etc.) and at all levels of its organization (genes, organisms, ecosystems).

Therefore, the concept of biodiversity embraces all life on Earth. It includes the way of expressing or appreciating the diversity that exists at the various levels of life organization. It reflects the number, variety and variability of living organisms and the systems that make them up.

Medications - e.g. natural / traditional or processing products

Housing / Protection - e.g. supply of construction materials

Fuels - e.g. wood and coal

Food - species that are the subject of hunting, fishing, collecting, etc.

Click

Click on the images below and discover the social benefits of biodiversity.

Biodiversity (5)

The true value of biodiversity is immeasurable:

Ecological benefits (indicatively):

Biodiversity (5)

"Biodiversity means the diversity of living organisms of all origins, including, inter alia, terrestrial, marine and other aquatic ecosystems and ecological complexes of which they are a part. It also includes diversity within species, between species and ecosystems." In a few words, biodiversity is defined as the diversity of life in all its forms (plants, animals, fungi, etc.) and at all levels of its organization (genes, organisms, ecosystems).

Therefore, the concept of biodiversity embraces all life on Earth. It includes the way of expressing or appreciating the diversity that exists at the various levels of life organization. It reflects the number, variety and variability of living organisms and the systems that make them up.

Civilization

Leisure & tourism

Research, education, monitoring

Silicate minerals (main component of rocks):

- Nesosilicates (forsterite, olivine andalusite)
- Sorosilicates (epidote)
- Cyclosilicates (beryllium, cordierite, alinite)

- Fibrosilicates (pyroxenes, wollastonite, diopside)
- Phyllosilicates (muscovite, biotite)
- Tectosilicates (quartz, plagioclase, zeolites)

Mineral Wealth (1)

Mineral Wealth 1

Mineral wealth belongs to natural resources and, through its exploitation, conditions are created for employment and economic prosperity. Minerals are divided into the following categories:

Silicate minerals

Silicate minerals are the main component of rocks. In terms of economic importance, they are of great interest. Building materials such as bricks, gravel, cement, glass, ceramics and porcelain, are either silicate minerals themselves or produced from them.

Silicate minerals are divided into six categories:

- Nesosilicates (forsterite, olivine andalusite): These minerals contain independent tetrahedra $(\text{SiO}_4)^{4-}$, not interconnected and have high hardness.
- Sorosilicates (epidote): In this formula two tetrahedra $(\text{SiO}_4)^{4-}$ are connected by a common peak, i.e. by a common oxygen forming pairs (Si_2O_7) .
- Cyclosilicates (beryllium, cordierite, alinite): Three, four or six tetrahedra $(\text{SiO}_4)^{4-}$ are interconnected by a common oxygen.

- Fibrosilicates (pyroxenes, wollastonite, diopside): The tetrahedra are connected to each other by common O₂ and form chains: a) simple, and pyroxenes are created and b) double, and amphiboles are created.
- Phyllosilicates (muscovite, biotite): When three oxygens from the tetrahedron belong to a neighboring tetrahedron at the same time, creating tetrahedral sheets.
- Tectosilicates (quartz, plagioclase, zeolites): Three-dimensional network of tetrahedra that each one shares all of its oxygens.
General unit formula SiO₂.

Non-Silicate Minerals:

- Carbonate minerals - contain the carbonate group as anion
- Sulfate minerals - have the sulfate root as anion
- Phosphate minerals - have the phosphate root as anion
- Sulfur minerals - compounds with metals
- Oxides and hydroxides
- Native elements

Mineral Wealth (2)

Mineral Wealth 2

Non-silicate minerals

- Carbonate minerals: They are minerals that contain the carbonate group as anion. Depending on the way that the cations are connected, there are two types of structure, Calcite and Aragonite.
- Sulfate minerals: They include minerals that have the sulfate root (SO_4^{2-}) as anion. They are as anhydrous as baryte and as hydrate as gypsum.
- Phosphate minerals: These minerals have the phosphate root as anion and a representative mineral is apatite.
- Sulfur minerals: They include compounds with copper (chalcopyrite), iron (iron pyrite), zinc (sphalerite), molybdenum (molybdenite), lead (galena).
- Oxides and hydroxides: Typical examples of this group are: corundum (Al_2O_3), hematite (Fe_2O_3), magnetite (FeOFe_2O_3), titanium (TiO_2), pyrolusite (MnO_2), spinel group (oxides of Mg, Al, Mn, Zn). The main hydroxides with economic importance are $\text{Al}(\text{OH})_3$ and $\text{Fe}(\text{OH})_3$.
- Native elements: More than 30 native elements have been found in the Earth's solid crust. Most of them are metals e.g. Gold, Silver, Iron, Copper, Platinum. Others are non-metals e.g. Sulfur,

Native elements - more than 30 native elements have been found:

- Gold Group (gold, silver, copper)
- Iron - Platinum Group (iron, nickel, cobalt, rubidium, lead and platinum)
- Sulfur Group (sulfur, selenium and tellurium)
- Carbon Group (diamond, graphite, amorphous carbon and coals)

Mineral Wealth (3)

Mineral Wealth 3

- Native elements: More than 30 native elements have been found in the Earth's solid crust. Most of them are metals e.g. Gold, Silver, Iron, Copper, Platinum. Others are non-metals e.g. Sulfur, Coal, some are gases: Neon, Krypton, Helium, and from the liquids Mercury is mentioned.
- Gold Group: Includes native gold, native silver and native copper.
- Iron - Platinum Group: This group includes the elements iron, nickel, cobalt, rubidium, lead and platinum. The most common of these are native platinum and palladium platinum.
- Sulfur Group: In addition to sulfur, this group includes native selenium and native tellurium.
- Carbon Group: The group includes diamond and graphite minerals. There are other forms of carbon besides crystal, amorphous carbon and coal (lignite, peat). Coal, petroleum and natural gas are formed from the organic matter that is buried inside the earth from the earth's surface, and under the influence of anaerobic bacteria, high pressures and temperatures give fossil fuels. Another form of carbon is artificial, which can be found in coke, charcoal and carbon black.

Renewable energy sources are:

- Inexhaustible / abundant and Environmentally cleaner
-

- Sparse forms of energy and High cost per unit of energy produced

The following energy sources are characterized as Renewable Energy Sources:

- Solar power

- Wind power

- Biomass

- Hydroelectric power

- Geothermal power

- Marine energy (tidal waves)

Click

Click to find out more

Renewable Energy Sources (1)

Renewable Energy Sources (1)

Solar power:

- Heating using active and / or passive systems
- Electricity generation through the use of:
 - Photovoltaic systems
 - Thermal steam production systems

Wind power:

- Provides potential for large-scale production of electricity
- Electricity generation through use of wind turbines

Renewable Energy Sources (2)

Renewable Energy Sources (2)

Solar power

Solar irradiance is used both for the heating of buildings, directly or indirectly and with the use of active and / or passive systems,

as well as for the production of electricity. Electricity is generated in two ways:

- i. By using photovoltaic systems that directly convert solar energy into electricity.
- ii. Solar thermal systems that use solar energy to heat a vapor-producing liquid that powers a turbine and a generator.

Wind power

Wind power is a renewable energy source that provides potential for large-scale electricity generation using wind turbines without serious environmental impact. Wind turbines (horizontal or vertical axis) are used both along with batteries in small installations and in addition to photovoltaic components, and are most often connected to the grid.

Biomass:

- Organic residues of various processes which are used for:
- Heating
- Power generation
- Movement

Hydroelectric power:

- The energy from the water drop is converted into electricity, with the help of a turbine.

Renewable Energy Sources (3)

Renewable Energy Sources (3)

Biomass

Biomass refers to the residues of various processes that directly or indirectly come from the plant world and which are used for heating, electricity generation, but also movement. These residues can come from municipal waste, from agricultural production (wood and crop residues, animal waste) as well as industrial by-products (from food or organic processing). With proper treatment, biomass is converted into gaseous fuel. Combustion of this gas produces electricity, with high efficiency and reduced environmental impact at the same time. This technology provides the maximum potential for energy production at Pan-European level. However, due to combustion it cannot be characterized as clean for the environment.

Hydroelectric power

In hydroelectric projects the energy from the water drop is converted into electricity, with the help of a turbine. Although hydroelectric projects do not produce harmful gases, in regards to large dams, other environmental parameters are taken into account, such as flood defenses, water quality, as well as the impact on the life of river organisms and the wider area.

Consequently, only small-scale hydroelectric plants (with a capacity of less than 30MW) are considered "green", while large-scale ones are simply considered "clean".

Geothermal power:

- Exploitation of water or water vapor temperature located at great depths for energy production.
- Water / steam temperature range: 25 °C - 350 °C
- Heating (when water / steam temperature <150 ° C)
- Electricity generation (when water / steam temperature > 150 ° C)

Marine energy (tidal waves):

- Wave power
- Tidal power

Renewable Energy Sources (4)

Renewable Energy Sources (4)

Geothermal power

Geothermal energy is produced by the conversion of hot water or water vapor located deep enough from the earth's surface into electricity. The temperature of the geothermal liquid varies from region to region and can range from 25 °C to 350 °C. When the temperature is lower, geothermal energy is used to heat homes and other buildings or facilities, greenhouses, livestock units, fish farms, etc. In cases where the geothermal liquids have a high temperature (above 150 °C), geothermal energy can be used mainly for the production of electricity. This energy is being used today at an increasing rate.

Marine energy (tidal waves)

Marine energy can be divided into two categories:

- Wave power - is the form of energy that results from the kinetic energy of waves. The phenomenon of winds results in the formation of waves which are exploitable in areas with high winds and on ocean shores.

Tidal power - is the form of energy that results from the gravitational attraction of the moon and the earth and which is exploitable during the difference of the altitude of the surface of the water level – low and high tide.

ENRM

Environment and Natural Resources Management (ENRM) includes developing processes and strategies that focus on:

Subsection 1.2. “Environment and Natural Resources Management”

Subsection 1.3. “Environment and Natural Resources Management”

In the allocation and conservation of resources.

Taking advantage of opportunities, avoiding risks, mitigating problems and preparing.

- Design - setting goals and objectives and creating / recognizing a series of alternative actions.
- Organization - it refers to the set of rules and actions with which the factors of production and consumption are harmonized.
- Management - assignment of tasks and evaluation of results.
- Audit - evaluation of the overall management objectives.

ENRM Tasks

ENRM Tasks

The basic tasks of ENRM are the following:

- Design: It is the process that defines the goals and objectives as well as the creation and recognition of a series of alternative actions, proposals, programs, strategy and policy by the manager in order to solve problems in the future.
- Organization: It is a management element that refers to the set of rules and actions with which the factors of production and consumption are harmonized, in a specific time and space, in order to achieve the maximum possible efficiency. Basically, the design is implemented through the organization.

- Management: It is extremely important for the assignment of tasks and the evaluation of the results.
- Audit: It is an integral part of the organization and is necessary to evaluate the overall objectives of the management. This is why it can often be applied by different entities, bodies or organizations.

- ENMR deals with the solution of practical problems that arise from the coexistence of humans and nature.
- It consists of a combination of scientific, political, social and economic practices.
- It deals with regulation of:
 - Socio-economic practices.
 - The effects caused by human activities on the environment.
 - The effects caused by the environment on the humans.

Environment and Natural Resources Management

Environment and Natural Resources Management

ENRM is essentially a process that deals with the interactions between the people and the environment and seeks to recognize the

environmentally desirable outcome taking into account the physical, economic, social and technological limitations and barriers.

Alternatively, ENRM deals with the solution of practical problems that arise from the coexistence of humans and nature..

ENRM typically consists of a combination of scientific, political, social and economic practices. It deals with the regulation of socio-economic practices and the regulation of both the effects of human activities on the environment and the effects caused by the environment on humans.

- In the first case, effects such as pollution or the deterioration and degradation of the environment by construction projects such as dams, roads or other infrastructure and facilities, etc. are included.
- In the second case, situations such as floods, landslides and other natural disasters are included.

Among others:

- It supports sustainable development
- It is a dynamic process
- It requires an interscientific, interdisciplinary or even "holistic" approach
- It incorporates the principle of prevention
- It emphasizes on management and not on exploitation

ENRM Characteristics

ENRM Characteristics

In general, ENRM has the following characteristics:

It is often used as a general term.

It supports sustainable development.

It is a dynamic process.

It requires an interscientific, interdisciplinary or even "holistic" approach.

It must integrate and reconcile different views on development.

It must coordinate science, social needs, policy making and planning.

It incorporates the principle of prevention.

It must recognize opportunities and threats and resolve problems.

It emphasizes on management and not on exploitation.

The time scale of the process exceeds the short-term limits and the spatial scale covers a wide range (local - global).

It deals with the environment that is affected by humans.

Among others:

- Bilateral and multilateral environmental treaties
- Development of environmental policies and voting
- Environmental risk assessment, analysis, and management
- Development of environmental rules and regulations
- Impact on and management of leisure and tourism

ENRM Topics (1)

ENRM Topics 1

The scope of its applications covers (but is not limited to) the following topics:

- Bilateral and multilateral environmental treaties (cross-border ecological management).
- Development of environmental policies and voting (participatory design and public consultation regarding environmental programs).
- Environmental risk assessment, analysis and management (risk recognition and communication studies).
- Development of environmental rules and regulations (for the disposal of waste, the emission of pollutants, and the extraction of resources, control, enforcement and control of compliance).
- Impact on and management of leisure and tourism (design and implementation of environmentally friendly programs).

Among others:

- Conservation of natural resources and reduction of the negative effects on the environment
- Economics of the environment
- Promoting positive environmental values
- “Delimitation” and investigation of environmental impacts
- Restoration strategies, methods and programs

for ecologically degraded areas.

ENRM Topics (2)

ENRM Topics 2

- Conservation of natural resources (designation and management of parks, shelters and other protected areas, designation and protection of wildlife areas).
- Environmental economics (financial justification for investments in environmental protection).
- Promoting positive environmental values through education, dialogue and dissemination of information.
- Reduction of negative effects on the environment.
- Evaluation and management of resources.
- “Delimitation” and environmental impact investigation (design of policies, rules and procedures for impact limitation).
- Strategies, methods and programs for the restoration of ecologically degraded areas.

It is relatively difficult to give a complete definition of ENRM:

- An approach that goes beyond the management of natural resources and includes the political, social and natural environment...

It deals with issues of value and distribution, with the nature of regulatory mechanisms and with interpersonal and geographical

equality as well as generational equality.

- Formulation of environmentally friendly development strategies
- The proper use and exploitation of livestock resources, which implies the simultaneous protection of the environment.

ENRM Definitions

ENRM Definitions

Therefore, due to the multifaceted and multidimensional nature of ENRM as well as its wide range of applications, it is relatively difficult to give a complete definition. The following is a set of definitions given to it:

- An approach that goes beyond the management of natural resources and encompasses the political, social and natural environment... It deals with issues of value and distribution, with the nature of regulatory mechanisms and with interpersonal and geographical equality as well as generational equality.
- Formulation of environmentally friendly development strategies.
- The proper use and exploitation of livestock resources, which implies the simultaneous protection of the environment.

Other definitions:

The control of all human activities that have a great impact on the natural environment.

The process of allocating natural and man-made resources so that the environment can be optimally used to meet basic human needs to a minimum level and on a sustainable basis, if possible.

The management of the environmental performance of organizations, bodies and companies.

ENRM Structure (1)

ENRM Structure (1)

1. Recognition of Needs and Objectives / Identification of the problem
2. Definition of Appropriate Actions
3. Creating a Plan
4. Implementation/ Evaluation of the Outcome
5. Development of Continuous Management
6. Management Evaluation and Adaptation
7. Future Environmental Management

ENRM Structure (2)

ENRM Structure (2)

In detail:

1. Recognition of Needs and Objectives / Identification of the problem: The environmental needs and the respective objectives - in the context of the problem in each case - the necessary information is recognized and collected.
2. Definition of Appropriate Actions: Based on the respective problem and the available information, the most appropriate actions are determined per case.
3. Creating a Plan: The set of actions as well as the accompanying processes (eg economical analysis, cost– benefit analysis, uncertainty analysis etc.) contribute to the development of the management plan.
4. Implementation / Evaluation of the Outcome : Implementation of the defined actions, monitoring their evolution and initial assessment of the outcomes.
5. Development of Continuous Management: Completion of the management plan for addressing secondary problems that may be related to the management of the respective problem and definition of the bases for future management.
6. Management Evaluation and Adaptation: Based on both the initial and the final assessment of the outcomes of the management plan, the plan adapts and focuses on the solution of issues that may have not been addressed in the initial implementation.
7. Future Environmental Management: This stage is supported by information from the previous stages and focuses on the recognition of problems that may need to be faced in the near future.

One or more of the reasons below may lead to the adoption of ENRM:

- Realistic reasons – fear or common sense

- Desire to reduce cost
- Compliance – of individuals, local government, companies, states and so on.
- Change of ethics
- Macroeconomics – the promotion of environmental management can lead to economic growth.

Adoption of ENRM (1)

Adoption of ENRM (1)

In general, before the 1980s, environmental and natural resource managers used to come from a limited range of specialties with little representation from the sociological and environmental fields. Their approaches were often authoritarian and did not involve public participation. Finally, over the last forty years, interest in natural resource management has declined in favor of environmental management, but recently both concepts have emerged and developed more participatory and socially aware approaches.

One or more of the following reasons may lead to the adoption of ENRM:

- Realistic reasons - fear or common sense makes people or managers to try to avoid a problem.
- A desire to reduce cost - it is better to avoid or deal with problems (possibility of extra profit) than with their consequences.
- Compliance – of individuals, local governments, companies, states and so on. National or international environmental agreements may be required by law.
- Change of ethics - research, the media, individuals or groups of activists can trigger new behaviors, agreements or laws.

- Macroeconomics - promoting environmental management can lead to economic growth.

A number of developments has contributed to the adoption of environmental management:

- The citizens of an ever-increasing number of countries acquired environmental consciousness.
- Non-Governmental Organizations, various bodies, companies and governments began to pursue environmental management.
- The media began to follow and to cover various environmental issues.
- Publications in North America and Europe [such as Silent Spring by Rachel Carson (Carson, 1962)] raised and reported environmental concerns in the 1960s.
- International conferences, meetings, agreements and declarations raised some environmental issues and supported environmental management.

Adoption of ENRM (2)

Adoption of ENRM (2)

After 1970, those involved in environmental issues began to move from recording problems, issuing warnings and demonstrating advocacy to environmental management, that is, problem solving, developing practical tools, and formulating rules.

A number of developments have contributed to the adoption of environmental management. More specifically:

- The citizens of an ever-increasing number of countries acquired environmental consciousness and expressed their reluctance to entrust environmental protection to governments and companies. This has resulted from the ever-increasing number of environmental accidents, the irrational use of resources and concerns about ecological threats.
- Non-Governmental Organizations, various bodies, companies and governments began to pursue environmental management.
- The media began to follow and to cover various environmental issues.
- Publications in North America and Europe [such as *Silent Spring* by *Rachel Carson* (Carson, 1962)] raised and reported environmental concerns in the 1960s.
- International conferences, meetings, agreements and declarations raised some environmental issues and supported environmental management.

- The foundation of the United Nations Environment Program (UNEP) in 1973, and other environmental actors.
- The US National Environmental Policy Act (NEPA - voted in 1970) and the creation of the United States Environmental Protection Agency (EPA) in 1970.
- The development of ecology and green policies since the 1970s.
- At the end of the 1970s, aid and funding providers began to demand environmental evaluation and management before providing support.
- The Brundtland Report in 1987 increased the awareness of the need for environmental protection.

Adoption of ENRM (3)

Adoption of ENRM (3)

- The foundation of the United Nations Environment Program (UNEP) in 1973, and other environmental actors.
- The US National Environmental Policy Act (NEPA - voted in 1970) and the creation of the United States Environmental Protection Agency (EPA) in 1970.
- The development of ecology and green policies since the 1970s.
- At the end of the 1970s, aid and funding providers began to demand environmental evaluation and management before providing support.
- The Brundtland Report - World Commission on Environment and Development, 1987 - increased the awareness of the need for environmental protection.

The basic principles of ENRM are prudence and diligence.
These are achieved through:

Policy making and planning
2
4
Establishing standards and rules, monitoring and controlling
Coordination (adopting an interdisciplinary and holistic approach)
The functionality of applications
ENRM Principles
ENRM Principles
"Biodiversity means the diversity of living organisms of all origins, including, inter alia, terrestrial, marine and other aquatic

ecosystems and ecological complexes of which they are a part. It also includes diversity within species, between species and ecosystems." In a few words, biodiversity is defined as the diversity of life in all its forms (plants, animals, fungi, etc.) and at all levels of its organization (genes, organisms, ecosystems).

The concept of biodiversity therefore embraces all life on Earth. It includes the way of expressing or appreciating the diversity that exists at the various levels of life organization. It reflects the number, variety and variability of living organisms and the systems that they compose.

Public participation in decision-making within ENRM is considered necessary for the following reasons:

- The public may be able to provide advice which otherwise would be omitted.
- Fears and conflicts in management can be reduced when the public is informed.
- If people identify with the management, they might as well support it.
- It reduces the risk of communication gap between the experts and the "locals" or end users.

Participation in ENRM (1)

Participation in ENRM (1)

Public participation in decision-making within ENRM is considered necessary for the following reasons:

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- If people identify with the management, they might as well support it.
- It reduces the risk of communication gap between the experts and the “locals” or end users.

It should be noted here that the audience usually consists of more than one stakeholder group who may have different, perhaps conflicting, views and goals. Strong groups tend to dominate the weaker people who are usually marginalized. Thus, managers must be able to ensure that no team is excluded from the process.

Indicatively, the following groups can participate in ENRM:

- Local, regional, national and international governmental organizations.
- Research institutes.
- Agencies in charge of implementing the regulations.
- Businesses of all sizes and multinational companies.
- International financial institutions.
- Environmental non-governmental organizations.
- Representatives of environmental users.

Participation in ENRM (2)

Participation in ENRM (2)

Based on this variety, the following groups of participants in environmental management can be mentioned:

1. Local, regional, national and international governmental organizations, including global actors such as the United Nations Environment Program.
2. Research institutes, such as universities, academies, and national laboratories.
3. Agencies in charge of implementing the regulations, such as the United States Environmental Protection Agency.
4. Businesses of all sizes and multinational companies.
5. International financial institutions, such as the World Bank and the International Monetary Fund.
6. Environmental non-governmental organizations, such as the World Wildlife Fund (*WWF*).
7. Representatives of environmental users, including tribes, fishermen and hunters.

The main link between these different groups is the need for accountability regarding the use of nature's wealth. However, even though there is a strong cooperation, relationships are often at odds because of the different goals that each group seeks to achieve.

So far, mainly in developed countries, the relevant legislation has been developed since 1970 in order to ensure the transparency

of planning and development. However, there are some countries that prefer not to give such a degree of control to the public. In other countries, the public prefers to leave the responsibility of environmental management to the state, while in others the authorities believe that the public is not ready or able to participate in this process.

- ENRM includes the application of a set of objective and subjective approaches - It is a combination of policy, planning and management.
- There is no single and widely accepted framework to shape its application - there are guides for policies, procedures, standards, etc.

ENRM can adopt three distinct positions:

- Preventive Management - exclusion of adverse environmental effects.
- Reactive Management - reducing or controlling the effects.
- Compensatory Management - mitigation of the effects through compensatory measures.

ENRM Approaches (1)

ENRM Approaches (1)

ENRM includes the application of a set of objective and subjective approaches. It is a combination of policy, planning and

management, but there is no single and widely accepted framework to shape its implementation. However, there are guides regarding policy, procedures, standards and systems [e.g. the widely adopted ISO 14001].

Each situation faced by environmental managers is to some extent unique, and the approach adopted reflects the perceptions and the background of those involved, the particular situation, the time, the available funds and many other factors.

ENRM can adopt three distinct positions:

1. Preventive Management – which aims to the exclusion of adverse environmental effects.
2. Reactive Management – which aims to the reduction and the control of the effects.
3. Compensatory Management – which aims to the mitigation of the effects through compensatory measures.

There is a wide range of political and philosophical positions that characterize the approach adopted:

ENRM Approaches (2)

ENRM Approaches (2)

Specialized Approach - reaction to a specific situation.

Problem Solving Approach - Identifying Problems and Needs.

Systems Approach - specially designed for systems analysis.

Regional Approach - mainly ecological zones or biogeophysical units.

There is a wide range of political and philosophical positions that characterize the approach adopted:

ENRM Approaches (3)

ENRM Approaches (3)

Approach of experts in many specialties - environmental management in various fields.

Approach of the Strategy for the environment and natural resources management.

Voluntary Sector Approach - Environmental management encouraged and supported by volunteers.

Commercial approach - environmental management for businesses and public bodies.

Human ecology approach.

Sustainable development is one of its main goals of ENRM.

Providing an internationally accepted definition of sustainable

development is a difficult task.

According to the definition given in its text "Our Common Future":

"Sustainable Development is considered the process that meets the needs of the present without compromising the ability of future generations to meet their own needs"

Sustainable Development (1)

Sustainable Development (1)

ENRM is closely linked to the concept of Sustainable Development. Most managers would accept that sustainable development is one of the key objectives of ENRM. However, providing an internationally accepted definition of sustainable development is a difficult task. Thus, most users of the term accept that:

"Sustainable development requires maintaining the quality of the environment, and ensuring that the benefits of using resources are shared equally among all existing groups, and that current activities do not limit living options nor degrade the environment of future generations..."

According to the definition in the text "Our Common Future" created by the United Nations World Commission on Environment and Development in 1987, it is the process that meets the needs of the present without compromising the ability of future generations to meet their own needs (Soubotina, 2004; Carr, 2009).

Thus, in the context of sustainable development, the goal of ENRM is to optimally increase goods and services derived from nature, and to maintain this extension indefinitely, without causing environmental destruction, in order to maximize human prosperity, security and adaptability. This process requires high quality management of the environment and human resources / agencies, as well as the ability to identify and mitigate or avoid various risks and finally adapt to socio-economic and physical threats.

The interpretation of sustainable development varies:

- Some see it as a search for harmony between people and their environment.
- Some fail to accept that in a finite world there can be no unlimited demand for resources.
- Some feel that there may be a shift to less environmentally friendly quality improvements of human life.
- Some believe that technology will allow the expansion of the boundaries of nature in a sustainable way.

Sustainable Development (2)

Sustainable Development (2)

As a concept, sustainable development is based on two, often contradictory, traditions: one deals with the limits that nature presents to humans and the other with the potential for the ever-increasing material development of man. The interpretation of sustainable development varies:

- Some see it as a search for harmony between people and their environment.
- Some fail to accept that in a finite world there can be no unlimited demand for resources.
- Some feel that there may be a shift to less environmentally friendly quality improvements of human life.
- Some believe that technology will allow the expansion of the boundaries of nature in a sustainable way.

Due to the complexity of the nature of sustainable development, the proposed practices are usually inapplicable or the term is often used in a misleading way. So ENRM must safeguard the use of the concept and try to develop workable strategies without excessive audits.

The main trends that prevail in terms of the obligations of sustainable development are:

- Maintaining ecological integrity and adoption long-term supervision
- Completing environmental protection and development,
- Satisfying, even the minimal, human needs,
- Supervising equality between generations, between members of different groups and between species,
- Applying science, technology and environmental knowledge for global development,
- Accepting a relative economic development (without

exceeding the limits set by the environment).

Trends and Obligations of Sustainable Development

Trends and Obligations of Sustainable Development

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Two of the many definitions of the Ecosystem Approach:

Definition 1

Definition 2

Ecosystem Approach

Ecosystem Approach

The effort of the management to satisfy the human needs through the use of natural resources while maintaining the biological wealth and the ecological functions required for the maintenance of the structure and the functions of the ecosystems under study.

The integration of scientific knowledge on ecological relations within a complex, socio-political and valuable framework towards the general goal of long-term protection of the natural integrity of ecosystems.

Principles of the Ecosystem Approach (1):

Principles of the Ecosystem Approach (1):

Resource management goals are a matter of social choice.

Management should be decentralized to the lowest and most appropriate level on a case-by-case basis.

Ecosystem managers must focus on the impact of management actions on neighboring and other ecosystems.

Understanding and managing ecosystems in an economic context.

Maintaining the structure and functioning of ecosystems and maintaining ecosystem services must be a priority of the ecosystem approach.

Management must take place in the context of ecosystem functionality.

7.The ecosystem approach must evolve in accordance to the appropriate spatial and temporal scale.

8.Ecosystem management objectives should be set on a long-term basis.

9.The management must recognize that change is inevitable.

10.The ecosystem approach must seek balance and integration between conservation and use of biological diversity.

11.The ecosystem approach must consider all sources of relevant information, including scientific, endogenous and local.

12.The ecosystem approach must include all of the relevant sectors of society and science.

Principles of the Ecosystem Approach (2):

Principles of the Ecosystem Approach (2)

7.The ecosystem approach must evolve in accordance with the appropriate spatial and temporal scale.

8. Ecosystem management objectives should be set on a long-term basis.

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Stage 1

Stage 2

Stage 3

Stage 4

Stage 5

Ecosystem Approach Process:

Ecosystem Approach Process:

Defining the impact of the ecosystem under study on neighboring ecosystems. Defining long-term goals and flexible ways to achieve them.

Defining the impact of the ecosystem under study on neighboring ecosystems.

Recognition of the most important economic issues affecting the ecosystem and its inhabitants.

Characterization of the structure and operation of the ecosystem under study and definition of management and monitoring actions.

Defining the main stakeholder groups, defining the extent of the ecosystem and developing the relationships between them.

The main advantage of this process is achieving a balance between the use and the conservation of biodiversity.

Policies, actions and programs that apply the principles of the ecosystem approach may include:

- Greater cooperation between stakeholders.
- A more holistic approach.
- Better application of scientific knowledge and knowledge of stakeholders for decision making.
- Less conflicts between different sectors.
- Restoration of the operation of ecosystems.

Advantages of the Ecosystem Approach:

Advantages of the Ecosystem Approach

The main advantage of this process is to achieve a balance between the use and the conservation of biodiversity. This contributes, to a certain extent, to human well-being without compromising natural resources (sustainable use). This ensures, in the long run, that the natural environment will continue to provide its valuable services. Policies, actions and programs that apply the principles of the ecosystem approach may include:

- Greater cooperation between stakeholders, integration between sectors as well as connections across geographical boundaries.
- A more holistic approach - rather than just meeting regulatory requirements.
- Better application of both scientific knowledge and the knowledge of stakeholders for decision making.
- Less conflicts between sectors: mutual benefits, and solutions that meet different goals.
- Restoration of the operation of ecosystems.

Within the general framework of ENRM a large number of tools have been used.

The most important tools are:

- Environmental Impact Assessment
- Driver – Pressure – State – Impact – Response Framework

- Analysis of Strengths - Weaknesses - Opportunities - Threats

Management tools:

Management tools

Within the general framework of ENRM a large number of tools have been used. The preference and use of these tools always depends on the desired result, the available resources, the available data, the knowledge and experience of the researcher, the nature of each problem and finally, the general field to which this problem belongs.

The most important tools are:

- Environmental Impact Assessment
- Driver – Pressure – State – Impact – Response Framework
- Analysis of Strengths - Weaknesses - Opportunities - Threats

- The purpose of the tool is to help support relevant decisions.
- Briefly, the EIA can be defined as a process which:
“Defines and Manages (recognizes, describes, measures, predicts, communicates) potential [or actual] effects [direct or indirect, individual or accumulated] of the proposed [or existing] human actions (programs, plans, legislation and other activities) and their alternatives to the environment [physical, chemical, ecological, social, economic, cultural, etc.]”.

- The United Nations Economic Commission for Europe, defines the EIA as “the impact assessment of a planned activity on the environment”.

Environmental Impact Assessment (1):

Environmental Impact Assessment (1)

The adoption of the Environmental Impact Assessment (EIA) began in 1969 with the National Environmental Policy Act of the United States of America (NEPA) and quickly spread to other countries such as Canada, Australia, West Germany and France.

This method was developed with the aim of studying the environmental aspects of the design of various projects and its purpose is to help support relevant decisions. Briefly, the EIA can be defined as a process which:

“Identifies and Manages (recognizes, describes, measures, predicts, communicates) the potential [or actual] effects [direct or indirect, individual or accumulated] of proposed [or existing] human actions (programs, plans, legislation and other activities) and of their alternatives to the environment [physical, chemical, ecological, social, economic, cultural, etc.] ”.

The United Nations Economic Commission for Europe defines the EIA as "the assessment of the impact of a planned activity on the environment".

The EIA, regardless of the above definitions, is commonly used as a kind of study of the effects caused by the various policies and legislation on the environment and humans rather than as a means of assessing the impact of a project on the environment.

The process followed each time in the EIA, can take several forms. However, its most important stages are:

Environmental Impact Assessment (2):

Emergence

Environmental Impact Assessment (2):

:

Advantages:

- It presents the environmental aspects of the proposed project to decision makers.
- The public participates in the process.
- It is well known and widely used around the world.

Disadvantages:

- The costs for its implementation are high.
- The usual lack of monitoring the results.
- Those who apply EIA are usually based on incomplete data from local authorities.

Disadvantages / Advantages Environmental Impact Assessment

Disadvantages / Advantages

The advantages of this tool are following:

- It presents the environmental aspects of the proposed project to decision makers.
- The public participates in the process.
- It is well known and widely used around the world.

On the other hand, its disadvantages are:

- The costs for its implementation are high.
- The usual lack of monitoring the results despite the fact that it is included on the process.
- Those who apply EIA are usually based on incomplete data from local authorities.

It is appropriate to mention that the EIA is considered a very useful tool as, if the process is carried out correctly, it can provide very

useful and important information regarding the environment of each area as well as the views and special needs of the local community.

- The framework acronym - DPSIR, comes from the initials of the English words Driving Forces, Pressures, State, Impacts, Responses.
- The idea came initially from social studies and later expanded internationally to organize indicator systems in the context of the environment and later sustainable development.
- The final form of the framework was developed at the end of the 90s
- This framework organizes the information about the environment.

Driver – Pressure – State – Impact – Response Framework (1):

Framework 1

Driver – Pressure – State – Impact – Response Framework

Driver – Pressure – State – Impact – Response Framework (2):

Emergence

Framework 2

The tool consists of the following elements creating a chain in the context of the cause-and-effect relationship:

- Driving Forces: Driving forces are human needs, along with various other natural factors.
- Pressures: Human activities that put pressure on the environment.
- State: The various pressures result in the influence of the existing state of the environment.
- Impact: The changes in the state of the environment in turn, cause some effects on the functioning of the systems under study
- Responses: Responses are the efforts made by policy and decision makers.

Driver – Pressure – State – Impact – Response Framework (3):

Framework 3

The tool consists of the following elements creating a chain within the cause-and-effect relationship:

- Driving Forces:

Driving forces are human needs along with various other natural factors. Examples of primary driving forces at the individual level are the needs for food and housing while secondary driving forces are the needs for transportation - movement, entertainment, etc.

- Pressures:

Driving forces lead to human activities that are necessary in order to meet the various needs. These activities put pressure on the environment and can be divided into three categories:

1. Intensive use of natural resources.
2. Land use changes, and
3. Emissions (chemical, waste, radioactivity, noise) into the air, the soil and the water..

Some of these pressures may be the following:

- Use of resources.
- Land use change.
- Waste generation.
- Noise generation.
- Emissions of various pollutants (direct and indirect) into the air, the soil and the water.

- State:

The various pressures result in the influence of the current state of the environment such as the quality of various environmental components (soil, water, air, etc.). The state of the environment is the combination of chemical, physical and biological factors.

Some of the environmental factors that are affected are:

- The quality of the air.
- The quality of the water (lakes, rivers, groundwater, seas etc.).
- The quality of the soil (natural areas, agricultural areas).
- The ecosystems (biodiversity, vegetation, soil organisms, etc.).
- The human population (health).

• Impacts:

Changes in the state of the environment in turn, cause some effects on the operation of the systems under study. These effects can be far-reaching as the ability of systems to support life (biodiversity reduction) can be affected, resulting in economic and social problems.

• Responses:

Responses are the efforts made by policy and decision makers to:

- Correct the problems created by the various pressures
- Prevent and reduce the intensity of pressures
- Reduce the intensity of the effects
- Limit the power of the driving forces

- The use of the framework is so widespread that most environmental indicators, have been designed on this basis.
- The DPSIR framework does not have a dynamic character.
- This weakness deprives it of the ability to give feedback on the data and re-evaluate the results produced at each stage of the method.
- This approach can not follow the complexity of the nature of the various problems.

Driver – Pressure – State – Impact – Response Framework (4):

Framework 4

It is worth noting that the use of the framework is so widespread that most environmental indicators are designed on this basis. It should also be noted that the DPSIR framework is not dynamic. This, while not limiting its ability to describe as well as possible the various factors under consideration, deprives it of the ability to provide feedback on the data and re-evaluate the results produced at each stage of the method. This can create problems for decision makers, as this approach cannot follow the complexity of the nature of various problems. Thus, the gradual replacement or improvement is considered appropriate.

- It is more commonly known with the international term SWOT Analysis.
- Derived from the initials of the words Strengths, Weaknesses, Opportunities and Threats.
- It is a general technique of designing and organizing a coherent decision-making framework.
- The conception and application of this analysis started by the business world 50 years ago.

The purpose of the analysis is to effectively reinforce the data of the internal dynamism of the system, and the opportunities that the external environment has to offer, with a simultaneous attempt to eliminate or reduce internal weaknesses and to address threats from the external environment.

Analysis of Strengths - Weaknesses - Opportunities - Threats (1):

Analysis 1

The Analysis of Strengths - Weaknesses - Opportunities - Threats, is better known by the international term SWOT Analysis which, comes from the initials of the words *Strengths, Weaknesses, Opportunities and Threats*. SWOT analysis is a general technique of designing and organizing a coherent decision-making framework, which may concern an institution, a company, a geographical area, etc. In general, this approach captures - photographs - the current state of the system under study.

The conception and application of this analysis began about 50 years ago in the business world, and to date, has been used in a large number of cases, especially in the field of strategic business planning.

The purpose of the analysis is to effectively enhance the elements of the system's internal dynamism, and the opportunities offered by the external environment, while attempting to eliminate or reduce internal weaknesses and address threats from the external environment.

SWOT analysis consists of four basic elements:

- Strengths - Advantages: It refers to the comparative advantages that a system has and which help in achieving the goals set.
- Weaknesses: It refers to the limitations, defects or imperfections of the system that hinder the achievement of the objectives.
- Opportunities: They are the favorable situations in the external environment of the system.
- Threats: They refer to the external environment of the system and constitute the various adverse situations that may lead to risks in the implementation of any action.

Analysis of Strengths - Weaknesses - Opportunities - Threats

(2):

Analysis 2

SWOT analysis consists of four key elements as part of a broader strategic plan:

- Strengths - Advantages: They are part of the internal environment a system and refer to the comparative advantages that a system has and which help in achieving the goals set.
- Weaknesses: They refer to the limitations, defects or imperfections of the system that hinder the achievement of the objectives.
- Opportunities: They are the favorable situations in the external environment of the system.
- Threats: They refer to the external environment of the system and constitute the various adverse situations that may lead to risks in the implementation of any action.

SWOT analysis aims at:

- Reducing uncertainty regarding the implementation of a specific development policy action or program.
- Identifying the dominant and critical determinant factors (internal and external) that affect the success of the development policy, action or program.
- Supporting an integrated strategy linking development action to both endogenous potential of the area to which it applies, as well as to the external environment.

Analysis of Strengths - Weaknesses - Opportunities - Threats (3):

Analysis 3

According to the European Commission, SWOT analysis aims at:

- Reducing uncertainty regarding the implementation of a specific development policy action or program in a geographical unit - region - with particular characteristics.
- Identifying the dominant and critical determinant factors (internal and external) that influence the success of a development policy, action or program.
- Supporting an integrated strategy linking development action to the endogenous potential of the area in which it is applied, as well as to the external environment.

- SWOT analysis should be used and applied in cases where it may be beneficial.
- Under no circumstances should it be perceived as a method without any problems and weaknesses.

- In many cases, the technique is limited in creating extensive lists of factors, without documenting their severity or assessing their criticality.

Analysis of Strengths - Weaknesses - Opportunities - Threats (2):

Analysis 4

SWOT analysis should be used and applied in cases where it can be useful and especially in cases of design, evaluation or problem solving where the distinction between external and internal environment is essential.

However, SWOT analysis should in no way be perceived as a method without any problems and weaknesses. In many cases, the technique is limited in creating extensive lists of factors, without documenting their severity or assessing their criticality. In this way the analytical element is limited, while the technique is transformed into a purely descriptive one. This fact results to the weakness of its creative use in the next stages of decision-making or in taking specific actions and measures.

Summary

Summary

Natural environment is the set of factors that affect and determine life on the planet. The natural environment is composed of biosystems which are powered by solar energy and consists of four (4) main sphere: the biosphere, the atmosphere, the hydrosphere and the lithosphere. These spheres include all the natural resources that humans use directly or indirectly for the purpose of survival (primarily) and evolution. This exact element (the use of natural resources by humans) defines the concept of natural resources. The use of natural resources and the environment in general, as well as their parallel protection, is achieved through the principles of management of specific objects. Environment and Natural Resources Management, in addition to a significant set of concepts, implementation frameworks and principles, includes a significant number of tools with proven value and reliability.

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