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Educational Thematic

Natural Resources Protection through Business Activities

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Educational Unit 1 "Natural Environment and Natural Resources"

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). 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.

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).

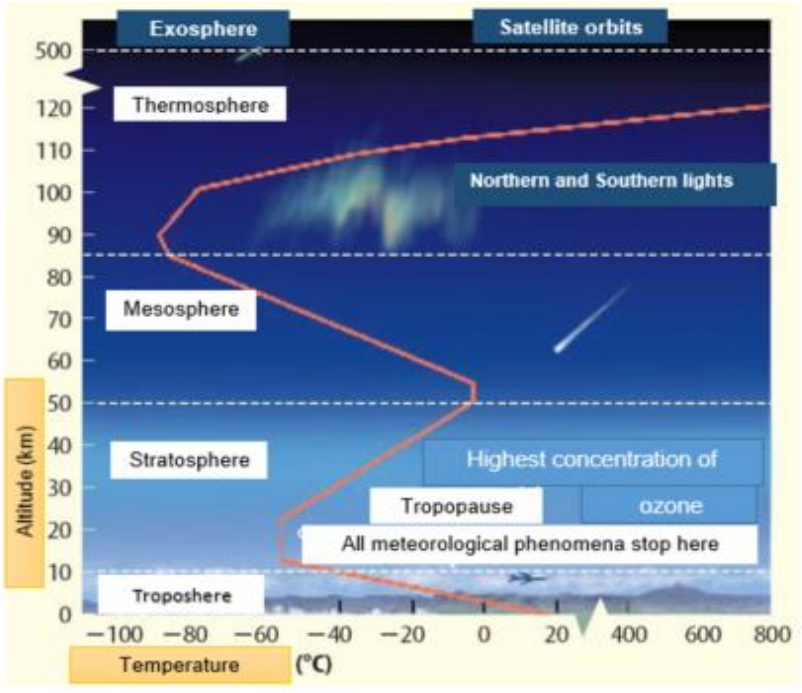

Image 1. The division of the atmosphere based on temperature

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.

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.

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):

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.

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.

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.

- 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 transpiration 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).

The five main pedological factors are the following (Βούτσινοςκ.ά, 1998; Μπαντάση, 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

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.
- 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.
- 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.

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 (Salixalba - 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.

Non-silicate minerals

- Carbonate minerals
- Sulfate minerals
- Phosphate minerals
- Sulfur minerals
- Oxides and hydroxides
- Native elements: More than 30 native elements have been found in the Earth's solid layer

1.2.6. Renewable energy sources

The main characteristics of renewable energy sources are that they are 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 (Κορωναίος, 2012):

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

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.

1.3.2. Participation in Environmental Management

The participation of the public in decision making in the context of EM & NRM is considered necessary (DelmasandToffel, 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.

1.3.3. 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 (Soubbotina, 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.

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.

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.

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.

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.
- Stage 2: Characterization of the structure and operation of the ecosystem under study and definition of management and monitoring actions.
- Stage 3: Identification of the most important economic issues affecting the ecosystem and its inhabitants.
- Stage 4: Determining the impact of the ecosystem under study on neighboring ecosystems.
- Stage 5: Defining long-term goals and flexible ways to achieve them - includes.

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.

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.

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

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).

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).

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)
- In environmental pollution

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)..

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 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

The world population is expected to reach 9 billion by 2050 (Gandy, 2004).
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).

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, 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% (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.

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.

The increasing rate in the size of cities is more evident in recent years. 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 and by 2050 will reach 70% (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).

Urbanization effects three particularly important resources:

- Soil
- Water
- Biodiversity

A. Impact of Urbanization on Land Resources

According to Marcotullioet.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 (Beeket.al., 2008).

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.

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).

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.

Environmental pollution can be divided into different categories based on specific criteria 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.

By recipient - depending on the recipient 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.

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.
- 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. 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 presents the categories and dimensions of environmental pollution (Τσιλιγκιρίδης, 2015).

Dimensions of the pollution	**Manifestation of phenomena**	**Effects**
Global	– Atmospheric ozone depletion – Climate change – Ocean pollution	– Increase of dangerous radiation – Increase in average global temperature – Alteration of large ecosystems
Transnational	– Acid rain – Pollution of rivers, lakes, seas	– Destruction of forests and lakes – Alteration of ecosystems
Regional/local	– Smoke – Photochemical smog – Pollution of surface and groundwater	– Risks to human health – Destruction of wetlands
Working spaces	– Emission of toxic substances	– Diseases in the working spaces
Living spaces	– Emission of toxic substances by industrial products	– Long-term effects on human health

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 (Τσιλιγκρίδης, 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 NOx emissions (Καραγιάννη κα. 2014; Τσιλιγκρίδης, 2015):

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 %.

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 CO_2. 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

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).

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 NOx. 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/m^3 (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, NOx, etc.
- Solar radiation of high intensity.

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).

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.

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.

Contamination

- Air contamination:
- Water contamination:

Irrational use of natural resources

- Fishing/Fish farming
- Mining
- Wood gathering

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).

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.

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.

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 (CO_2) – mainly responsible for 50% of the magnitude of the greenhouse effect and consequently climate change. It is produced during the combustion of all current fuels such as coal, liquid and gaseous hydrocarbons or biomass.
- Methane (CH_4) – contributes in about 13% in the creation of the greenhouse effect. CH_4 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
- Atmospheric ozone (O_3) – contribution reaching 7%. It comes in a serious percentage from emissions of sulfur compounds, from large fires of tropical forests and mainly volcanic eruptions with planetary effects

- Nitrous oxide (N_2O) – contribution at 5%. N_2O 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.
- Water vapor (H_2O) – contribution at 3%.
- The various forms of chlorofluorocarbons (CFCs), which are also the main cause of stratospheric ozone holes, by 22%.

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.

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.
- 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.

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.

Educational Unit 3 "Environmental and Natural Resources Management Systems"

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, Μανδαράκα 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 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).

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.

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.

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.

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.

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

- Higher workload - extra hours

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:

- 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

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).

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 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.

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.

Subsection 3.2. "ISO 14001 Environmental Management System"

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

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.

3.2.1. ISO 14001

The ISO 14001 standard was first published in 1996 and mainly includes the requirements of an environmental management system.

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.

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.

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.

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.

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.

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.

3.3.1. EMAS Implementation Steps

Here is a brief presentation of the implementation steps, which an organization needs to apply to participate in EMAS (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.

II. Environmental Analysis.

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.

III. Environmental Objectives and Program

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.

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.

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.

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.

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.

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.