WATER AND ITS MAGICAL POWER

ERASMUS+ STRATEGIC PARTNERSHIP FOR SCHOOL EDUCATION
2014–2016

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CONTENTS

INTRODUCTION

This book represents the final product of the Erasmus+ Partnership "Water and Its Magical Power", being the result of the work done by the joint teams of students and teachers from the six partner schools, during the two years of observation activities, researching activities, practical applications, information processing, learning / teaching / training activities, cultural exchanges and artistic activities. **Water** was chosen as the theme of the project and as the central theme of the book due to the importance of this resource for all natural, social and economic aspects and processes on our planet since ancient times to the present day.

Water is responsible for the shaping of the relief of the Earth's crust; it is present in all of the physical, chemical and biological processes which take place in the bodies of the living organisms and it has a decisive role in the spread of them on the globe.

Over the course of the history of mankind, water has been a major factor in the spread of the population on Earth, being necessary and having an important role in all stages of human life, in all human activities, in all religious rituals, generating the largest concentrations of population.

By harnessing the force of the waves, the tides and marine currents, water is a rich and an inexhaustible source of green energy, it is an indispensable resource for all industries worldwide and has generated successful business opportunities.

Water is one of the oldest, cheapest and most efficient means of transport and communication, enabling expeditions of discovery and conquering new terrains, and the last centuries have become the engine of one of the most attractive and dynamic tertiary activities, known as tourism.

Due to the rapid population increase and the pressure exerted by humans on the environment in the last decades, there has been a rapid multiplication of pollution problems and insufficient freshwater resources, problems that jeopardize food safety, peace and health of the planet.

This book helps those wishing to become familiar with aspects of water resources around the globe, and represents at the same time an important

teaching material for all the teachers eager to make their students realize the importance of protecting this vital resource.

Taking into account the complexity of the information about the role of water throughout human history, the huge importance of water in the modern society in which we live and the issues generated by the report available / use, we considered that it would be relevant and effective to structure the book into the following chapters:

Chapter I – “The Role of Water in the History of Humanity”;

Chapter II – “The Role of Water Nowadays”;

Chapter III – “The Water Problems in Europe Today”;

Chapter IV – “Identifying Solutions to Solve the Water Problems”.

Also, the book has a fifth chapter, one which is a curriculum, where the first four chapters are used in a course entitled "The Problems of Water Today".

The structure above is logical, easy to understand and follow, and the fact that the book was written in the English language gives it a high degree of accessibility and practical applicability, representing an important and useful teaching material for all teachers eager to make their students aware of the need to protect this vital resource.

We are convinced that the results of our work, materialized in the making of this book, will be of great help to all those who believe in a better future for humanity, who want to live in a world without pollution, a healthy world, a world without concerns at least about the world’s freshwater supplies.

Constantin Hriscu – project coordinator
Colegiul Naţional “Garabet Ibrăileanu” Iaşi, Romania

Chapter I

THE ROLE OF WATER IN THE HISTORY OF HUMANITY

INTRODUCTION

In this chapter the role of water in human history is examined, beginning from the ancient times till the end of the 19th century.

The first unit shows the important role water played in many religions as it is a cleaner and, at the same time, purifies the body and soul. Water implies regeneration, and that's how it becomes the symbol of life.

In the second unit we examine how the right or the wrong use of water influenced urbanization. So, some cities flourished because of their correct systems of irrigation used for cattle-raising, agriculture, the hygiene and hydration of the population, while others were overrun by fatal epidemics as the result of the dramatic falloff of the quality of water.

The third unit lines out the impact of water in agriculture. So, we watch the great civilizations of western Asia, China, Egypt and India as well, to be founded near rivers and lakes where large amounts of water, clever techniques of irrigation and water storage, and rich fertile soil resulting from annual inundations of the rivers were provided.

The fourth unit refers to the most famous nautical peoples: the Phoenicians as the pioneers of trade and marine voyages, Egyptians, Chinese, Arabs, Vikings, the marine democracies of Italy, English and Dutch. The last part of the unit is about watermills, both the ancient and the modern steam engine, and other machines which used water and vastly contributed to the development of Industry, Navigation and Sailing.

The fifth unit describes how water influenced the great geographical discoveries. Beginning from the ancient Greeks, the pioneers who used the sea-roads for trade and colonization, we continue to the discovery of America by Christopher Columbus and his Spanish fleet, the exploration of Australia by England and of Africa by the Europeans, and we reach the beginning of the 20th century with the attempt of discovering Antarctica.

The sixth unit mentions the ways in which water inspired authors as the symbol of eternity, creation and punishment, painters - with Leonardo da Vinci being the prominent one - and famous composers such as Beethoven who imitated its forms and sounds.

The seventh unit traces the role of water in the histories of the six countries. So, we can read how seas, rivers, lakes and ports influenced their religions, the urbanization of their population, their economical evolvement, navigation, industry and trade, the geographical discoveries their ancestors made, their civilization and art.

Maria Birba

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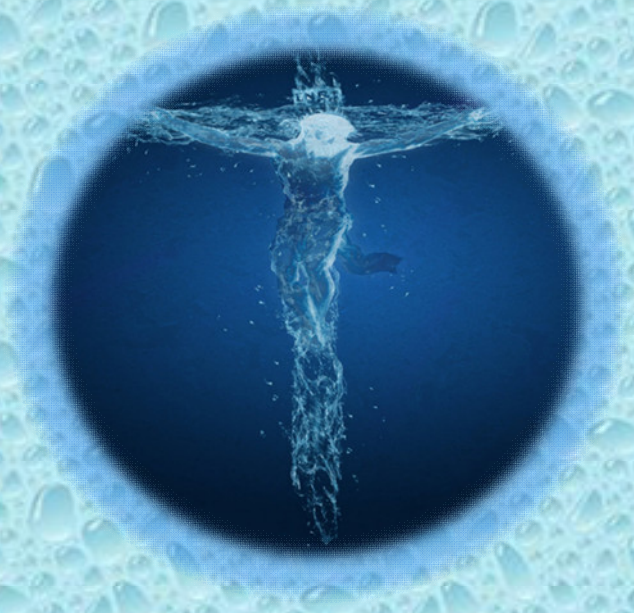


I.1. Water in Religion

A vital factor for human life, but also for animal and vegetal life, water represents one of the most important elements that exist, and, at the same time, the symbol of soul cleansing and holy life.

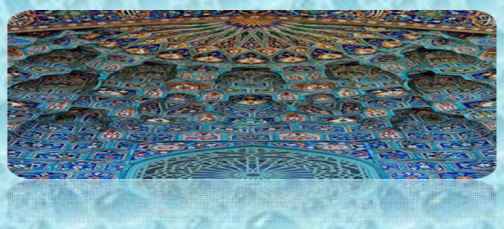
Also, water has an important role in many religions and that results from the quality of being a cleaner and, at the same time, the one that purifies the body and soul. Likewise, the water is vivifying, the one which receives and offers the living possibility, the one which can provide life.The well known historian of the religions, Mircea Eliade, said that water symbolizes the totality of the virtualities, being the matrix of all the living possibilities. Waters implies regeneration, and that's how it becomes the symbol of life.

Water is the one which creates, yet the one that can destroy life and that's why it is seen from many points of view by the believers of different religions. Therefore, its meaning in different religions causes not only curiosity but also interest and diversity.

In Buddhism, water is associated with the life beyond, for that reason water is poured in a bowl placed in front of the dead and the Buddhist monk (who recites the prayer). As rain fills the rivers that pour into the ocean, just the same way the soul will reach from where he left. In Hinduism water has cleaning powers, that's why it has such a special role that can be seen especially in the 7 sacred rivers: Ganges, Yamuna, Godavari, Sarasvati, Narmada, Sindhu and Kaveri.

In Islam, water is the one that cleans and purifies; without water a Muslim is not clean and he cannot approach the prayer to Allah, that's why in the mosques there will always be a place for the purifying water.

In Judaism, Torah is the one which commands the Jews to clean their hands and feet before taking part in temple rituals. In Hebrew, the rain water is a purifying element; in every synagogue there is a sewerage that collects the water in a tank which is later use for different purification rituals.



In Christianity, water represents a complex symbol, for a complex religion, and, at the same time, a vital element for life. Water appears in the second verse of Holy Scripture which says that after being created, the Spirit of God was hovering over the waters. The real presence of the Holy Spirit over waters shows that He was the one to take care of the aquatic animals. Water is the one to receive the divine creatures at the divine order and the one which always withdraws to defend the land. Therefore, everything was brought to life by Holy Spirit.

In the Old Testament we meet countless testimonials about water and about its role in the human history. God sends the punishment to unbelievers by water that covers the whole Earth, unfaithful meeting their death by water. Also, it is quite interesting that God had promised not to lose anymore ground with water, as he did in the flood.

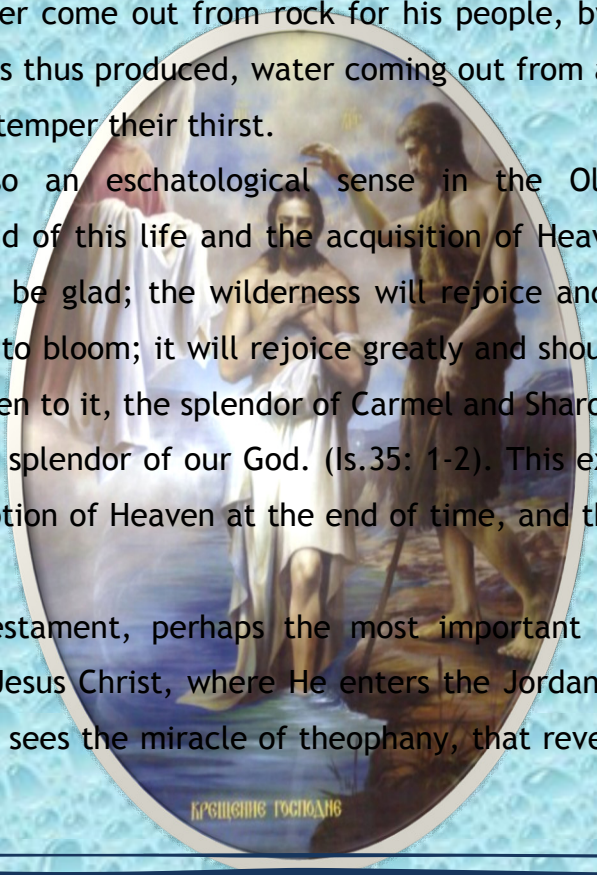
Water's cleansing role is, thus, underlined by this event, but it is also noticed water's withdrawal after the Great Flood and the rebirth of the whole nature. And this means a rebirth from the dead, a reshape of the world, of nature, of life. It is to be taken into consideration that God promised that He would never perish the earth through water, the way he did during the Great Flood.

The greatest Prophet of the Jews, Moses, whose life history begins on water, is the one who will lead the Jewish people towards liberation from Egyptian

bondage. His mother, in order to protect him from the Egyptians who killed all males by order of the Pharaoh, put him in a basket on the Nile waters. His way was guided towards the Pharaoh's House, where he would be found by his daughter. He will be named by her according to the situation he was found in, with the name of Moses, which means *from water I have him removed* (Exit, chapter 2). Moses is the one who will save his people from the Egyptian bondage, passing it through the Red Sea. Water is the miracle of salvation of the Jewish people. Passing through the water to the people is, in the metaphorical sense, the cleansing of sins, and shifting to another world, a world of beauty, of right, of freedom. Also, for the Egyptian people, water becomes, this time a disaster, which is a known truth: water can kill, but water gives life, too.

Moses is the one who will give water to his people while being thirsty in the desert. The need for water offers Moses the opportunity to complete a new miracle: to make water come out from rock for his people, by hitting it with his scepter. The miracle is thus produced, water coming out from a rock, water which enables his people to temper their thirst.

Water has also an eschatological sense in the Old Testament, the anticipation of the end of this life and the acquisition of Heaven: the desert and the parched land will be glad; the wilderness will rejoice and blossom. Like the crocus, it will burst into bloom; it will rejoice greatly and shout for joy. The glory of Lebanon will be given to it, the splendor of Carmel and Sharon; they will see the glory of the Lord, the splendor of our God. (Is.35: 1-2). This exclamation of joy is actually a rich description of Heaven at the end of time, and the joy of those who will taste it.



In the New Testament, perhaps the most important presentation about water, is baptism of Jesus Christ, where He enters the Jordan and is baptized by John the Baptist, who sees the miracle of theophany, that revelation of the whole

Trinity at the time of Baptism: Father the one who confesses the Son orally, This is baptized, and the Holy Spirit descends like a dove upon the Son of God. The miracle takes place there in Jordan; Jordan turns water into magic in demonstration of holiness. Therefore, the combination of the Messiah with water is not accidental, because He is the first revelation of the Jordan, where he was baptized with water. Like water that comes down from heaven, the Son of God comes down from heaven to water the world with His teachings. Through baptism, Christ sanctifies water and turns it in cleansing water, and therefore in Romania, people who believe in God do not wash their clothes that day as a sign of sanctity and respect to the water and its nature.

Therefore, the combination of the Messiah with water is one telling, in light of the Epiphany or Baptism, the first image of which is associated with the River Jordan, where he was seen for the first time in the world.

About water and its magic that has witnessed the Savior, who, in a discussion with a poor woman (John Chapter 4) talks about water that can give her to drink, and if she drinks from it, she will never be thirsty. It is the water of life, the word of God and His teachings.

Water is the symbol of birth in Christianity, in this sense, the Savior saying to Nicodemus: unless a man is born of water and the Spirit, he will not enter the kingdom of heaven. (In.3,5). The birth of water and the Spirit is the transformation of the old man, that man of sin in a new man, pure, new life, sinless and united with God, this being done by water power.

The miracle and the transformation by water continues even today on every new Christian, through baptism made with holy water, for whom the priest prays saying: *"You, Master of all, show this water, water of redemption, water of holiness, body cleaning and soul absolution, forgiveness of sins, soul lighten, the second birth bath, spirit renewal, spirit adopt, garment of incorruption, source of life."*

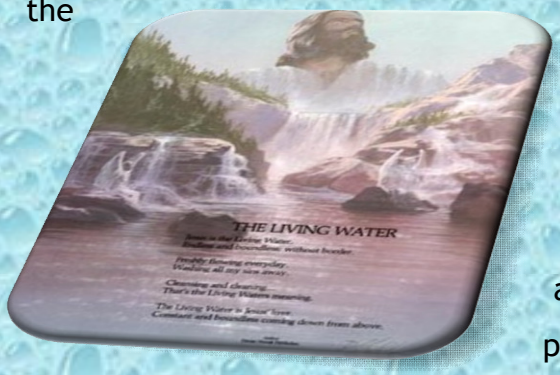
The cleansing role of water is shown in the conversation that Jesus Christ has with His Apostles, when He is washing their feet, telling them: *"The one who has bathed does not need to have his feet washed, because all is clean. And you are clean…"* (In. 13,10). Also in the New Testament it is said about the water which is alive, or the water which is re-born, saying: *"The one who believes in Me, like the Holy Scripture said: rivers of alive water will flow from his belly. And this was said about the Spirit they have to receive, the one who believes in Him." (In. 7,39-39)*

The first miracle that Jesus Christ made was through water. He transformed the water into wine at the weeding from Cana Galileii. It is the symbol of water through which the miracle was produced and of the wine as the embodiment of the Jesus Christ's blood.

Another miracle that was done in the time of The Saviour by water, a miracle which would seem hard to believe for many, is the one from Vitezda Bathing Place, which is presented in Saint John's Evangelica, chapter 5, where it is said that the miracle of healing came from the sky; an angel of God fell from the sky and troubled the water, from time to time, and the one who entered the water was cured, no matter of the sickness that he had.

In some places from the New Testament water is associated with God's Word, an example in this sense is the text from Efeseni, where it is mentioned that Jesus's Church was consecrated by Him, by cleaning it through the power of water.

From Jesus's rib came out blood and water when he was pricked by a soldier on Golgota, as John the Apostle said, and this is why in the Communion water and wine are added. Thus, water becomes an element component of Holy Communion, of the biggest Mystery of the Church, of the communion between Jesus Christ and Christians, being added twice, once when the holy gifts are prepared, and after the consecration warm water is added. This thing shows that the Communion is made with the Body and the Blood of the Jesus who is alive. Regardless how it is looked at, it should not be forgotten and it must be accepted that water is the gift from God for people. Therefore, the Christian's journey begins with baptism, as a gift from God for His creation. Christian's baptism in holy water is a gate opened towards the Christian life. Through baptism, the Christians acquire divine sonship, becoming sons of God by grace, fact that offers the Christians the chance for a new life.



In the Orthodox Church there is a special service of blessing the water. "Aghiazma", as it is called the holy water in Church, is the one that, once consumed, offers its sanctification of the believer and all those who receive it in faith and holiness take the blessing. Furthermore, even things are sanctified with this holy water - surroundings, gardens, houses, vineyards, being useful for dashing away harmful insects, repellent for fruits and vegetables. The honour which is brought by Christians to the "aghiazma" is special, this being drunk on an empty stomach and no drinking. In the Orthodox Church, there is a day when the Holy Great Water is made, the Epiphany day, the day when Christians believe that the nature of water is holy, and that Jordan is a source of blessing to every home. Therefore, "aghiazma" is blessed water which does never alter, and acts as a remedy that protects man and his entire household.

In addition to the feast of Theophany, in orthodoxy there is a holiday called Life-Giving Spring, which recalls of a spring of the mother of God, to which those who came and drank water from, were cured, regardless of the disease. Also, it is a day in which the Orthodox Christians go to Church to get this consecrated water and bring it to their home, to be helpful and healing.

In conclusion, water in Christian theology is a vital element, which gives life, which blesses, through which God has shown Himself. It is also an element of the presence of the haric divinity among the people. Water is the one which God found God, which He showed to the whole world; it is, at the same time, the component element of the Holy Communion, and, at the same time, the one which is much helpful to the Christians. In other words, where water means life, there is holiness and greatness.

I.2. The Impact of Water in the Spread of Population in the World and in Urbanization

The Importance of Water in Muslim Cities

Water is an exceptionally important element in life. Sometimes water is scarce but it remains vital.

Sometimes it is scarce because of irrigation matters. This is not the case of the City of Damas in Syria because the spring called Figa has some canals flowing to the houses, the baths, and the gardens. It is also the case of Fes, a city in Morocco in which all the streets have running water thanks to the canals carefully built. Moreover this water provides a better rendering of the fields, the creation of fountains and also a better quality of wheat.

The canals were therefore the most used technique of water irrigation. It was used for the cattle, the agriculture, the hygiene and hydration of the population.

This common use of water was much appreciated everywhere but in some cities the water irrigation was not correctly done: it was not equally allocated. For instance, the city of Fes is a large city composed originally of two different neighbouring cities: a river divides the two parts of the city. On one side the river is only a tiny trickle of water whereas on the other side the water flows in abundance. This creates inequalities between the populations because in the part where the water flows there is no irrigation system to help the nearby city.

We can thus say that water is a precious resource which we must preserve, but which we must also share so as not to create social turmoil.

In the Middle Ages, as nowadays, water has always been an absolute necessity in the life of human beings.

Marrakech in Morocco is at the same time situated close to the Mediterranean Sea and near the desert. In The Middle Ages it must have been quite difficult to have access to drinking water. They had to use the wells that were already built, that pumped water from the groundwater tables: these groundwater tables were sometimes many meters under the ground or the sand.

In that time, a man called UBAYD ALLAHB founded a technique: it helped the city of Marrakech to bloom and have such beautiful gardens and to grow its own food to eat.

The city of Tolede is situated east of Talavera in Spain. This city did not have the same problems as the ones in Marrakech. That city has a much better geographical situation: indeed we can notice that the earth is fertile; and what is more, it is situated close to a large river: the Tage. The population took advantage of that. They even built an aqueduct that allowed them to have access to water in an easy way; it bloomed and prospered henceforth.

The two cities had the same needs when they set up their territory. The most urgent need was to provide water to the population. Then there was a need of water for the fields, which required a lot of water.

When these needs could be fulfilled, they could think of designing much more beautiful buildings, creating lovely gardens with many plants. In the same way, they designed fountains. The water was so abundant in Marrakech that huge public baths and Hammam were constructed: indeed for that, hundreds of liters of water were required and the city could face the demand.

Historical Overview of London Population

As a consequence of the growth of the British Empire and the industrial revolution, London experienced an exponential level of growth throughout the 19th century.

During this period the city expanded into a giant metropolis and became known as Greater London. Every day from the crowded suburbs millions went to work. In 1800 construction of bridges was necessary, because people wanted to cross the river and had to use a way to do it, or employ a waterman.

The Great Stink

At the beginning of the nineteenth century in London the population increased a lot: from 900,000 it grew to 6.5 million in a hundred years. As a result, there was an increase of poverty and malnutrition. The other problem was a dramatic rise in water because the sewers were clogged and there was a horrible smell in London.

FARADAY GIVING HIS CARD TO FATHER THAMES;
And we hope the Dirty Fellow will consult the learned Professor.

The horrible state of the sewers had a terrible consequence: a cholera epidemic. A lot of people died: 50% of the children died before the age of 5. Doctor John Snow discovered that it was the polluted water that provoked the cholera. Indeed the story tells that in a brewery – a place where they make beer, the people who worked there were never infected because they did not drink water!

The summer of 1858 was particularly hot: it was so hot that the city was asphyxiated by the smell: this is what is called “The Great Stink”. The smell

became so strong that people could not breathe. The Thames River smelled so bad that the Government – situated by the river in the Parliament - could not work. It was terrible.

The reasons for this stench, this horrible smell, was that millions of tons of sewage (dirty water) came flowing in the river Thames in the 1850s. As a result the parliament had to close. This had never happened before! We could see people blocking their nose in the streets!

The consequence was the project of the construction of five large sewers in London. It was an exceptionally huge project that was prepared very quickly because the people with power – the deputies - were personally concerned since they could not actually work.

Mr Joseph Bazalgette was the civil engineer who managed the whole project with a budget of three million pounds. He had 1100 (eleven hundred) miles of street sewers built, for example.

However it took twelve years to be completely built: from 1858 to 1870. Just before the end of the construction there was another cholera epidemic in 1866.

So this is the story of the London period called "The Great Stink" in the 19th Victorian London.

Trades and sanitation

Before the sanitation period in London, there were quite a few trades: these trades have disappeared afterwards:

1. The TRASHERS who walked about the whole city sewers, looking for objects to salvage: they worked in groups of families and they were used to having all sorts of diseases.
2. The GRUBBERS who did the same sort of work as the TRASHERS but they rummage through the open air canals.
3. The MUDLARKS who walked along the Thames River mud in order to collect all sorts of objects that they sold afterwards. It was very common to see children doing that sort of work.

4. The NIGHTMEN also called the men of the night, who drained the cesspools and cart off the human excreta. They took the excreta to the countryside where it was used as a fertilizer.
5. The FLUSHERMEN who were men hired by the sewer company to knock about the rubbish to give a way to the water. They were wearing some waterproof overall to protect themselves.
6. The RAT CATCHERS who were hired by the city to catch the rats that blocked the sewers. These people helped to stop the propagation of many diseases before and after THE GREAT STINK.

I.3. Water and Socio-economic Development: Agriculture

Water is important also in the last period of the Earth's development. Two million years ago, with the appearance of mankind, the Earth's climate became warmer. It made it possible for the modern man to practise sedentary agriculture, domesticated plants and animals, thus allowing the growth of civilization.

First settlements, first farmers?

In prehistoric times clans of people who lived in caves travelled from place to place following the animals. These hunter-gatherer bands were following animals which were moving near rivers and other sources of water.

Agriculture involving domestication of plants and animals was developed around 12,000 years ago, although earlier people began altering communities of flora and fauna for their own benefit through other means such as fire-stick farming prior to that. Agriculture has undergone significant developments since the time of the earliest cultivation. The Fertile Crescent of Western Asia, Egypt and India were sites of the earliest planned sowing and harvesting of plants that had previously been gathered in the wild. Independent development of agriculture occurred in northern and southern China, Africa's Sahel, New Guinea, parts of India and several regions of the Americas. Agricultural techniques such as irrigation, crop rotation, the application of fertilizers were developed soon after the Neolithic Revolution but have made significant strides in the past 200 years. The

change in the way in which people obtained food (domestication and agriculture) also means that all civilizations have depended on water.

The first settlements were founded in the hottest and most futile regions of the world. For these early settlements the sufficient amount of water was vital. Founding settlements close to rivers and watercourses is a typical feature of all first permanent villages.

The rivers were important from various points of view. Firstly, they were used as the source of livelihood (fishing). Secondly, the river was important for tactical reasons. It was an ideal barrier against animals and various forms of attacks. Lastly, the sufficient amount of water was also important for the whole civilizations that used rich fertile soil resulting from annual inundations of rivers. That was typical for Ancient times.

The Ancient Times

All the major civilizations were established around watercourses. The first city states in Mesopotamia region were formed around 3000 B.C. Mesopotamia means the land of rivers and it is a name for the area between two rivers – Euphrates and Tigris. The river Nile was important for ancient Egypt, rivers Indus and Ganga for ancient India and for distant China were vital rivers Huang He (The Yellow river) and the Yangtze River.

The birth and establishment of the oldest empires meant increased productivity and concentration of people. It brought the emergence of irrigation which has been a central feature of agriculture for over 5000 years, and was the basis of the economy and society of early societies.

Mesopotamia

Mesopotamia encompasses the land between the Euphrates and Tigris rivers, both of which have their headwaters in the mountains of Armenia in modern-day Turkey. Both rivers are fed by numerous tributaries and the entire river system drains a vast mountainous region. It is widely considered to be the cradle of civilization in the West. Together with Egypt, Mesopotamia had the best conditions for agriculture.

There were frequent rains in the north, on the other hand the land in the south was dry. Therefore a sophisticated system of canals was essential. Sumerian agriculture depended heavily on irrigation. The irrigation was accomplished by the use of canals, channels, dykes, weirs and reservoirs. The frequent violent floods of the Tigris, and less so, of the Euphrates, meant that canals required frequent repair and continual removal of silt, and survey markers and boundary stones needed to be continually replaced. The government required individuals to work on the canals in a corvee, although the rich were able to exempt themselves.

The irrigated farming together with annual replenishment of soil fertility and the surplus of storable food in temple granaries created by this economy allowed the population of this region to rise to levels never before seen, unlike those found in earlier cultures of shifting cultivators. This much greater population density in turn created and required an extensive labor force and division of labor with many specialized arts and crafts. At the same time, historic overuse of the irrigated soils led to progressive salinization, and a Malthusian crisis which led to depopulation of the Sumerian region over time, leading to its progressive eclipse by the Akkadians of middle Mesopotamia. The year 2350 BC can be marked as the fall of Sumerian empire because it was conquered by Sargon of Akkad.

Ancient Egypt

Ancient Egypt was a civilization of ancient Northeastern Africa. It was concentrated along the lower reaches of the Nile River in what is now the modern country of Egypt. It is one of six civilizations globally to arise independently. Egyptian civilization is considered to emerge around 3150 BC. The success of ancient Egyptian civilization came partly from its ability to adapt to the conditions of the Nile River valley for agriculture. The predictable flooding and controlled irrigation of the fertile valley produced surplus crops, which supported a more dense population, and social development and culture.

A combination of favorable geographical features contributed to the success of ancient Egyptian culture, the most important of which was the rich fertile soil resulting from annual inundations of the Nile River. The ancient Egyptians were thus able to produce an abundance of food, allowing the population to devote more time and resources to cultural, technological, and artistic pursuits. Land

management was crucial in ancient Egypt because taxes were assessed based on the amount of land a person owned.

Farming in Egypt was dependent on the cycle of the Nile River. The Egyptians recognized three seasons: Akhet (flooding), Peret (planting), and Shemu (harvesting). The flooding season lasted from June to September, depositing on the river's banks a layer of mineral-rich silt ideal for growing crops. After the floodwaters had receded, the growing season lasted from October to February. Farmers plowed and planted seeds in the fields, which were irrigated with ditches and canals. Egypt received little rainfall, so farmers relied on the Nile to water their crops. From March to May, farmers used sickles to harvest their crops, which were then threshed with a flail to separate the straw from the grain. Winnowing removed the chaff from the grain, and the grain was then ground into flour, brewed to make beer, or stored for later use.

The ancient Egyptians cultivated emmer and barley, and several other cereal grains, all of which were used to make the two main food staples of bread and beer. Flax plants, uprooted before they started flowering, were grown for the fibers of their stems. These fibers were split along their length and spun into thread, which was used to weave sheets of linen and to make clothing. Papyrus growing on the banks of the Nile River was used to make paper. Vegetables and fruits were grown in garden plots, close to habitations and on higher ground, and had to be watered by hand. Vegetables included leeks, garlic, melons, squashes, pulses, lettuce, and other crops, in addition to grapes that were made into wine.

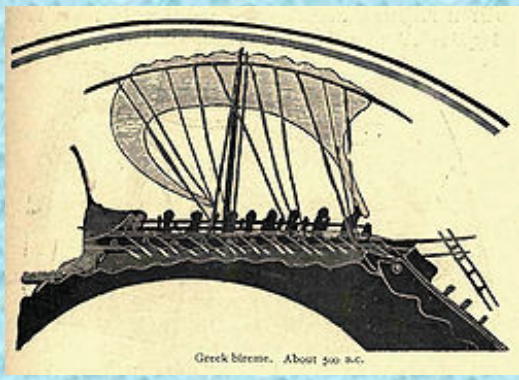
I.4. The Role of Water in Development of Navigation, Industry, Trade

Since ancient times a lot of nautical peoples were renowned for their boldness and their achievements. From the beginning, navigation was linked to the element of water relating to the Sea and lakes but to rivers as well. Apart from war activities, intense trade mobility thrived.

Phoenicians

These people, settled in the territories known today of Lebanon, Syria and Israel, were very keen on trade and marine voyages. Since the 14th century B.C. the Phoenician tradesmen transferred Egyptian products even to England! They often came into contact with the Greeks in Cyprus, also founding the colony of Citio. Roughly 700 B.C., when reaching their heyday, they spread all over the Mediterranean Sea bringing together all the civilizations of the Mediterranean basin, and that was their greatest contribution to human progress.

Among their special fabrications were the ships "dieris", "dicroton" and "monocroton".



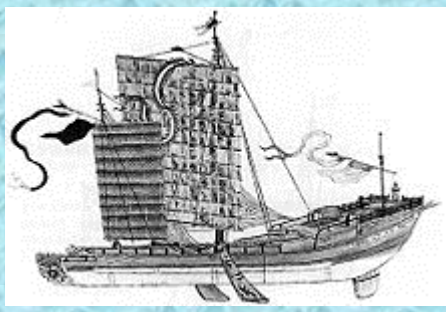
By the 7th century B.C. the holdovers of the Phoenician civilization at the western part of the Mediterranean became the Carchedonians who rose to become a mighty nautical power till their homage to the Romans in 146 B.C. Among the main products of the Phoenician trade were the transparent vitreous cookwares. They merchandised, too, jewel, gold, wood and beautiful multicolored cloths. Their most dominant merchandise however was the color crimson, a deep red color they produced from a species of shells called Haustellum brandaris.

The Egyptians

The Egyptians created trade relationships with the Phoenicians, the Cretans and the islanders of the Aegean Sea mainly during the period of the 'New Kingdom' (1540-1075 BC.). The internal trade of Egypt flourished significantly because of the Nile River, as well. Numerous

small crafts, the “feloukes”, sailed on the river both following the river-flow and with the help of yearly winds. That’s why famous trade and administrative centers were founded on its banks.

The Chinese



During the Chans’ dynasty (206 B.C. – 220 A.D.) the export trade was favored and trade relationships among China and the peoples of the Mediterranean Sea were established. Chinese silk, copper mirrors of the Chans Dynasty and so on, confirm the presence of the Chinese in Greek and Roman times. In the beginning of the 15th century AD the Ming dynasty held seven nautical expeditions towards the SE regions of Asia up to the coasts of Somalia of Africa using tens of big ships called “giunche”.

The Arabs

Since the middle of the 8th century A.D. the Arabs set up international trade which they founded in major cities and acted as the middlemen of it. Since the middle of the 9th century the Arabs founded trade colonies on the coasts of India, of SE Asia and China. They transferred spices and other products of luxury from the upper East to the Arabian and Byzantine markets, mainly through Iraq. The Fatimid dynasty who dominated in Egypt during the 10th century fortified the trade relationships with India through the Red Sea.

The Arabian fleets however went about on nautical raids in the Aegean Sea and its islands. The Arabian pirates brought terror and dread to the people who suffered by their attacks.

The Vikings

Since the 8th century A.D. the seas of Northern Europe are dominated by the Vikings (or the “Normans” as called by the peoples of the Western Europe, or “Russians” as called by the Slavic peoples, or “Varags” as called by the

Byzantines) who sally from the Scandinavian peninsula and pillage the coasts. They were sailors and merchants who travelled up to Byzantium, the Arabs and China. Their characteristic ship is the "drakar" having length approximately 24 meters and crew of 16 men. It looked like a modern day whaling ship.

Russian traders from the domain of Kiev traveled on their "pirogues", as their boats were called by the Byzantine emperor Constantine the 7th ("the Born in the Crimso") and their crew consisted of 40 men. They sailed on these boats in Dneiper River and the Black Sea and visited Byzantium to trade furs and slaves in return for their much desired Byzantine silken cloth.

Italy

In the 11th and 12th century A.D. the sea trade activity of the marine democracies of Pisa, Venice, Genoa and Amalfi was impressive and increased their

political, financial and military power. They participated in the crusades, they created numerous colonies who traded spices, silk, perfumes, ivory, jewels and paints (such as the alum) which were valuable for the small industries of fabric. Closely connected to this tradition were the expeditions of Christopher Columbus on behalf of the Spanish throne. They used a new type of ship, the famous "karavela".

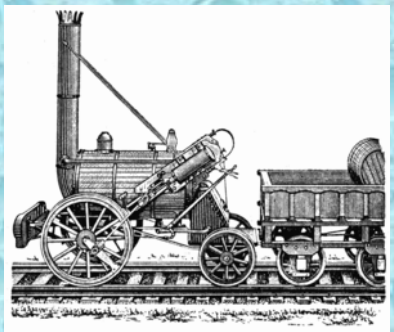
The Use of Water in Industry

Water was utilized since the ancient times for the improvement of the humans' way of living and for the development of small industries and of those later to come.

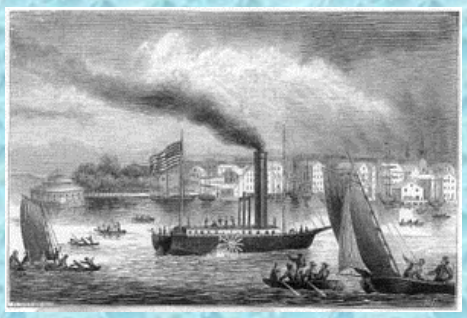
The **watermill** was the very first machine to produce work that humans constructed using natural, mild and renewable source of energy. This machine was using the power of the water falling from a high point or its flow, serving the needs of the preindustrial societies, and replacing the power of humans and animals.

The history of the watermill begins with the watermill which is generally mentioned in some scriptures of the Sumerians. The oldest known watermill is referred to as “hydraleti” by the Greek geographer Strabo. According to the tradition, it lay at Kavira, in the palace of Mithridates the 6th (the “Evpator”), king of the Pontos, where it was seen by the Roman conquerors in 64 B.C. and was described by the writers Vitruvius and Plinius.

An invention connected to water was the “aeolosphere” or “**steam turbine**”, the very first steam engine of humanity. It was invented by Heron of Alexandria, an engineer and geometrician between 1 B.C. or the 1st. century. There are two tubes above a boiler and a sphere with two nozzles laying around the curved edges of the tubes. When the water of the boiler is warmed, it vaporizes, passes through the two upright tubes, comes into the sphere and flows out rapidly from the two nozzles forcing the sphere to an opposite continuous rotation.



The “locomotive (steam-car)” or simply the “steam engine” was the first way of pulling the railway trains. The steam is produced by warming the water with the use of coal or wood or petrol-oil. Then the steam is canalized to the boiler and moves some pistons which transfer the motion to the wheels of the steam-machine. The very first machine of this kind was constructed by Tomas Savery in 1698 for pumping water. The next important step was Thomas Newcomen’s steam-machine in 1712 which was improved by James Watt.



Steam-machines played an important role in the development of navigation and sailing by **steamship**. The first ship which was constructed by Robert Fulton to move using a steam-machine was the wheeled ship “Clermont” in 1807. In 1820 the usage of steam in the ships began to generalize.

Netherlands and England

The large financial progress both of England and Netherlands was based on the evolvement of their marine trade and on the increase and the renewal of their shipping. At the end of the 16th century AD English and Dutch ships dominate on the Mediterranean Sea, they control a significant part of the exchange of goods and they are responsible for the reorganization of marine trade.

At the beginning of the 17th century a financial crisis broke out. Then the Dutch and the English merchants change their trade activity to enterprises which work on the distribution of goods at a low price, they easily find merchants and consequently till the middle of the 17th century the Dutch businessmen become the first financial power all over the world. Amsterdam becomes a very important financial center with its stock-market controlling the trade and monetary transactions of the whole continent.

The Dutch navigation

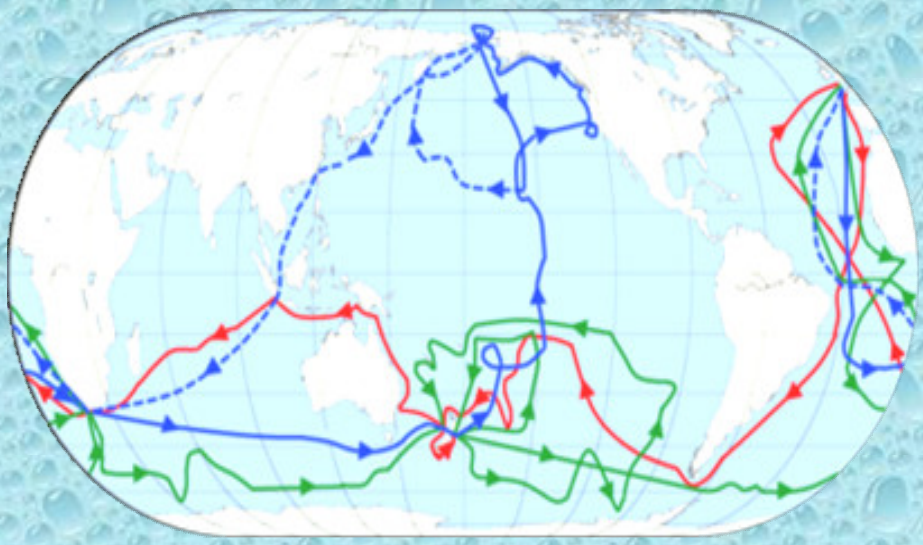
During the period 1595-1602 the Democracy of the United Provinces of the Low Countries organized at least twenty delegations to Eastern India. In 1602 the Dutch Company of the Eastern India was founded as a result of the unification of the Dutch companies which were established in the East. The Dutch Company monopolized even the trade of the Cape of Good Hope. In order to protect its monopoly it had the freedom to conquer entire lands and to place local governors, and to prevent trade transactions of the Dutch colonies with other countries as well. In this way, a true empire was established, having Batavia on the island of Java as its center. They were bringing to Europe new products as pepper, tea, coffee and chocolate. Very soon they became the most important sugar merchants of the world.

The navigation of England

During the reign of Elisabeth I, English businessmen tried to develop Navigation. So, the conflict between England and the United Provinces of the Low Countries was inevitable through the rivalry over the control of marine trade and the expanding of their colonies.

Through the “Navigation and Trade Act” of Cromwell and Charles the II the financial policy of England was protected, since the transfer of the merchandise to and from England was materialized exclusively by the English ships alone.

One of the most distinguished personalities in British navigation was James Cook. He was an English explorer, seagoing, cartographer and a captain of the British Royal Navy. He held three great expeditions on behalf of Great Britain and he sailed around the world twice. He was the very first British captain to circumnavigate the Earth by using the same ship.



Captain Cook’s voyages. The first voyage is indicated by the red line, the second one by the green line, and the third one by the blue line. The sea route of Cook’s crew, after his death, is indicated by the discontinuous blue line.

I.5. Water and the Great Geographical Discoveries

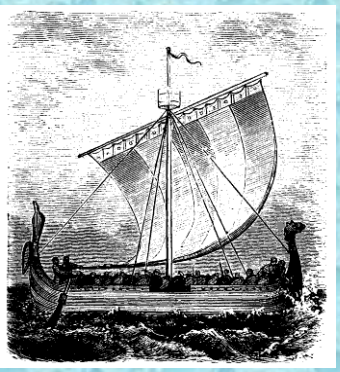
Why choosing Water?

From the origins of human life, we have always been linked with nature, and specifically with water. Our predecessors set their villages next to the water, cooked with it, but also built rods, nets and hooks to fish. But not everything was about food; they used water to transport their goods.

From Rafts to Ships

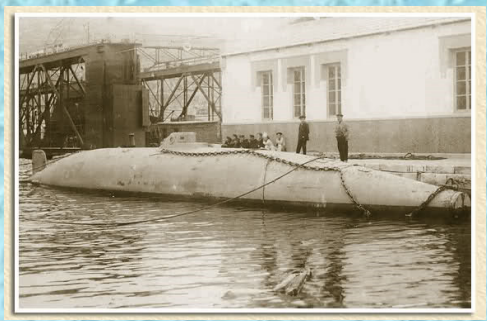
Humans stared to use rafts on the river and ships on the sea, because ships had better storing place than a horse or a donkey, and they were faster than any other land transport. The main problem about ship speed was if there was wind or not, because they didn't have engines, so they had to use a sail, a mast, oars and a rudder to sail.

The first try was "the raft": a kind of boat made of logs tied together. They used them to sail through the rivers to the coasts. For example, a typical raft in Spain is called *"nabata'"*. It was used to transport logs of wood.



The first ships were built 1200 years b.C by the Phoenicians, with cedar wood. They were the first sailors who set up links between the Eastern Mediterranean Sea and the Western Mediterranean Sea. Those ships were like a little prison, because they had to be moved by oars, and the slaves and some sailors were the ones who pulled the ship.

Everything changed when *The Age of the Sail* began. Clippers as the Cutty Sark became very famous. And eventually, some centuries afterwards, the biggest change would come, *the steam*. Humans started to build steam ships because they would no longer need a sail or oars, and they could even travel further and return faster. Some of this kind of ships quickly became joy cruises, which purpose had nothing to do with transport.



However, a vital purpose of the shipping industry through history was war. Also the idea of sailing under the surface has become real with the submarine,

whose first prototypes were designed by the Spanish engineers Isaac Peral and Narciso Monturiol.

The Pioneers: Greeks, Romans, Vikings

Ancient Greece was a rich and wealthy civilization thanks to the trade by water, as the Romans also did. Trade was their main source for buying goods, so their power grew as they conquered new lands on the coasts of the Mediterranean Sea. They also discovered new places and learnt from some different cultures. They became the Kings of the Aegean and Mediterranean Seas. The Greeks were also the first colonizers in history, and they were the first empire in using ships as a War weapon. During the time of Alexander the Great, Greece was the biggest power on the entire planet.

Rome became the world greatest empire thanks to the sea, which allowed them to move around its Empire.

The Vikings were great sailors; they had already sailed dominating the North Seas, thanks to the amount of rivers, lakes, isles, and fjords that helped them transport goods through water better than by a land full of mountains, forests and swamps. Vikings are also said to have reached Greenland, so they would be the first Europeans in America.

The Middle Ages: Aragonese Crown Expansion through the Mediterranean Sea

From the 13th to the 15th century, the Aragonese kings started some ambitious expansive politics through the Mediterranean Sea to open new commercial routes conquering Sicily and Sardinia. More eastern, Aragon took Athens and Neopatria; Alexandria, Damascus, Albania, Armenia were also conquered. This political and military expansion made the international trade

increase and Aragón became one of the most powerful kingdoms across the Mediterranean Sea. In the 14th century the economic golden age finished because Turkey conquered Constantinople in 1453 and all the Mediterranean routes became less important as the ones to the North Sea or to America were growing.

Meanwhile, in the other side of the Earth, Polynesia

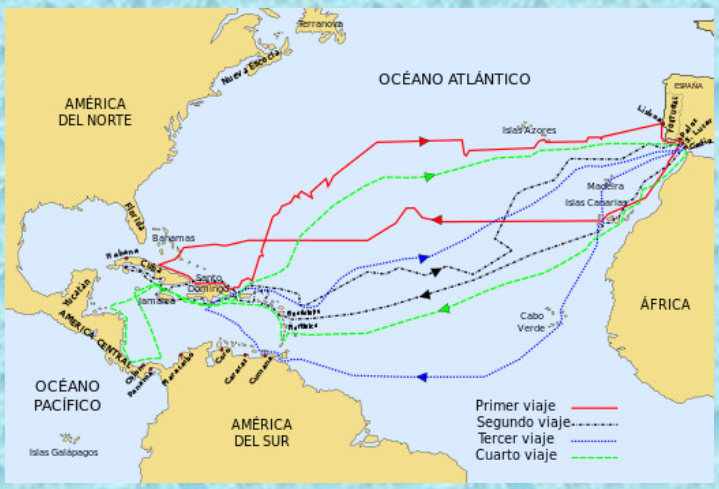
Polynesian settlements started around the year 1000 b.C, from Samoa, to Hawaii, Tahiti and finally New Zeeland in the 8th century. They travelled from one island to another by a kind of boats called catamarans, built with wood, and with hemp rafts. They are said to be the first people on crossing the Pacific Ocean with the rafts, reaching Pascua Island (called Rapa Nui).

The Great Discoveries of the Renaissance

The main purpose of navigation in the fifteenth century was to reach the West Indies because it was a wealthy territory and Eastern countries wanted to lead the spice trade. Seville was a key port to the Indies: Regular fleets, for trade and discoveries were armed expeditions.

The discovery of America happened on Friday October 12th 1492 when a Spanish fleet led by Christopher Columbus with three ships called La Niña, La Pinta and La Santa María, crossed the Atlantic Ocean and reached some American islands. Columbus was looking for an alternative to the Indian route. The expedition unveiled the existence of a New World, which was one of the highlight moments in world history. It meant the meeting of two worlds that had evolved independently, without knowing about each other's existences, which changed the course of Western history.

On behalf of the Catholic Kings of Castile and Aragon, Columbus travelled four times from Europe to America in 1492, 1493, 1498 and 1502. The arrival of Columbus to America also caused a major and global expansion of navigation and commerce between



towns and countries. From that moment on the so called "colonization of America" began and Portuguese, English, Dutch and French also got to settle their own colonies for trade businesses.

18th and 19th Centuries: Australia and Africa

In 1770, England decided to send an expedition leaded by James Cook, to sail and mapping the Australian coast. When they went back to England, the reports made during the expedition generated an especial interest for Australia, because they thought it could be a nice solution for the British penal overpopulation problem. From 1788, Great Britain started a political colonization, founding South New Wales, Tasmania, Western Australia, Southern Australia, Victoria and Queensland.

The 19th century was the European exploration century in Africa. Here, water had a very important role, because the great extension of desert and jungle made it better for conquerors to sail through the rivers (Congo, Niger, Zambezi, Orange…) inside the continent or travelling around Africa through the sea. David Livingstone crossed the Kalahari Desert and discovered the great water routes of the High Zambezi, and Victoria Waterfalls. Other expeditions led by different explorers were the discovery of the Nile's original source, or the route through the Sahara Desert.

And now, Antarctica

Even now, when we think mankind has discovered every single corner of the planet, Antarctica remains a target to the explorers. It has no native population and its human history did not begin until the nineteenth century, when the continent was discovered. During a period of 25 years, Antarctica became the center of an international effort which resulted in intensive scientific and geographical exploration.

Reaching the South Pole was one of the main objectives for exploring countries. Norway was the first country arriving to that point, thanks to Amundsen and its crew.

Nowadays, Antarctica has become more familiar to us, and that continent covered by a huge ice layer starts unveiling its secrets. Some of the European countries, such as Spain, France or Bulgaria have scientific bases. To explore the continent, ships are especially important. One example is the Spanish Oceanographic Research Vessel *Hesperides (A-33)*, based in Cartagena and operated by the Marine Technology Unit. Some of these expeditions and experiments are carried out in cooperation with other countries, as the Spanish Bulgarian campaign.

I.6. Water's Significance in Artistic Language: Folklore, Literature, Painting, Music

The Magical Power of Water in Literature and Folklore

Water in tales is the symbol of: creation, punishment and purification. The creation of the narrative being: "and God made the expanse and separated the water, which was under the firmament from the waters which were above the firmament". In fairy tales, regardless of whether it is a deep lake or a river which flows with frantic force or a huge ocean, water has always been both a friend and a foe.

In Biblical symbolism, the importance of water is diverse. It is a symbol of the Holy Spirit, through which God helps people. In ancient philosophies and mythologies, water was perceived as the main substance of the world and the source of fertility and life. In folk tales, it is presented as a source of life, loaded with magical power, with the ability to regenerate, purify and heal. Many legends about the fountain of life prove the statement that water is a symbol of eternity. Rain water is clean and in fairy tales is a symbol of life and creation and the sea is salty and carries a curse.

However, water can also represent evil and disorder. The symbolic importance of water in fairy tales is different, for example, the Grand River - a

symbol of knowledge and ignorance, and the great sea – symbol of the mystery. In water sources live mythical monsters, snakes and fairies. In magic the winged Dragon Tales is the patron saint of the waters. Water occupies an important part in magic fairy tales. It touches everything. According to some stories it represents the matter and the spirit. The water reflects the diversity of life – good and evil. It can represent both creation and destruction. Water is a memory for life – past, present and future.

In ancient times chemistry was not so developed, therefore the ancient people considered water as a god. The different peoples and tribes had different gods, goddesses and myths about the water.

In the Greek Mythology the first god was Pontus. Another god was the Oceanus. Another famous god in Olympian pantheon was Poseidon, called Neptune in the ancient Roman pantheon.

In the North Germanic Mythology the god of the water was Aegir and his wife was the goddess Ran. Niord - the patron of seamanship fishing, shipbuilding and he controlled all the sea breezes.

According to the ancient people from Mesopotamia, Ea was the god of the water and oceans, one of the three superior gods

Not only in the Old World, but also in the American continents there are a lot of myths about water. The Mayans believed that Chaac was the god of the rain and thunder, and in the Aztec mythology - Atl was the god of the water, Akuekuiotesimuati was the goddess of the ocean and the river/patron of the working women/ and Atlaua - a powerful god of the water/a patron of the fishermen/.

The Slavic people also believed in the so-called Water Spirit. Dana was the goddess of water, but also the one of life and fertility. This is how people connected water with life and fertility. Dodola, Dudula or Didila was the goddess of rain, the ancient god Perun‘s wife. It was believed that while Dodola was milking her heaven cows it was raining on the Earth. This is why in times of drought, people organised Dodolle festival in honor of the goddess and asked her to support them in front of god Perun. In the beliefs and folklore of the Slavic peoples there is the image of the Water Spirit - a creature with superpowers and the personification of the water forces. It was believed that the water spirit

inhabited the water pools; most often the lakes, the marshes, the deep river pools, the dams near the millsand etc. It was thought that the Water Spirit, was not nice to people - he chased the careless ones and drowned them - mostly the ones who were swimming in the pools after sunset.

Water can be seen in the stories and fairy tales of the Bulgarian folklore too. The tale “The Dark Lake” tells the story of a girl, who goes to a lake in the Pirin mountains. She wants to have blue eyes (like the lake which is blue in the morning) and golden hair (the lake looks as if it is “golden” in the afternoon because of the sun), because of her love for a boy. The girl becomes too proud and wants to become a queen because of her beauty. The lake becomes dark with anger forever, because it cannot bear the greedy and unthankful girl. A lot of myths and folklore connected with the water were created because of its magical power and the poorly developed chemistry in the ancient times.

The Magical Power of Water in Painting and Art

The study of water in art may involve examining the different ways in which it has been represented. Water has often been shown in the form of a symbol or stylized in some way.

During the Renaissance and later, water is represented more realistically. Many artists painted the water in motion - a flowing stream or river, a turbulent ocean, or even a waterfall - but also enjoyed views of calm waters - lakes, slow-moving rivers, and views of a calm sea.

Since ancient times, art has served cults of water, giving images that personify both the physical and metaphysical aspects of water and the numerous water divinities. Female water divinities have received particular attention from artists.

In more practical terms, Roman architects built great aqueducts, in order to move water from one place to another, and huge baths while sculptors have designed many beautiful fountains.

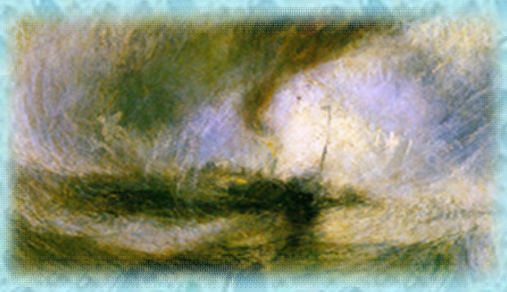
In Ancient Egypt, the hieroglyphic sign for water was a horizontal zigzag line; the small sharp crests represent the ripples on the water's surface. The name for water was “uat”, which also means the color green. Water and green were

considered synonymous because water was believed to symbolize the earliest form of soul.

WATER in MOTION

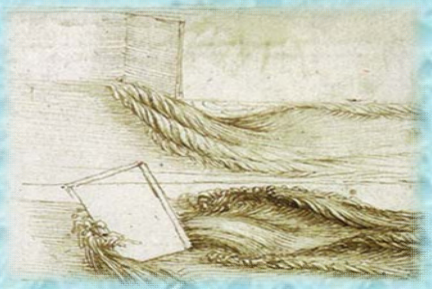
(image source National Gallery, Washington, DC)
Ludolf Backhuysen *Ships in Distress off a Rocky Coast*, 1667

The violence of the sea, however, held a special attraction to the Romantic artist during the 19th century. A painting by the English painter, Joseph Mallard William Turner, shows a boat caught in a snowstorm *(Snowstorm at Sea: Steamboat of the Harbours Mouth, 1842)*



LEONARDO DA VINCI and WATER

Leonardo da Vinci was fascinated by water. For him it was full of paradox.



Leonardo, Study of water passing obstacles, c. 1508-9

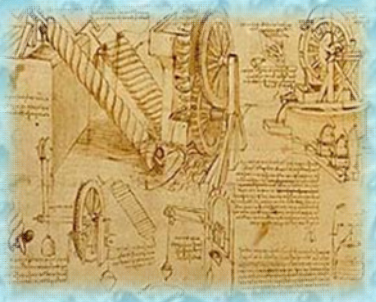
Leonardo described water as "the vehicle of nature" ("*vetturale di natura*"), believing water to be to the world what blood is to our bodies. As Leonardo understood it, water circulated according to fixed rules. It falls as rain or snow, springs from the ground, and runs in streams and rivers to the vast reservoir of the seas. Water is essential to humans, animals and plants, yet it can also be the instrument of their destruction. Its power is irresistible.

Leonardo had witnessed great storms, and conducted numerous studies of the motion of water. He examined the motion of waves and currents, and was the first to postulate the principle of erosion: "Water gnaws at mountains and fills valleys. If it could, it would reduce the earth to a perfect sphere" (Codex Atlanticus, 185v).

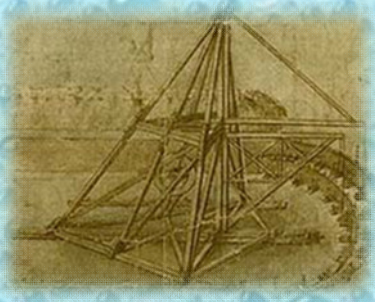
Leonardo studied water also with a view to learning how to control it. Throughout his life, Leonardo was obsessed with a fear of a great watery cataclysm. In his drawings and in his writings he describes terrible floods and inundations and great storms.

His drawings indicate a special fear of swirling waters. There is nothing more terrifying, he felt, than a swollen river breaking its banks and sweeping people, animals, houses, trees, and even the land itself down into the sea. Leonardo had witnessed such disasters when the Arno River burst its banks on 12 January 1466, and again in 1478.

As a result of these events, and as a way of dealing with his fears, Leonardo devoted lot energy to developing ways or devices to control and move water around water. He also designed locks and canal systems, and invented machines for excavating canals.



Left: Leonardo, Machine for raising water (Codex Atlanticus, f. 26v)
Right: Leonardo, Machine for excavating canals (Codex Atlanticus, f. 4v)



One large scale but never realized plan was for a navigable canal linking Florence to the sea. The scheme included cutting a series of giant steps with locks to enable ships to sail up into the hills. The water would be raised from one level to the next by a huge siphon. In Milan, he worked on a system of locks and paddle wheels for washing the streets. He also had plans for draining the unhealthy marshes of the Val di Chiana.

The Magical Power of Water in Music

The water and the music have gone together for a very long time. Some of the oldest information is from the native population of America. They used “water drums”, that is a drum within drum, but the inner drum is being filled with water to affect the timber of the sound. A Water Gong is affected to a modern use of traditional gongs and tam-tams. That instrument was struck and then lowered into

a tub of water which lowered the pitch. Or even the everywhere-known glass harp which is made of wine glasses. It is played by running moistened fingers around the rim of the glass. Each glass is tuned to a different pitch, either by grinding each goblet to the tuning is permanent, or by filling the glass with water. In the modern times there is an instrument that uses water to produce sounds it is called hidraulophone which is an instrument played by direct physical contact with the water where sound is generated or affected. Water Drums exist in various cultures. In some areas in Africa and New Guinea, hollow gourds were placed in larger vessels and struck.

Many composers have imitated water sounds. Ludwig van Beethoven was influenced by the water and wrote his 6th Symphony. Jonathan Green imitated the water in his 3rd symphony named "Water". The "Water music" is a collection of orchestral movements, often published as tree suites, composed by George Frederic Handel.

I.7. Unity in Diversity - Water and Local History

I.7.1. The Role of Water in the Romanian History

"History is geography in movement" **- Herder**

This concise presentation attempts to illustrate one of the essential coordinates of the historical becoming of today's Romanian people. It is important to emphasize the overwhelming influence that large rivers, the Danube and the Black Sea have played upon the course of the Romania's history. Since ancient times, Roman and Greek interest in the area is well known. The antic history notes the importance of the Greek cities union - Histria, Tomis, Callatis (Mangalia),

Dionysopolis (Balchik) and Odessa (Varna) - Mesembria (Nesebar). The capital of the union was Tomis (Constanta).

A decisive fact is the Danube, one of the major international ways which passes through our land and flows into the sea. For centuries the borders of the Roman Empire depended on the Danube as a river which was difficult to cross. Out of caution fortresses were built at critical points on the eastern border of the Empire. Important centers of the Empire emerged in this area, and several famous rulers were born here. They left behind ancient settlements, roads, ruins and artifacts. Alongside this river one can find testimonies of times when the Danube represented the border between empires and worlds, from the time of Ancient Rome to the Cold War. They were built a long time ago to protect the borders, but today, as monuments of the turbulent history of the Balkans, they could become part of cross-border cooperation between the countries of the Danube region in the field of tourism.

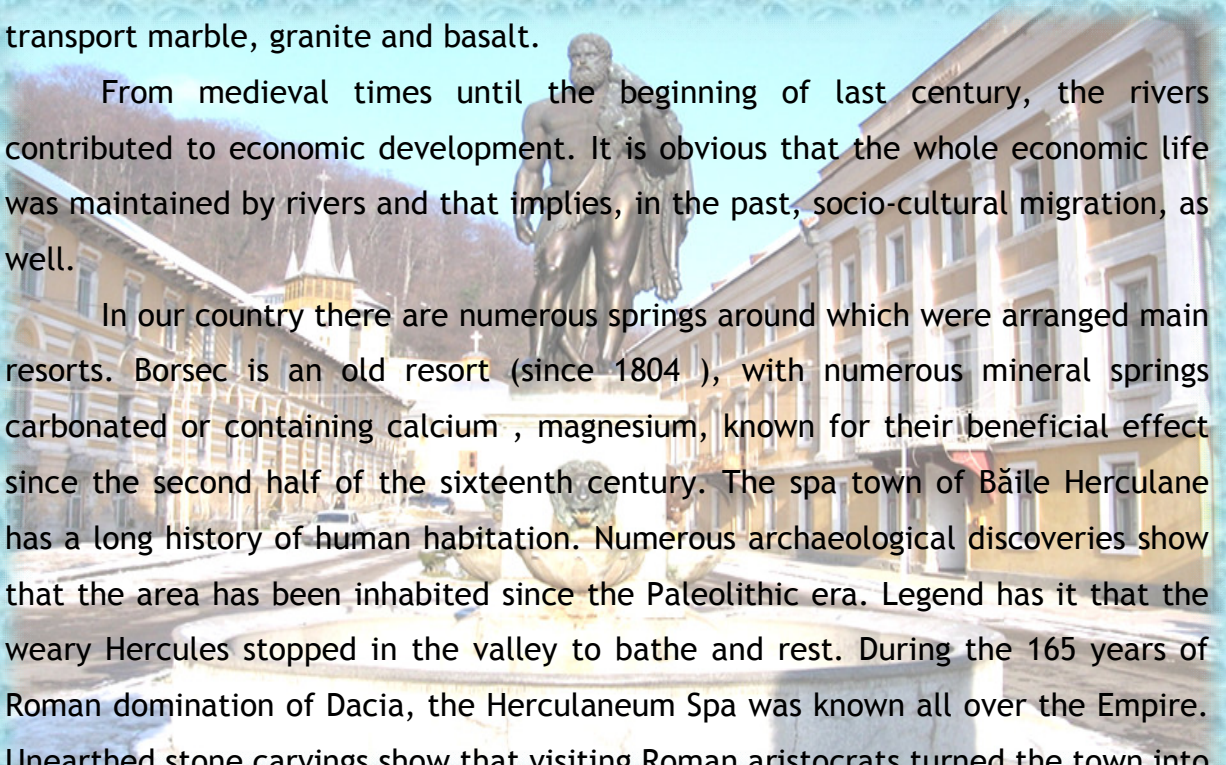
Fishing, one of the oldest occupations of the population in the Danube Delta, is also an important economic activity now occupies more than half of the working population of the Delta , enabling fishermen currently authorized to conduct commercial fishing. Recovery of fishery resources in natural water basins is based on traditional methods that have been used since ancient times. The first fishing regulations appeared in the Middle Ages during the Ottoman administration.

Cities were born at the crossroads of trade routes, water courses, besides fortresses, monasteries. The cities were less numerous, the highest number of people were in the sixteenth century fortress Alba (20 000) and Brasov (10,000). Subsequent prosperity of cities - Brasov, Sibiu, Bistrita – appear because of their trade relations. Internal trade routes were, in the past, water course or mountain passes.

Great reliance was placed on water power. The water-powered sawmill (“joăgar”) originated in the sixteenth century but the number increased rapidly in the eighteenth. The “joagăreni” worked on the cutting, transport and processing of wood. In 1844 there were

960 “joagãre” in Transylvania. The use of water power reached the highest levels at this time with fulling/wash mills, cornmills and sawmills. Building these installations was a considerable labour in itself, involving not only the mills but also the feeder canals and ponds known as “jilipuri” and “iazuri” or “scocuri” at Gura. Meanwhile a limited number of cornmills were needed, while the textile industry required the multiplication of fulling mills (“pive”) and wash mills (“vâltori”). Rudarie Valley in Almaj is the largest watermills park in south-eastern Europe.

So collecting firewood and timber for manufacturing (“lemne de lucru”) was an important task, especially in winter and spring. Systematic exploitation was obvious from the first half of the nineteenth century with floating on the rivers (for example Cibin, Bistrita, and Sadu). Construction timber could be supplied as rafts consisting of tree stems roped together (“plute închingate”), with a simple tiller (“fel de protap”) for navigation, while casual floating (“plutăritul liber”) was used for firewood. In The Middle Age Turkish merchants transported wood to Galati and Chitila, necessary for construction of ships. This type of “rafting” was used also to transport marble, granite and basalt.



From medieval times until the beginning of last century, the rivers contributed to economic development. It is obvious that the whole economic life was maintained by rivers and that implies, in the past, socio-cultural migration, as well.

In our country there are numerous springs around which were arranged main resorts. Borsec is an old resort (since 1804), with numerous mineral springs carbonated or containing calcium , magnesium, known for their beneficial effect since the second half of the sixteenth century. The spa town of Băile Herculane has a long history of human habitation. Numerous archaeological discoveries show that the area has been inhabited since the Paleolithic era. Legend has it that the weary Hercules stopped in the valley to bathe and rest. During the 165 years of Roman domination of Dacia, the Herculaneum Spa was known all over the Empire. Unearthed stone carvings show that visiting Roman aristocrats turned the town into

a Roman leisure center. Six statues of Hercules from the time have been discovered. A bronze replica of one of them, molded in 1874, stands as a landmark in the town center.

The Romanian Navy has been founded in 1860 as a river flotilla on the Danube. After the unification of Wallachia and Moldavia, Alexandru Ioan Cuza, the Ruler of the Romanian Principalities, decided on the 22nd of October 1860 by order no. 173 to unify the navies into a single flotilla.

"Fulgerul" (The Lighting) gunboat, built in 1873 at Toulon, was the first military ship to have sailed under Romanian flag in maritime waters.

During the War of Independence, the name used in Romanian historiography to refer to the 1877-1878 Russo-Turkish war, the Romanian Navy sailed under Russian flag.

The rivers and The Black Sea have played an important role in the economic development of Romanian cities. For example, Romanian Port of Constanta is a major part of the country's history. Starting from the 6th century B.C. was discovered Tomis, the antique city of Constanta. It was known as a trade center mainly for its geographical characteristics. Tomis city was situated near the Black Sea. Water was one of its main characteristics to make it become an important maritime port.

1898

Today

The waters have been the source of Romanian industry development since the beginning of modern history. In 1896 was built the first hydroelectric factory in our country, Sadu, which still works. The river Olt has the largest numbers of hydroelectric works in Romania. The Olt River springs from the Massif Hasmas and flows into the Danube River near the village Izlaz. It has a length of 614 km and an average flow of 190 cubic meters per second. In the middle of the Olt River are located 12 hydroelectric equipped with Kaplan turbines and few small hydropower stations, with a total installed power of 500.1 MW and electricity production project 1482.49 GWh per year.

Galati is a city in the historical region of Moldavia, eastern Romania. Galati is the largest port town on the Danube River. Despite the wars and unrest, Galati developed based on trade (especially grain exports). In 1805, France and England established vice-consulates. In 1832, the School of the Holy Archangels Michael and Gabriel was founded. Two years later, in 1834, Austrian ships had arrivals scheduled and in 1837, Galati was declared a free port (this was revoked in 1882). In 2011, the Romanian census recorded 249,432 residents, making it the 8th most populous city in Romania. Galati is a major economic centre built around the Port of Galati, naval shipyard, the Arcelor Mittal Galati steel plant and mineral exports.

In conclusion, Water has always been an important resource in Romania, in the Romanian history, representing the basis of urbanization, socio-economic development, trade, industry and art.

I.7.2. The Role of the Water in the Greek History

WATER AND RELIGION IN ANCIENT TIMES

Deities

Water has intense presence in ancient Greeks' religion. Indeed, a lot of rivers, lakes, seas were considered to be gods.

Poseidon, one of the main gods of the ancient Greeks, was responsible for the marine phenomena. Additionally, he was the god of the Land and the Sea, of the rivers, the lakes and potable Water. His characteristic equipment was his trident with which he quelled the seas, created floods, rough seas and even earthquakes. He was considered the patron god of the sailors and the fishermen. Cyclops Polyphemus in Homer's 'Odyssey' was one of his sons. His official wife was Amphitrite. The Romans worshipped him giving him the name Neptunus.

Poseidon's cupreous statue
(National Archaeological Museum, Athens)

Amphitrite, Poseidon's wife, was the goddess of the Sea, one of the 50 Nereids or Oceanids. Poseidon's and Amphitrite's attendants were the sea-horses, the Oceanids and Nereids, the Tritons and other marine daemons, too.

Triton was Poseidon's and Amphitrite's son. His main symbol was the marine horn which produced sounds to which nobody could resist.

Thetis was Nereus' daughter and the famous hero Achilles' mother. She married Peleus, with whom he gave birth to Achilles.

Proteus is considered the first form of life on Earth because of his ability to take any form he wanted. Sailors called him 'The old man of the Sea' and he was considered their patron god. He knew all the depths and the secrets of the Sea.

God-Rivers

Rivers were other important aquatic gods. In Peloponnese one can find three of the most famous: Alpheus, Neda and Peneus. Alpheus was Oceanus' son. His love for Arethousa, the gorgeous nymph of the springs and the forests, has become a well-known myth.

Neda, Oceanus' daughter, was a nymph of the region of Arkadia. Because Arkadia was arid at that time, Rea transformed Neda to a river.

The Peneus River is connected to Hercules' legendary fifth labour. According to the myth, Hercules demolished the walls of Augean stables, turned the rivers Peneus and Alpheus towards the stables and cleaned them.

Water in the Orthodox Religion

The Greeks have been Orthodox Christians since the first century A.D. and they have been using Water in the life of Church during all the rites. All the Greeks are baptized. The Water of the baptism procedure symbolizes the purity of Soul and the human's spiritual adoption by God. The Baptism symbolizes Christ's burial, his Resurrection and the beginning of a new life and spiritual rebirth.

One of our valued saints is Saint Nicholas who is considered the patron saint of sailors.

Water is connected to blessings, too, which are carried out on Epiphany Day (6th January), on the first day of each month and on the first day of every new school year. We also believe that the Holy Water protects us and even more heals us. That is the reason why we drink it and then we keep it safe in small bottles.

THE IMPACT OF WATER ON THE POPULATION GROWTH AND ON THE URBANIZATION

Greece is situated at the southern end of the Balkan Peninsula virtually surrounded by the Mediterranean Sea and it has a vast number of islands while flooded by lakes and rivers. Its population growth depended significantly on this extensive existence of water. Some of the most important Greek ports of both the ancient and the modern times are the following:

Athens and Piraeus

Piraeus was and still is the largest and most important port in Greece and the Eastern Mediterranean Sea. It is located 10 km away from the center of Athens. Piraeus prompted the city of Athens to a great cultural and financial prosperity through trade, shipping and fishing. Indeed, the citizens of Athens had the most powerful fleet in Greece and in the entire ancient world.

Ports of Peloponnese

Killini had been inhabited since the Paleolithic Age. It was the seaport of Ancient Olympia and of Ancient Ilis.

Pylos was mentioned by Homer as Nestor's kingdom. The modern city was built around the castle which had been constructed by the Ottomans in 1573 A.D. to control the southern entrance to the bay of Navarino.

The great urban center of Patras is connected to the large port of the city. After 280 BC the city played an important role in the foundation of the coalition of cities of the Achaean League. During the Roman times, it was altered to Colonia Augusta Achaica Patrensis (CAAP) and became one of the most populous cities in Greece. In 1204 AD Patras was conquered by the Crusaders and became the seat of the Latin Ducat of Achaia in the princedom of Achaia. During the Ottoman

occupation and at the beginning of the 20th century it was the largest and the most prosperous port and city in the Peloponnese.

WATER AND FINANCIAL - SOCIAL GROWTH

Financial growth – Agriculture

In the Peloponnese the plains were those which provided life to the population as the biggest production was that of cereals. For centuries the plain of Achaia has been producing eggplants, tomatoes, pepper, pears and beans, the plain of Elis tomatoes, raisin, olives, watermelons and strawberries, and the plain of Messinia olives and oranges.

Financial growth - Thermal Springs of our region

Killini

These thermal springs were well known since the ancient times as Pausanias mentions in his script "Eleiaka". The waters of the springs have therapeutic properties mainly for respiratory disorders. The Baths of Killini have been an independent settlement by the year 1912.

Kaiafa Baths

Well-known baths that are connected to the history of the area. Their systematic operation starts in 1907.

Financial growth – Fishing and Lagoons

Kotichi's Lagoon

Between the river beds of Peneus and Larisos there is Kotichi, a typical Mediterranean lagoon that communicates with the shallow sea region. The lagoon is the recipient of the water which comes from 9 dingles that enrich it with fresh water. It is also an immigration area for the fish fauna.

Social development

Therer were a lot of villages that thrived thanks to their short distance from large rivers. Examples of such villages that were built in proximity to the Alpheus River are: Ancient Olympia, White Houses, Gyros. Louvro, Nea Kamena, Dimitsana, Stemnitsa etc. Eritmanthos, another big river of our region, was the place of settlement of many people.

THE ROLE OF WATER IN THE DEVELOPMENT OF NAVIGATION, INDUSTRY AND TRADE

Navigation

According to archaeological findings, the first ships sailed in the Aegean Sea in 7000 BC. The Cycladic people (3000-2000 BC) were the first to dominate the Aegean, giving later their position to the Cretans of the Minoan period and these were succeeded by the Myceneans (Expedition of the Argonauts, Trojan War). From the 9th century BC onwards many other cities were involved in the trade such as Korinthos, Samos, Aegina, Corfu and Syracuse. Lastly, the Athenians, with the creation of their powerful fleet took over the reins in the marine area.

There were many kinds of Greek ships and the most known among them were Thiraean Ships, triremes and olkades. The Athenian trireme was 35m long and its maximum velocity was 20 km/h. It was used for both commercial purposes and for war. The olkas was a sailing boat transferring merchandise. The boat in the picture is a copy of the famous wreck of Kyrinia (in Cyprus).

Industry

From the earlier years Water was used widely in the field of industry. The most common use was in the watermill for the production of electricity, flour and gunpowder.

Watermills and Gun-powder watermills

The oldest watermill is mentioned by Strabo. In Greece, watermills existed in Roman Times. Often the construction of a watermill was accompanied by the construction of the miller's house.

Dimitsana, a town of the central Peloponnese, was the most famous place in all the Ottoman Empire thanks to its mills. Watermills usually served local needs and ground mainly barley and meslin (mixture of wheat and barley) and more rarely corn, wheat and animal feed.

Dimitsana had also been the place of the professional production of gun powder for centuries. This activity was at its acme in the 19th century when 14 watermills, which used the water of the Lousios River and of the rains of the region, worked at the same time to refuel almost all the Greek territory.

Trade in the Danubian principalities

Apart from the ancient times, even during the following centuries, the commercial activities of the Greek cities depended on Water. Specifically, during the 15th century AD and later a lot of Greeks settled in cities near the Danube river (Odessa, Vienna, Trieste, Budapest etc.) because of the continuous wars and expansion of the Ottomans, and dealt with the trade of leather, cotton, carpets etc. very successfully.

At the census of 1860 at the three most important ports of Danube were counted: 36,000 Greeks at Galati in Romania, 26,000 at Vraila, 3,000 at Soulinas. So, almost the fifth of the population of those most important ports of Danube consisted of Greeks.

WATER AND THE GREAT GEOGRAPHICAL DISCOVERIES

From ancient times, Water had an enormous contribution to the discovery of geographical regions and the establishment of colonies. Specifically, in Greece two major settlements took place, in the 11th and the 8th century BC correspondingly. So, an extensive population movement was made which began from the main

Greek peninsula and ended to Macedonia, Minor Asia, the Black Sea, Northern Africa and Gibraltar.

Especially the 2nd Colonization, which was much more extensive than the first one, had as a result all the coasts of both the Mediterranean Sea and the Black Sea to be specked with a huge number of Greek colonies. The contact of the colonists with other nations widened their spiritual horizon and many new professions appeared (craftsmen, potters, painters, merchants).

The Greek colonies which were established during the 2nd Colonisation.

The voyage of Pytheas of Massalia

Pytheas of Massalia (approximately 380–310 BC.) was an ancient Greek merchant, explorer and geographer from Massalia (modern-day Marseilles in France). He described his voyages to Great Britain and probably Iceland and other regions of Arctic Circle in his books *On Ocean and Earth Period*.

Nearchus' sailing by the coast

The most important case of geographical discovery by the Greeks during war expeditions is that of Nearchus, one of the generals of Alexander the Great. Nearchus achieved to explore a sea path from the mouth of the Indus

river to the mouth of the Euphrates' river. He began his expedition on the first days of October of 325 BC and ended triumphantly in February 324 BC.

WATER AND TRADITION

Our people have captured the power and the value of Water in a lot of folk songs which praise fountains and stone-bridges. We find the "immortal Water" in plenty of songs and fairytales, which can make someone immortal or bring them back to life if they are already deceased.

Also, according to another popular belief, the dead persons drink the Water of Oblivion and forget everything that exists in the upper world. Water can make a place fertile (for example, in the song "Ena nero kyra-Vangelio"- "Water, Lady Vangelio"). Other songs refer to the beneficial impact of water on the external appearance of people.

In our folk literature there are typical proverbs with allegorical meaning like: "Water and fire do not relate by marriage" (for things totally opposite). The power and the value of water are reflected in typical phrases found in Greek Philosophy and History, too, such as: "Ariston men hydor "meaning "Greatest however [is] water": Pindar's' verse, cited by Aristotle and Plato (Rhetoric and Euthedemus, correspondingly). The phrase "Ge kai hydor" (earth and water) is connected to the Greek-Persian wars. In Modern Greek it means unconditional subordination to a conqueror.

The customs which are connected to water are numerous, too. Women used to go to the public fountain on New Year's Day and leave offerings, to "sweeten the waters". A special part in the folklore customs related to water possessed the so-calling "speechless water": in the morning of New Year's Day the housewife got up, took a stone from the yard and put it near the fire-place, and then she went to the public fountain to take the "speechless water". There are also customs connected to praying for rain like "Pirpirouna", usually when a drought occurs.

The Modern-Greek tradition is full of myths, legends, traditions about the Ladies of the springs, Fairies and Dragons, and Spirits enunciating the ubiquitous presence of Water.

Generally, Water is considered to bring good luck in the house. So, in a lot of regions of the Peloponnese, water is sprinkled on the way of the traveller so

that he will become safe and "flow" as water does. The same custom is related to the bride, too, or to a woman when she is going to give birth. In a lot of dry regions the bridegroom took as dowry a cistern, too, because water was a treasure and its collecting and keeping was priceless:

"We have no rivers, we have no wells, we have no springs, only a few cisterns — and these empty — that echo, and that we worship" (Giorgos Seferis, Nobel Prize of Literature in the year 1963).

1.7.3. The role of Water in the Czech Republic

Water, from the very beginning, takes a very important role in our country. It is an entire part of our existence till today.

Water in religion

The main religion in our country is Christian – Roman Catholic so that the main connection with water we can find in the Bible.

Water and Bible

In the Book of Revelation we can read: "Worship him who made the heavens, the earth, the sea and the springs of water." This text reminds us of the fact that God is the Lord of creation and that water plays an important part in the creation of the World. Water is also important in the fate of many biblical characters because they usually live in those parts of the world where there is a lack of water. We can also read that water is the bearer of death and danger. The evidence of this fact is given in the story of the flood, the Egyptians being drowned in the Red sea or a general fear of deep waters and sea. Psalms "Therefore he raised his hand and swore to them that he would make them fall in the wilderness" (and deep waters) or "The Lord in heaven is stronger than the noise of great waters, yes, he is stronger than the great waves of the sea" are other proofs of this statement.

Water in traditional customs and habits

Morana - she was the symbol of death and winter and during the spring she was thrown into the water, river, pond as a symbol of the beginning of spring and a new life.

Easter water pouring – men pour women during Easter as a symbol of health and "wake up" in spring.

Water and social- development: agriculture

That is true mainly if we speak about the first settlements, first farmers in our area which appeared near rivers. No wonder that even many centuries later, water reached the prominent position again thanks to building of ponds.

Fish farming in Bohemia

Ponds are man-made water reservoirs. The inflow can be a river or a stream and the outflow is regulated on the embankment which serves for water retention. At the beginning their function was fish breeding, water supply, reduction of flooding and creating ice in winter. The oldest and the first documented pond in Bohemia is Dvořiště pond from 1115 which was founded during the reign of John of Luxembourg. There are about 21 000 ponds in the Czech Republic today. In this picture you can see pond Jordán in Tábor.

Fish farming has a long tradition in Bohemia. It was supported during the reign of John of Luxembourg or Charles IV. It was also supported by the noble family Vítkovci, the Rosenbergs or the Schwarzenbergs. The 15th century represents the biggest expansion. The Hussite period meant a big decline. The best known fish pond designers are e.g. Josef Štěpánek Netolický, Jakub Krčín, Josef Šusta, Mikuláš Ruthard of Malešov and Jan Stanovský of Čechtice.

Josef Štěpánek Netolický

He was one of the best known Czech fish ponds designers. He also worked as an architect and builder. He came from a peasant family in Netolice. On the turn of the 15th century he learnt the fish pond designing craft during the construction of ponds near Lomnice nad Lužnicí.

His best known ponds are Horusický rybník, Opatovický rybník or Kaňov rybník. Zlatá stoka (The Golden Sewer) is also very famous. It is connected to other

canals and it controls inflow and outflow of all big ponds in Třeboň region. It is almost 45 km long and it was finished in 1518. The main purpose of the construction was the water supply system.

Jakub Krčín

His whole name is Jakub Krčín of Jelčany and Sedlčany. He was a significant Czech founder of fish ponds. Although he came from a poor lower noble family, he studied water management at Charles University in Prague. But he is said to quit his studies. In 1561 he entered into the service of the Rosenbergs. It happened thanks to intercession by Eva of Rožmberk who was saved by him in the forest after falling off a horse. He was named the burgrave of Český Krumlov. He took part in a competition to build the Prague aqueduct and he won. He was a follower of Josef Štěpán Netolický- another fish ponds designer. He designed a few ponds – Spolský pond or pond Potěšil. He also enlarged many other ponds. In 1571 he founded pond Nevděk (today Svět = the World) due to which he ordered partial demolition of the town of Třeboň.

Mikuláš Ruthard of Malešov

He is also one of the significant Czech fish ponds designers. He came from a lower noble family near Kutná Hora. He worked near Chlum u Třeboně where he created a large system of ponds (in the middle of 16th century). Here the deepest pond in the territory of Bohemia was built – Staňkovský rybník (with its depth of 16 metres = 4 average floors). He invented the 3 – step method of fish farming.

The largest pond in the Czech Republic and in the world

The Rožmberk pond is the largest pond in the Czech Republic. It was designed and built by Jakub Krčín in 1584–1590. The construction was carried by over 800 people who removed such a big amount of soil that could fill up a cube 90x90x90 metres (for illustration – an average floor 4 metres high). The necessity of this construction was supported by the vast flood that arrived from the South Bohemia to Prague in 1544. The pond was to regulate the occurrence of floods in future. The embankment (built of soil and strengthened by trees) is more than 2.3 kilometres long and almost 60 metres wide. The water volume can reach 6.3 cubic

metres, the water surface is 490 hectares and the maximum depth is only 6.2 metres. According to certain definitions the Rožmberk is also considered the largest pond in the world.

Water and social-development: industry

Water that has been convincing us of its great power and strength lets people make new machines. Thanks to those machines it was possible to use energy which was necessary to help people with their work. So that the first water wheels appeared.

Water wheels

A water wheel or a mill wheel is the oldest device for acquiring energy from flowing water. First physical evidence of water wheels comes from Mesopotamia from 3rd century BC. It was water wheel for lower water – water was coming to the wheel from the bottom.

In 14th century water wheels spread in Europe and in our country too. Those were water wheels constructed for the upper water – water was flowing from the top.

Water wheels were used for many kinds of hard work e.g. for mineral and stone extraction. Because of this fact we can say that the widely spread opinion of water wheels being used only near mills, is false. Due to spreading of water wheels all over the world the human kind started the second landscape remaking (the first remaking was in the period of the first farmers).

Examples of water wheels used in our area:

The sawmill: This was the special kind of saw that used water wheel as a source of mechanical energy. Sawmills were usually a property of millers because the milling of grain was only a seasonal case.

Stoupa: This machine using water energy was meant to mash various kinds of materials. By this device the first waterproof material was made.

Hammer: It was used for smithing of iron and was controlled by two smiths.

River mill: Those were two ships anchored on water stream. The water wheel was between the ships and on the ships there was a milling device. River mill served as a mill for grain.

Water turbines: We know, for example, Pelton turbine, Francis turbine and Kaplan turbine which is considered to be the most important one. For the first time it came into service in the factory manufacturing yarn. Viktor Kaplan invented his turbine in our town – Brno.

Water and urbanization

All the rivers were very important till The Middle Ages and very often they were considered to be the only possible ways to travel in the landscape which was rarely populated. There existed many different groups of people with various languages and the rivers created a natural border between them. There are lots of towns and cities which were founded on the rivers in our country.

Historical towns on the rivers in our area:

Moravský Krumlov –Rokytná river, Znojmo –Dyje river, Ivančice – the junction of the rivers Oslava, Jihlava and Rokytná , Dolní Kounice – river Jihlava, Rájec nad Svitavou – the junction of the rivers Svitava and Býkovka, Veveří castle –Svratka river and Veverka stream, Lednice – Valtice area – (UNESCO) – the Dyje valley, Hodonín –Morava river, etc.

Towns in the Czech Republic on the river junction:

Jaroměř – three rivers Labe, Úpa, Metuje, Hradec Králové – rivers Labe and Orlice, Mělník- rivers Labe and Vltava, Plzeň – rivers Mže, Radbuza, Úhlava, Úslava, Brno – rivers Svratka, Svitava, Litoměřice – rivers Labe and Ohře , Ústí nad Labem – rivers Labe and Bílina , České Budějovice – rivers Malše and Vltava, Ostrava – rivers Ostravice and Odra, Olomouc – rivers Morava and Bystřice and many others.

Spa -towns

The belief in the curative powers of natural healing sources, spa, drinking water and spa therapy goes back to the past and these methods are used in medical care today. Spa resorts were founded near locations rich in natural sources - mainly spring water or thermal water used for bathing procedures and drinking treatment. Deposits of peat, boggy soil and mud provide valued material for hot bath and mud body masks. Many favourite spa resorts were established thanks to their favourable climate.

Our biggest and best known spa – Karlovy Vary (Carlsbad)

Karlovy Vary is a spa town situated on the confluence of the rivers Ohře and Teplá, the altitude is 380 metres. The spa district runs along the river Teplá. According to the legend, the emperor Charles IV discovered the hot springs while hunting. Carlsbad hot springs are brought to the surface from the depth of more than 2000 metres. Mineral salts and carbon dioxide are among the substances dissolved in the spring water during its passage to the surface. The abundance of springs is about 2000 litres per minute, 9/10 of which is represented by hot spring called Vřídlo itself. The temperature of 12 Carlsbad springs varies from 41,2 °C (Sadový pramen) to 73 °C (Vřídlo). The curative effects of the springs are mainly used for treatment of digestive system organs and metabolic disorders.

There are lots of local names in the Czech Republic which are connected with water. It means that in this case water accompanies us almost everywhere. Our students dealt with this theme in special worksheets. Hydronyma are the names of rivers, seas, oceans, lakes, glaciers, ponds, swamps and waters in general. Some examples of Czech names associated with water:

The origin of the name Moravia belongs to the oldest European designations with a basic meaning of a swamp. The word Moravia relates to water environment and refers to water, rivers, streams etc. The root of the word is mar or mor which means a sea. This word base is possible to be compared with naming of a sea in some ancient languages such as -mare (Latin), -muir (old Irish), -meri (old German), morje (old Slavonic). The base of the name Moravia was used by a Roman historician Plinius at the beginning of the Christian calendar when he was describing so called Amber way that went through Moravia. Approximatelly at the same time Moravia was mentioned by another Roman historician, Tacitus.

Ostrava is a river Ostravice and also a city. The name designates a river with very fast and wild flow.

The Vltava is the Czech longest river which springs from the Šumava mountains. The origin goes back to an old German word Wilthahwa with the meaning of the wild water.

The Svratka river as Swarta is also known from the old German language and means black water. Svitava is also a river and its name could be explained as clear water.

Brod - this word occures in most place names in our country, especially in town names e.g. Český Brod, Havlíčkův Brod, Uherský Brod but the same frequency of naming is known also from Britain (Brod = ford) e.g. Stratford, Oxford. This word is very frequently used in German (furt) such as in Frankfurt or Schweinfurt etc.

Brno - originates from 11th century. The base of the name can be seen in an old Slavonic word 'brn' which means mud. The first settlement was founded near the furt accross the river Svratka and was surrounded by swamps. Also some names of the city quarters somehow associate water e.g. Žabovřesky (the place where you can hear the sound of frogs), Komárov (the place with a lot of mosquitoes).

Water and the Great Geographical Discoveries

The Czech Republic is a land located country. We can´t talk about great geographical discoveries connected with water in our area. But the water played a big role in forming karst areas in our country: Český kras, Moravský kras, Hranický kras etc. Brno is situated on the south of a world-know karst area. Moravian Karst is one of the most important karst areas of Central Europe. In the area of Moravian

Karst, there are more than 1100 caverns and gorges. The Punkva Caves discovered by Professor Karel Absolon in 1919 are the most famous of all thanks to their connection with the bottom of the Macocha Abyss and the cruise on the subterranean Punkva River.

The Bull Rock Cave (jeskyně Býči skála) is located in the Josefov area of the Křtiny Valley in the middle part of the Moravian Karst. The entrance part is called the Hall (also Entrance Hall, Hallstatt Hall, Předsíň in Czech). The Hall is the site of the famous "Hallstatt burial" discovered by Jindřich (Heinrich) Wankel, M.D., in 1872. In this picture you can see a famous bronze statue of a bull found in this cave.

Water and Art

There are a lot of Czech folk songs inspired by water. Probably the famous masterpiece of music influnced by water is *VLTAVA* by Bedřich Smetana. It is one of the six symphonic poems composed between 1874 and 1879. It is a part of a set called My homeland – Má vlast. Bedřich Smetana was born on March 2nd 1824 in the East Bohemian town of Litomysl as the seventh child of a fairly wealthy man who was the head brewer in the Litomysl castle brewery. *Vltava* is probably Smetana's most famous piece. He died shortly after his sixtieth birthday, on May 12th 1884.

The Vltava (Moldau) is the Czech longest river. It is running from Šumava mountains and merging with the Elbe at Mělník. The Vltava is our national river and goes through Praha (Prague) too. In this picture you can see our famous bridge - Charles bridge and Vltava river.

Water sprite (vodník) is one of the well-known characters in Czech fairy-tales and literature. We know him from pictures by Josef Lada or from fairy-tales by Václav Čtvrtek.

He is usually connected with all types of water areas such as lakes, ponds, rivers or streams. Mostly he is described as an ugly, bad person who tries to harm people. He usually sits on a willow and smokes a pipe or plays a violin. Sometimes we can meet him in a pub. But not all the water sprites are really bad, in some stories they are very good-hearted.

Some examples in Czech culture

Literature: Karel Čapek: Devatero pohádek, *Pohádka vodnická* (1931), Václav Čtvrtek: *Vodník Čepeček*, Václav Čtvrtek: *Vodník Česílko* , Karel Jaromír Erben: *Vodník* (from Kytice) etc.

Music: Zdeněk Fibich: *Vodník* (melodrama), Antonín Dvořák: *Vodník* (poem set to music), *Rusalka* (opera)

Art: Josef Lada – a lot of pictures of a good-hearted water sprite sitting on a willow and smoking a pipe

1.7.4. The Role of Water in the Spanish Space

Urbanisation and Spread of Population

The Spanish population and demography depend a lot on water. The first civilizations already appeared near big rivers and close to the seas. That happened first with the Iberians and the Celts, settling along the valleys of rivers Ebro and Duero in the Neolithic. The Phoenicians came to the Iberian Peninsula on 114 B.C. and they founded Gadir (Cádiz) and later they spread over Malaca (Málaga) and Abdera (Almería). They stayed in the south of Spain, near the coast of the Mediterranean Sea.

Other big water civilizations also came to our contry: The Greeks came to Spain in the 7th century B.C., and later they founded Emporion, today known as Ampurias, on the coast of the Mediterranean Sea. So did Carthaginians in the 2nd century B.C, but more than a simple colony, they started an imperialistic Mediterranean project in the Iberian Peninsula. They founded Qart Hadasht (Cartagena), their most important naval base and soon they managed to dominate Andalusia, Levant, the Balearic Islands and the valleys of the rivers Douro and Ebro.

But maybe the most important ancient people who arrived to Spain were the Romans. From 218 B.C, it only took them 200 years to control the whole territory of the peninsula and its islands. Most of the cities founded by the Romans are on riversides, to use rivers as a way of communication and transport. Zaragoza (Caesar Augusta), founded by Caesar Augustus on the bank of river Ebro, is a good example.

WATER AND AGRICULTURE

In the past, agriculture was the base of the Spanish economy and water is the most important factor to develop fertile lands. Nowadays, agriculture is already important and water continues being essential. Throughout history, agriculture and the way of supplying water for cultivating lands have progressed. In the prehistoric times, rain water was the main source for growing plants. The Romans created new systems for storing and driinge water: aqueducts were a good example (*photo: Aqueduct of Segovia*)

In The Middle Ages, especially during the Muslim period, the fields used for farming were highly exploited as well as technologies were simultaneously improved with ditchs, treadmills and cisterns.

In the 18th century agriculture evolved a lot, since it turned more scientific. In Spain the improvements in crops began and there were new varieties of plants. There were also improvements in the traditional tools as the plough, and new machines like rippers and threshers appeared. Nowadays, the introduction of machinery makes the work of cultivating and watering plants simpler. In Spain one can water on wheels, aspersion or drip, the latter being a technique that allows us to save larger amounts of water.

WATER AND TRADE

Trade in Spain has always been very important and it has been carried out thanks to the water networks: rivers, oceans and seas. Inner trade in Spain could be developed thanks to water. The roads were hilly and they had many obstacles, so rivers were the main mode of transport.

The outside trade has also been very important in Spain. Surrounded by water (south of the Mediterranean Sea in the west, the Atlantic Ocean in the East, and the Bay of Biscay in the North), Spain has traded a lot with Mediterranean Europe and other continents such as Africa or America.

WATER AND INDUSTRY

Water is an important resource for industrial activities. Its use has changed along time, reducing its former use as a primary power source (windmills and turbines.) Nowadays, it is crucial for industrial development because it has been used as a reactor or as a thermal regulator in boilers and cooling towers.

Each industry requires, according to its characteristics, an appropriate use of water. The industry uses water primarily as:

a) a raw material.

b) a route for transport.

c) a heat transfer element. We need it in heating and cooling processes.

d) industrial waste container. Water is the most common transport vehicle for waste and discharge.

e) a source of energy. Spain has a high hydroelectric potential developed over time. At present, we have a very effective hydroelectric generating system. Within all the renewable sources of energy we work, the hydroelectric energy is the technology higher consolidated and more mature, thanks to the orography and the large number of dams. In total, in Spain there is a total capacity of reservoirs of 55.00hm3 and the 40% are hydroelectric reservoirs, one of the highest proportions in Europe and in the world.

Water wheat mill "San Antonio" built in 1852
Medina de Rioseco (Valladolid)

WATER AND ENVIRONMENT

Water is a necessary element for life; without water the animals, the plants and the humans could not live. Our ecosystem, our society and our economy need fresh water to survive.

The environmental pollution is one of the problems in Spain. Water pollution is a modification of this source of life, usually caused by humans, that becomes dangerous to humans, to fishing, to industry, to agriculture and many other activities. It can be caused by natural disasters or from human activities. At present the most important is caused by people. Development and industrialization use large amount of water and they generate a lot of waste that is connected to the rivers. The use of fluvial or maritime means of transport also pollutes water.

In Spain there are a lot of natural water reserves like rivers and lakes and there are artificial water reserves too, like dams and reservoirs. Nowadays most of them are protected in order to preserve their particular flora and fauna.

Las Tablas de Daimiel National Park (Ciudad Real)

Gallocanta Lagoon (Zaragoza)

WATER IN LEISURE AND ART

Art has been the way in which communities and cultures express their experiences, traditions, beliefs, feelings and emotions. For artistic creation we use many techniques and tools, like water. Throughout history water has been an important source of inspiration for many artists. Painters, sculptors and filmmakers have made universal works related to water. For example, in painting we highlight Joaquín Sorolla´s works, reflecting the light and the atmosphere of the Mediterranean coast. In the cinema we highlight the film “Lo imposible” by Juan Antonio Bayona.

Valencia beach in the morning light - Joaquín Sorolla

On the other hand, architects have also been interested in water. They have built fountains as La Cibeles in Madrid or the Lions´ fountain in Granada and many other structures like Segovia´s aqueduct or architectural spaces like "Jameos del Agua" in Lanzarote.

Apart from transmiting pleasant feelings, the turbid, polluted or dark water also transmit feelings of sadness, agony and despair. We can see it in many musical plays and poems.

Nuestras vidas son los ríos
que van a dar en la mar,
que es el morir;
allí van los señoríos
derechos a se acabar
y consumir

allí los ríos caudales,
allí los otros medianos
y más chicos,
y llegados, son iguales
los que viven por sus manos
y los ricos.

(Our lives are fated as the rivers
that gather downward to the sea
we know as Death;
and thither every flood delivers
the pride and pomp of seigniory
that forfeiteth;

Thither, the rivers in their splendor;
thither, the streams of modest worth,—
the rills beside them;
till there all equal they surrender;
and so with those who toil on earth,
and those who guide them.

Jorge Manrique, *Coplas a la muerte de su padre (XV century)*

Water is also important in many leisure activities, for example, in water sports, spas or water parks. People value the quality of the environment, the beautiful landscapes and the quality of the water when they decide where to enjoy their free time.

In Spain this is very important because Spain is a very tourist country for its beaches. Hundreds of visitors come every year to enjoy them. We have beaches for any kind of visitors: the wild, rocky beaches of the Cantabric coast in the North, the sandy long Mediterranean beaches of Andalucia, the crystal clear small beaches of Balearic Islands or the black sand volcanic beaches of the Canay Islands.

Cala Morell, Menorca

I.7.5. The Role of Water in the French Space

Waterways, canals and navigation in France

From their early days, the French have used streams and rivers to have access to areas hard to reach. However the different seasons made it difficult. Therefore, new waterways had to be implemented. The consequences were numerous: it helped irrigation in the fields and cleaned up swampy lands. This is the reason why the first canals were digged in France.

As soon as the sixteenth century, Adam de Craponne suggested a connection between:

- The Mediterranean Sea
- The River Loire and the River Seine.

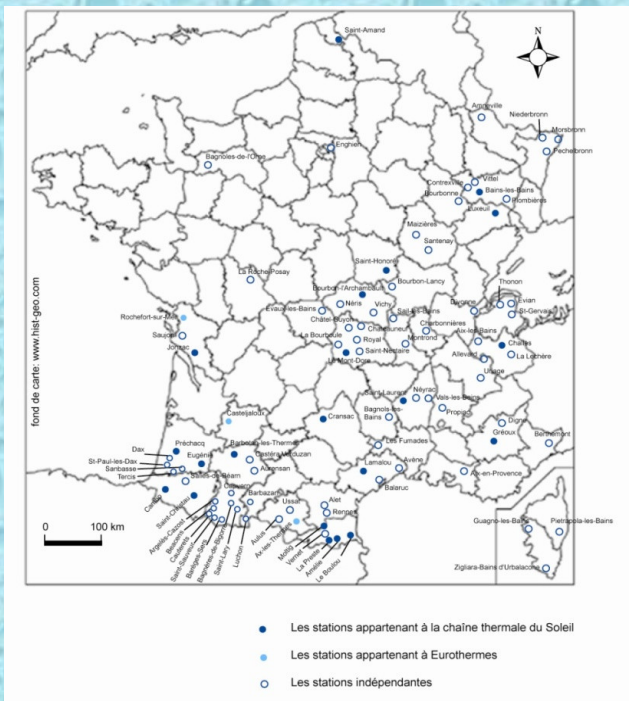
Beginning of the canal du Midi

Beginning of the Canal de Briere

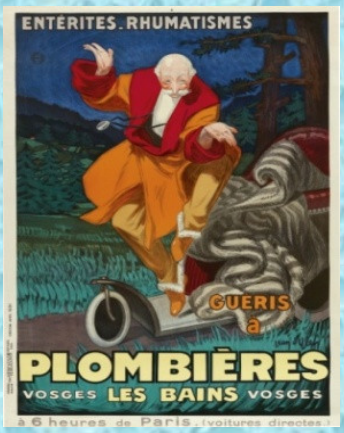
The constructions of these canals helped solve two important problems: the construction of floodgates and the water distribution from the watershed. A floodgate is like a step in a stairway: it helps the canal to pass the difference in levels. It is thus easy to join two rivers stepping over a hill, for instance.

Thermal baths resorts in France

Nowadays with its 108 thermal baths resorts, France is ranked the third place in Europe. Many thermal bath resorts have been built near very ancient Roman baths: there used to be Roman baths in cities such as Néris-les-Bains, Luxeuil-les-Bains, Bourbonne-les-Bains, or Aix-les-Bains.



Map of the thermal health resorts in France



At the origin, the thermal baths used the mineral sources that had therapeutic properties. The water was used as a medicine.

Each health resort had a specific property and it helped relieve some illnesses.

Thermal water is not only used through baths and showers, it is also inhaled and drunk.

As early as 1605, Henry IV implemented an actual organization of thermals. There was a medical supervision of the springs and this idea has been reinforced in the following centuries

At the same moment, these thermal resorts have become marvellous holiday's destinations: they offered to the persons having hydrotherapy the best care and entertainment at the same time. The first places offered walkways because walking in the open air were part of the therapy. In 1806 casinos were allowed by Emperor Napoleon 1st during the thermal season.

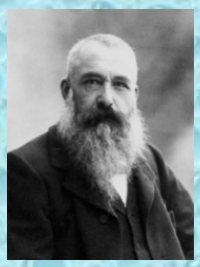
Art: painting

In the 19th century in Paris, France, a group of artists created the movement called the Impressionism. Its founding members were Claude Monet, Edgar Degas

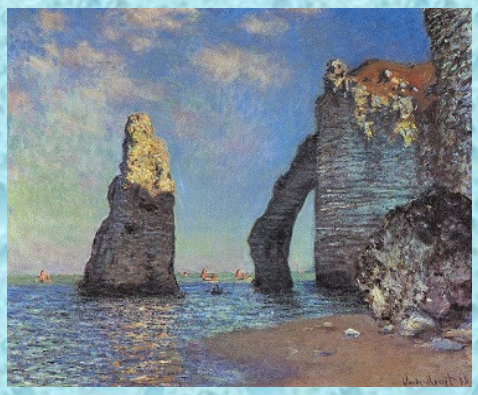
and Camille Pissarro among others. Although they had been much criticized in the beginning – they were rejecting the established styles- exhibitions were organized and they grew popular from 1874 to 1886.

These impressionists had their inspiration in suburban and rural Paris, or the daily life of local villagers. Some preferred to depict the vacationers' rural pastimes. The boating and bathing establishments that flourished in the outskirts of Paris became favorite motives. It is their personal emotion and sensitivity that nourish their vision. Their paintings were quite innovative.

For instance, two major painters had a special view as regards water: we can notice Claude Monet who – in his lovely house near Paris called Giverny- chose to paint the little river in his garden at different times of the day:



Claude Monet
(1840-1926)



The Cliffs at Etretat, 1885

Water lilies and Japanese bridge,1897-1899

Gustave Caillebotte (1848-1894) – who was an accomplished sailor - had a more realistic way to paint compared to his painters friends. He depicted the Parisian lifestyle in water scenes.

Gustave Caillebotte
(1848-1894)

Paris street, on a rainy day, 1877

Les Périssoires,1878

1.7.6. Bulgarian Traditions and Water

Republic of Bulgaria has a very important location. Its territory is situated in the middle of the Balkan Peninsula. The crossroad location defines the country as The Danube's, Black Sea's coast country, rich in water – rivers, lakes and mineral springs. Water is a very important factor for the settlement, population development and economical future of Bulgarians. During lifetime water is an indivisible part of the Bulgarian traditions, culture, poetry and real life.

Most of the Bulgarian traditions are related to the power of water – starting with one's birth. The old females go to church and pray for a holy water, explaining that it is for a newborn. The priest should say the so-called "Babina molitva" (grandmother's prayer) over the water and give her a candle. The day when the baby and his/her mother leave the hospital and go back home, the grandmother sprinkles the holy water around the house and lights the candle from the church.

There are many traditions related to health. Epiphany /06.01/ - this festival has different names in different regions of the country, some of them are Cross, Voditsi or Vodokrashti. The holiday is so called because on that day anyone the one who wants to be healthy during the year have to take a bath in the river or at least wash himself / herself with river water. On this day, wherever there is water – river, sea or lake a ritual of throwing the cross of the local church is carried out. The men's traditional dance in the icy water called "Male horo" is also performed. And when the cross is taken out of the water, there is a liturgy called The Great Ceremony.

During the year water appears in other rituals. Midsummer day - it is believed that before "going to winter" the sun bathes in a water source and makes water healthy. Then the sun shakes and the dew that falls has special magical power. Therefore, everyone should be washed before sunrise in

running water or dew to be healthy during the year.

There is a belief that before starting a new activity, some water must be poured on your way, after that you step on it.

Bulgarians have a long and tough history. In many legends water is the symbol of escape. The most popular story tells how 40 girls with plaited hairs and entwined arms, jumped into the Black sea to avoid falling into Ottoman hands. Today, an obelisk called ’The gate of the 40 maidens’ is erected at the entrance of the Kaliakra Cape.

Mineral water are important for the development of the country nowadays. They had great importance during the Roman Empire period. Many of the emperors had villas near the hot springs. For example, villa Armira - it was an impressive construction. Spread on an area of 3600 sq.m, located in a wonderful garden for walks, it was a massive two-storey residential building with a panoramic terrace and a number of premises on two floors, surrounding an enormous open swimming pool, with sizes 11/7 m. It was surrounded by a wonderful fence-balustrade from marble lattices and Herms little columns with human heads above them. Around the residential pool there was a colonnade in Roman-Corinthian style, with friezes with gorgeous relief ornaments. This antique ensemble, a sample of the Roman architecture on a European scale, existed from 50-70 after Christ to 378 after Christ, when it was destroyed by the Goths. The largest in quantity and variety mosaic find in Bulgaria has been discovered in the villa. Especially precious are the mosaics of the master's bedroom, where in the northern side there is a portrait of the owner with his two children, painted the first half of the second century.

Those are the only mosaic portraits from the Roman Ages discovered in the country. On the whole floor, mosaics are with richly combined geometrical, plant, zoomorphic and anthropomorphic motives. Marble was richly used for the ornamentation of the mosaics, in the decoration of the pool and the colonnade

around it. In 2009 the country agency was honored with a gold medal "Armira" for successful tourist's goal that had roared upon tourism.

Public baths existed in Sofia at least as early as the 16th century. During his visit to Sofia in 1553–1555, Bohemian traveller Hans Dernschwam noted the presence of 1 large bath and 2 smaller baths on either side of the city. Dernschwam described the baths as follows: “The baths are located on the square; there is a big quadrangular building in front by the entrance, with a round Greek-style dome on top, like the Pantheon in Rome. It is richly covered in white marble. The big water conduits that lead the water into the baths are made of potter's clay. Each tube is approximately one Viennese cubit long and the separate tubes go through each other. They are plastered up like I have seen in Siebenbürgen (Transylvania) too, in old buildings in Thorenburg (Turda).

The Central Mineral Baths are a landmark in the center of Sofia, the capital of Bulgaria, a city known for the mineral springs in the area. It was built in the early 20th century near the former Turkish bath (then destroyed) and was used as the city's public baths until 1986.

Bulgarian territory has been populated from the ancient times. The first settlements were founded near river banks. Many of the archeologists say that the oldest living place in Europe is Plovdiv. This beautiful, big city is located along the Maritsa River. During the centuries, Maritsa has an important role in the city development. Its source is in the mountain Rila, drains the Upper Trackian Valley and then, leaving the Bulgarian territory this river separates Greece and Turkey. Together, with the rich soils and mild climate along the river, agriculture is the main occupation of the population. Nowadays, the river is an important factor for the industry in this area. There are many factories that need water for working processes – electricity producing, metallurgy, food and beverage industry, etc.

Crossing the city, the river is a place for relaxation, sport and walking.

The Danube River is very important for Bulgaria. It is the Bulgarian north border. But this river is not only a border – it is a bridge between the European countries. Most of the villages and the cities along the river Danube appeared before the Roman Empire. Vidin is the most significant city and the closest point to Europe. It is a center of agriculture and chemical industry and also an important transport center. There are two European transport corridors and an important bridge between Bulgaria and Romania. Vidin is a tourist center, too, with its fortress Baba Vida.

The Danube is also important for the development of the cities Rouse and Silistra. Rouse is an old Roman city. It appeared as Sexaginta Prista – the port of the sixty boats. During the Ottoman Empire period Rouse was the biggest transport and trade center. After the liberation, Rouse was called the Little Vienna because of the beautiful buildings in European style.

The Black sea – our eastern border and the gate to the whole world! The Black Sea, being the only sea that gives Bulgaria a littoral access, is of primordial importance for the country. Down in, the importance of the Sea will be considered in details, but not as a water basin with all the sea resources it gives to the country, but from its perspective as a uniting point for the countries that surround it, being the milestone of a region that offers many opportunities, challenges and threats which differ according to the political agility of how the region is seen and considered. The region is an important center of tourism during the summer season (May–October), drawing millions of foreign and local tourists alike and constituting one of the country's most popular tourist destinations.

Water is everywhere around us. Water is our life and we cannot live without water. Water is an inspiration.

Chapter II

THE ROLE OF WATER NOWADAYS

INTRODUCTION

The second chapter of our book refers to the using of water nowadays in different aspects of our lives. The chapter shows that water is not only an important part of our everyday lives but it can also provide a lot of pleasure and fun.

The first unit presents a large number of sports involving water which are popular in France, Romania, Bulgaria, Greece and The Czech Republic, for example: swimming, water polo, rowing, diving, water skiing, surfing, sailing, skiing, biatlon, snowboarding, bobsleighing, skating, ice hockey, etc.

The second unit talks about tourism. Water and tourism are closely related. The first types of water tourism were thermal spas, cruises and seaside visits. Nowadays tourists still visit the wonderful beaches, take cruises and go to spa resorts. Many people are keen on water sports. In this unit we delineate important and famous places connected with water tourism in our countries.

The third unit describes how water influences and inspires artists. Water themes in art are the most attractive aspects if we refer to literature, sculptures, paintings, music, film, architecture or the others. In this part we can find examples of great masterpieces which draw inspiration from water. It lasts from ancient times to nowadays.

The fourth unit refers to the role of water in transport. We make a list of the biggest ports and navigable rivers. Water is often a political issue, too. The modern need of the increasing population across the world renders the issue of water management as crucial as ever. The last part of the unit talks about water political issues around the world.

The fifth unit explains using water in agriculture. Food and agriculture are the largest consumers of water followed by domestic application and industry. We describe the methods of irrigations and different types of pumps. Industry takes about 20 % of the water use in the world. This unit gives the description of different industrial sources and their need of water. At the end of this unit we

explain the advantages and disadvantages of electricity generating technologies as hydro-power or nuclear power. It is because industry, energy and water are linked, too.

The last unit gets us to know some detail information about new sources of energy. For example the ocean thermal energy, wave power, hydroelectric energy, osmotic power, desalination of seawater, recovering dew, smart irrigation or lagooning.

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Základní škola a mateřská škola Brno
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Czech Republic

II.1 Sport and Leisure Time

There are a large number of sports that involve water. Here we present the most popular in the countries involved in the project.

Swimming

The recreational activity of swimming has been recorded since prehistoric times. Although humans have been swimming for thousands of years, swimming only became a competitive sport in the early 1800s. Today, swimming is the third most-watched sport in the Olympic Games. In 1828, the first indoor swimming pool, St George's Baths was opened to the public. Competitive swimming became popular in the nineteenth century. Swimming is an event at the Summer Olympic Games, where male and female athletes compete in 16 of the recognized events each. Olympic events are held in a 50-meter pool, called a long course pool. In competitive swimming, four major styles have been established:

- Butterfly (fly)
- Backstroke (back)
- Breaststroke (breast)
- Freestyle (free)

In open water swimming, where the events are swum in a body of open water (lake or sea), there are also 5 km, 10 km and 25 km events for men and women.

Synchronized Swimming

It is a hybrid form of swimming, dance and gymnastics, consisting of swimmers (either solos, duets, trios, combos, or teams) performing a synchronized routine of elaborate moves in the water, accompanied by music.

Competitors show off their strength, flexibility, and aerobic endurance required to performing difficult routines. Swimmers perform two routines for the judges, one technical and one free, as well as age group routines and figures. The

origin - in 1933 & 1934, Katherine Whitney Curtis organized a show, "The Kay Curtis Modern Mermaids", for the World Exhibition in Chicago.

Water Polo

The history of water polo as a team sport began as a demonstration of strength and swimming skill in late 19th century England and Scotland, where water sports and racing exhibitions were a feature of county fairs and festivals. Men's water polo was among the first team sports introduced at the modern Olympic Games in 1900. Water polo is now popular in many countries around the world, notably Europe (particularly in Serbia, Russia, Croatia, Italy, Montenegro, Greece and Hungary), the United States, Canada and Australia.

The present-day game involves teams of seven players (plus up to six substitutes), with a water polo ball similar in size to a soccer ball but constructed of waterproof nylon. There are seven players from each team (six field players and a goalkeeper) are allowed in the playing area of the pool during game play. The two opposing teams must wear caps which contrast: with both (or either) goalkeeper cap color, with the other team's cap color and with the ball color.

The layout of a water polo pool showing the 2m and 5m markings (red and yellow), the half-way line (marked in white), a goal at either end and the length and width of the pool. Minimum water depth must be at least 1.8 meters (6 feet). The goals are 3 meters wide and 90 centimeters high. Water polo balls are generally yellow and of varying size and weight for juniors, women and men. The middle of the pool is designated by a white line. Before 2005, the pool was divided by 7 and 4 meter lines (distance out from the goal line).

Rowing

It is a sport with origins back to Ancient Egyptian times. It is based on propelling a boat (racing shell) on water using oars. By pushing against the water with an oar, a force is generated to move the boat. Modern rowing as a competitive sport can be traced to the early 18th century when races were held between professional watermen on the River Thames in London, United Kingdom. Rowing is one of the oldest Olympic sports and has been competed since 1900. Women's rowing was added to the Olympic programme in 1976. There are two forms of rowing:

- **In sweep** or sweep-oar rowing - each rower has one oar, held with both hands. This is generally done in pairs, fours, and eights.
- **In sculling** each rower has two oars (or sculls), one in each hand.

Diving

Diving is the sport of jumping or falling into water from a platform or springboard, sometimes while performing acrobatics. Diving is an internationally recognized sport that is a part of the Olympic Games. Although diving has been a popular pastime across the world since ancient times, the first modern diving competitions were held in England in the 1880s. Plain diving was first introduced into the Olympics at the 1904 event. The 1908 Olympics in London added 'fancy diving' and introduced elastic boards rather than fixed platforms. Most diving competitions consist of three disciplines: 1 m and 3 m springboards, and the platform. Synchronized diving was adopted as an Olympic sport in 2000. Two divers form a team and perform dives simultaneously.

Water Ski

Water skiing is a sport which you are towed by a motorboat while you are sliding on

one or two skis. Water skiing came about on June 28th 1922 when eighteen-year-old Ralph Samuelson, proposed the idea that if you could ski on snow, then you could ski on water. Ralph first attempted water skiing on Lake Pepin in Lake City, Minnesota, towed by his brother Ben. The competitions are in three groups: slalom, jumps, tricks. In slalom you use only one ski and you have to go round zigzagged between 25 buoys.

In the discipline jumps after you reinforce you should jump from the ramp and try to make as long as you can distance before falling down. And the last discipline is the tricks. This discipline includes driving on only one led while you are holding the rope with one arm. The newly record for water skiing on hands was set by an Englishman Wayne Kerals on September 1, 2013. He has passed nearly one kilometer /900.99 m/ on the lake Petersbarg in Illinois.

Surfing

Surfing is one of the most popular and extreme sports in the world. It is a blend of total athleticism and the comprehension of the beauty and the power of the nature. For centuries, surfing was a central part of ancient Polynesian culture. Surfing is also one of the few sports that create its own culture and lifestyle. This sport includes several things that are important.

The first one is that you need a board, the second is that you must be very concentrated and the third is that you should be trained for this type of sport, because it is too dangerous to practice it.

Three major subdivisions within standing-up surfing are long boarding, short boarding, and stand up paddle surfing, and these three have several major differences, including the board design and length, the riding style, and the kind of wave that is ridden.

Sailing

Sailing is a technique for moving the wind with sailing ship, sailing yacht, sailing boat, windsurf or kitesurf on water, sailing away on land or sailing sled on ice. Sailing is considered a sport. Sailing is a sport in all developed countries, such competitions are held in different classes popular in regions of the globe. The movement of the wind is not just water, there boats there Ice boat (on ice), there are wheels on sand or other flat surfaces.

Sailboat racing generally fits into one of two categories:

- **Class** - where all the boats are substantially similar, and the first boat to finish wins.
- **Handicap** - where boats of different types sail against each other and are scored based on their handicaps which are calculated either before the start or after the finish. The two most common handicap systems are the IRC and the Portsmouth Yardstick, while the Performance Handicap Racing Fleet (PHRF) is very common in the U.S.A.

DURING THE WINTER WE PRACTISE WATER SPORTS TOO – BUT USING THE OTHER TYPE OF THE WATER - THE **SNOW!**

Skiing

Skiing is a recreational activity and competitive winter sport in which the participant uses skis to glide on snow. Many types of competitive skiing events are recognized by the International Olympic Committee and the International Ski Federation. There are several types of skiing:

Nordic skiing - The Nordic disciplines include cross-country skiing and ski jumping, which have in common the use of bindings that attach to the toes of the skier's boots but not to the heels. Cross-country skiing may be practised on groomed trails or in undeveloped backcountry areas.

Alpine - Also called downhill skiing, alpine skiing typically takes place on a piste at a ski resort. It is characterized by fixed-heel bindings that attach at both the toe and the heel of the skier's boot. Because it is difficult to walk in alpine

equipment, ski lifts including chairlifts bring skiiers up the slope. Backcountry skiing can be accessed by helicopter or snowcat. Facilities at resorts can include night skiing, après-ski, and glade skiing under the supervision of the ski patrol and the ski school. Alpine skiing branched off from the older Nordic skiing around the 1920s, when the advent of ski lifts meant that it was not necessary to walk any longer. Alpine equipment specialized to where it can only be used with the help of lifts.

Telemark - Telemark skiing is a ski turning technique and FIS-sanctioned discipline. It is named after the Telemark region of Norway. It refers to using equipment similar to Nordic skiing, the ski bindings having the ski boot attached only to the toe. Alexis Pinturault is a French World Cup alpine ski racer and Olympic medalist.

Biatlon

Ekaterina Dafovska

The biathlon was born in the XIX century in Norway. It spread fast in other Scandinavian countries, after that in central Europe – Czech, Poland, Russia, Germany and etc. The first competition, registered on a paper was organized in 1767, near the Norway and Sweden border.

In the beginning of 21st century 56 countries became members in IBU. Over 31 counties participated in the World Cup and over 40 countries participated in the World Primacy and the Olympic games.

Right now in the Biathlon there are 7 disciplines:

- Individual start
- Relay
- Sprint
- Mass start
- Chase
- Team race
- Mixed relay

Snowboard

As a sport the snowboard is very popular all over the world. It is one of the most dangerous sports because it includes a lot of skills which are important during the snowboarding. It is a winter sport. It is not for everyone. You must practise it for a long time before getting on the board. Bulgaria is suitable for this kind of sport because our areas are mainly with mountains. Every year many tourists are here to celebrate and explore our places for snowboarding, for example: Pamporovo, Vitosha, Bansko and Borovets. They are available for everyone who wants to practice this sport. We have famous Bulgarian snowboarders like: Viktor Jekov, Aleksandra Jekova, Ivan Ranchev and many others who win silver, bronze and gold medals for Bulgaria every year.

This sport lifts you up face to face with your fears and makes you brave and gives you a chance to be above your abilities. When you are on the board you must be careful because the slopes in the mountains are awful and we can get an accident. The bad things happen very quickly. Usually winter sports are very expensive nowadays, but not everyone likes to play football or basketball or other popular sports. Sometimes by changing sports, you can realise that you can find a lot new ways to lose a few kilos and have some fun…

Bobsleigh

Bobsleigh is a winter sport performed in icy chute with special sleds (which have the same name) for two or four players. At the beginning the track is straight, but it gradually turns into ice chute with raised edges of bends. A sled designed for four contestants weighs 630 kg and that for two players 385 kg. Each carriage has four steel skates, the front two of which are controlled by steering wheel.

Times descent are measured to within one thousandth of a second. According to a legend like sport bobsleigh appeared in 1888 in St. Moritz, Switzerland, where English tourists join two skis to slide on snow hill.

Bobsledding is dominated by the British in the early years of development. From 1928 to 1956 dominated by athletes from the US, but by then the European Alpine nations take the championship. The most successful nations in the 21st century are Switzerland and Germany. The Swiss have won more medals in Olympic Games, World and European championships than any other country.

Figure Skating

Figure skating is a sport and activity in which individuals, duos, or groups perform on figure skates on ice. It was the first winter sport included in the Olympics, in 1908. The four Olympic disciplines are men's singles, ladies' singles, pair skating, and ice dancing. Non-Olympic disciplines include synchronized skating and four skating. In senior-level competition, skaters generally perform two programs (short and long) which, depending on the discipline, may include spins, jumps, moves in the field, lifts, throw jumps, death spirals, and other elements or moves.

- **Singles competition for men and women** (who are referred to as "ladies" in ISU rulebooks), where individual skaters perform jumps, spins, step sequences, spirals, and other elements in their programs.
- **Pair skating teams consist of a woman and a man**. Pairs perform elements specific to the discipline such as throw jumps, in which the man 'throws' the woman into a jump; lifts, in which the woman is held above the man's head in one of various grips and positions; pair spins, in which both skaters spin together about a common axis; death spirals; and other elements such as side-by-side jumps and spins in unison.
- **Ice dancing is again for couples consisting of a woman and a man skating together**. Ice dance differs from pairs in focusing on intricate footwork performed in close dance holds, in time with the music. Ice dance lifts must not go above the shoulder.

Famous Bulgarian skaters: Albena Denkova and Maxim Stavisky /at the photo/, Sonia Radeva

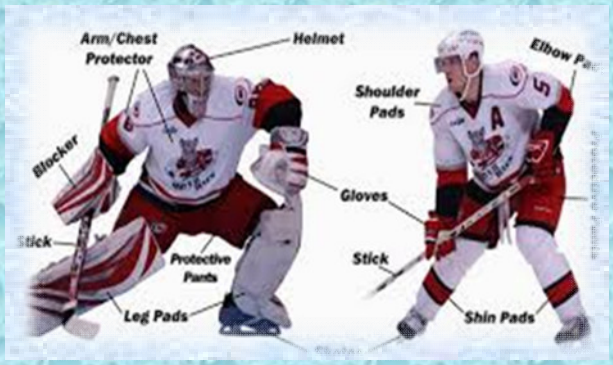
Famous French skaters: Philip Kandeloro

Short Track Speed Skating

Short track speed skating is a form of competitive ice speed skating. In competitions, multiple skaters skate on an oval ice track with a circumference of 111.12 m. The rink itself is 60m by 30m, short track competitions are held either as all-points meets, where skaters are seeded based only on their times for a standard distance (usually the 500m), or an age class, where people are seeded by age and gender.

Ice Hockey

Ice hockey is a contact team sport played on ice, usually a rink, in which two teams of six skaters use their sticks to shoot a vulcanized rubber puck into their opponent's net to score points. Professional hockey has existed since the early 20th century.



By 1902, the Western Pennsylvania Hockey League was the first to employ professionals. The league joined with teams in Michigan and Ontario to form the first fully professional league. The three major rules of play in ice hockey that limit the movement of the puck: “offside”, “icing”, and the puck going out of play. Ice hockey has been played at the Winter Olympics since 1924.

Ice hockey is one of the fastest growing women's sports in the world, with the number of participants increasing 350 percent in the last 10 years.

Water and Leisure Time Surfing

Surfing is a water sport in which you ride forward down the moving wave, which is usually carrying the surfer towards the shore. Waves suitable for surfing

are primarily found in the ocean, but can also be found in lakes or rivers in the form of a standing wave.

For centuries, surfing was a central part of ancient Polynesian culture. One variety of stand-up surfing is paddle surfing. Another prominent form of surfing is body surfing, when a surfer rides a wave on a body board, either lying on their belly, drop knee, or sometimes even standing up on a body board. Famous locations in Europe: Costa da Caparica (Almada, Portugal), Supertubos (Peniche, Portugal), Nazaré (Portugal) and etc.

Scuba Diving

Scuba diving is a form of underwater diving in which a diver uses a self-contained underwater breathing apparatus (scuba) to breathe underwater. Diving under water with air entrapment is known since antiquity. It is used in the collection of shells, pearls, corals and other underwater treasures.

The first diving suits of leather that allow descent to 18 meters were developed in France and England.

Scuba diving and diving may be amateur or professional, but both require preparation, training and license required.

Recreational Fishing

Recreational fishing, also called sport fishing, is fishing for pleasure or competition. The early evolution of fishing as recreation is not clear. For example, there is anecdotal evidence for fly fishing in Japan as early as the ninth century BC. Recreational fishing techniques include hand gathering, spearfishing, netting, angling and trapping. Recreational fishing has conventions, rules, licensing restrictions and laws that limit the way in which fish may be caught. Recreational fishing competitions (tournaments) are a recent innovation in which fishermen

compete for prizes based on the total weight of a given species of fish caught within a predetermined time.

Rafting

Rafting and white water rafting are recreational outdoor activities which use an inflatable raft to navigate a river. The development of this activity as a leisure sport has become popular since the mid-1970s, evolving from individuals paddling 10 feet (3.0 m) rafts with double-bladed paddles to multi-person rafts propelled by single-bladed paddles and steered by a tour guide at the stern. It is considered an extreme sport, and can be fatal. There are two main techniques:

Punching – Rafts carry great momentum, and on rivers hydraulics that are dodged by canoes and kayaks are often punched by rafts. This involves the rafting crew paddling the raft to give it enough speed to push through the hydraulic without getting stopped.

High siding – If a raft is caught in a hydraulic it will often quickly go sideways. In order to stop the raft flipping on its inside edge, the rafters can climb to the side of the raft furthest downstream, which will also be the side of the raft highest in the air leading to its name. In this position the rafters may be able to use the draw stroke to pull the raft out of the head.

Water Aerobics

While similar to land aerobics, in that it focuses on cardiac training, water aerobics differs in that it adds the component of water resistance and buoyancy.

Although heart rate does not increase as much as in land-based aerobics, the heart is working just as hard and underwater exercise actually pumps more blood to the heart. Exercising in the water is not only aerobic, but also strength-training oriented due to the water resistance. Moving your body through the water creates a resistance that will activate muscle groups.

Spa

A spa is a location where mineral-rich spring water (and sometimes sea water) is used to give medicinal baths. The belief in the curative powers of mineral waters goes back to prehistoric times.

Many people around the world believed that bathing in a particular spring, well, or river resulted in physical and spiritual purification. Such practices have been popular worldwide, but are especially widespread in Europe and Japan. The term is derived from the name of the town of Spa, Belgium, whose name is known back to Roman times, when the location was called Aquae Spadanae.

II.2. Water and Tourism

Water and tourism are two words closely related because tourism is really important for the economy in a country. Tourism without water is not possible.

GLOBAL DAY OF TOURISM AND WATER

To understand the importance of tourism and water we have to travel in time to the 27th September 2013 (World Tourism Day). On this important date everybody talked about the importance of water and tourism. The slogan of this important date was "Tourism and Water: Protecting Our Common Future". At the same time, in the International Year of Cooperation in the Water Sphere, different agents asked to try to protect water more.

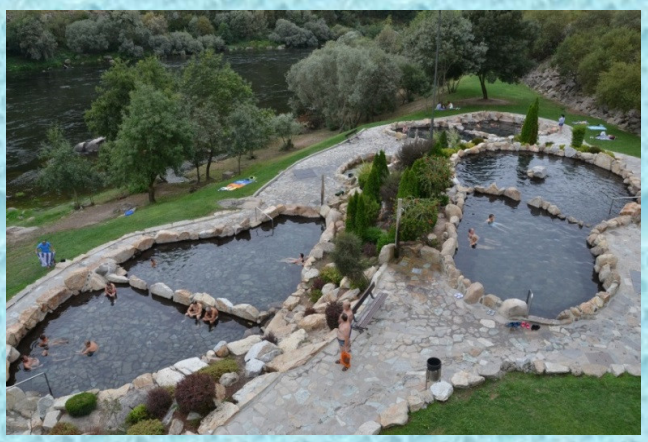
Why Is Water Attractive?

We have always been attracted to water, maybe because of the idea of being able to enclose in a pool something as uncontrollable as water; or maybe because of the simple fact of living on the blue planet.

With water you can do different activities which everybody likes. To do these activities we go to a lot of beaches or swimming pools, which are, maybe, the most visited places in summer. It is healthy to practise some water sports like swimming (it is nice for the back) or another water sports like waterpolo, surfing underwater exploration… (Snorkeling / scuba diving).

First Types of Tourism Related to Water

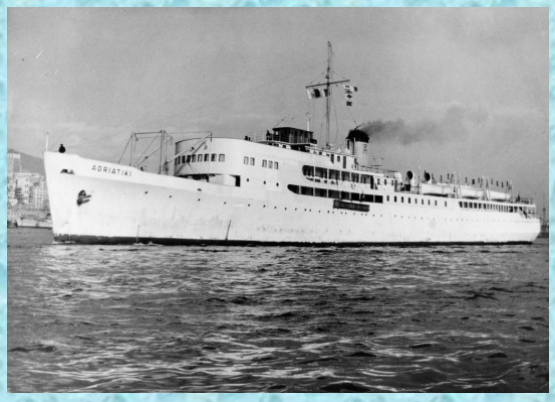
Water was more usually used to treat diseases and not to enjoy. People preferred health tourism. For example, in the thermal spas and the thalassotherapy centres in Galicia (Spain) they use water for treatment; they offer specific methods to cure different diseases.



Natural hot baths in Galicia.

Swimming in the sea is another common activity which most of people like.

Cruises as a way to enjoy your holidays started in 1835 when the newspaper "Shetland Journal" published an advert to travel to visit Scotland, Iceland, and the Faeroe Islands on a boat. The *Peninsular Navigation Company* was created at that time, later it was named P&O, and the famous "Cunard Line", which was created in 1840 by Samuel Cunnard.

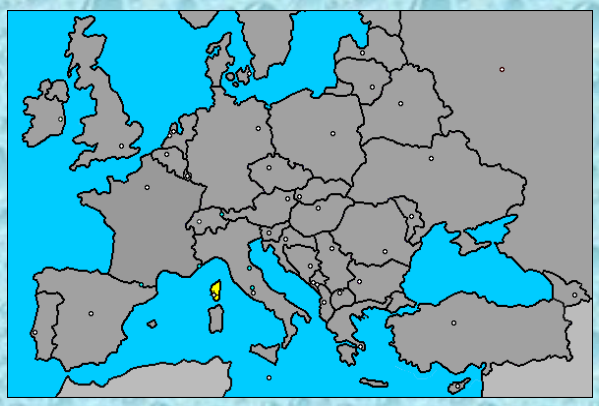


In these years cruises were not really important for tourism. The ships built at that time were used to transport people between Europe and America. When the planes appeared a lot of ships were adapted to become cruises and other boats had to be destroyed because the “liners” divided people in some classes and hosted them in different types of cabins. The cheaper cabins were a “bedroom” and the traveller had to share it with other 28 people. This type of cabin was not appropriate for the new travellers and the changes were really expensive. There were other ships which did not have a bathroom in the cabins and they had common bathrooms. These ships were soon remodelled to give the travellers more privacy. Today we have got about 280 companies which offer sea or river cruises with more than 30.000 cruises to 2.000 destinies.

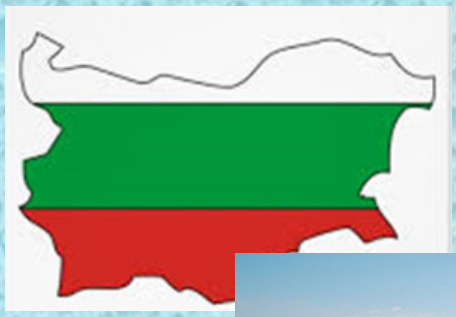
WATER AND TOURISM NOWADAYS

Tourism for Sun and Beach

In a list of the best beaches of the world made by the magazine “National Geographic” we can find the beach Palombaggia in Corsica (France).



There are cities with big beaches like Tsarevo (in the south part of the Black Sea). In the Natural Park of Strandzhawe we can find some interesting routes and in them, tourists can learn about the history of the animals and plants of the area. The rivers around Tsarevo are full of fish and it is really common to see fishers on bridges or on the banks of the rivers.



Cruisers

The Norwegian "Escape" is the biggest boat of the Norwegian Cruise Lines fleet. Its most popular route is the route of the West Caribbean. This route starts in Miami.

Aquatic Parks

A really cool aquatic park is the "Wet'n Wild Water World" in Australia. It has got some water-slides which are 12 meters high and you slide at 60 km/h.

Water sports and adventure sports:

The most important of these sports is swimming. Michael Phelps is one of the best swimmers in history. Another important sport is kayaking; that you can practice it in the sea or in a river.

A sport, which is highly practised and everybody knows, is surfing.

Water is not only in liquid state so we find water in solid state when we are practising skiing or snowboarding.

Water and Health

Now we like the healthy tourism more, going to spas and enjoying the tranquility of the water…

We love spa cities like, for example, Karlovy Vary (to the west of Prague), which are cities full of history. Karlovy Vary is a little city and a historical and tourist zone near a river where we find the thermal sources at a temperature of 72° C.

Deltas

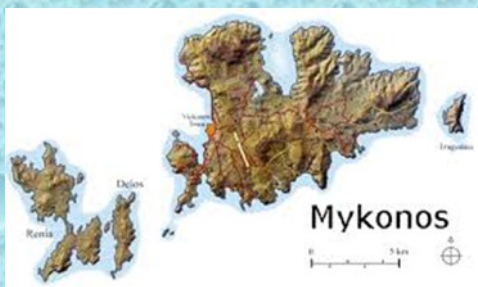
The Danube Delta is in Romania and it has a wild ecosystem, unique in Europe. The zone has been declared a biosphere reserve by UNESCO.

Islands

We find islands in cities like for example Île de la Cité in theSeine, (Paris). Notre-Dame cathedral one of the biggest cathedrals in Europe is in the southeast of the island.

The islands are famous for their beaches and for being great places for relaxing and having fun. Mykonos, in Greece, is a clear example. It is a little island, but very famous around the world for its beaches and funny time.

Near Mykonos we can find Santorini, one of the most visited islands in Greece, but on its deep blue seas we can also find the big islands of Crete, Rhodes or Zakynthos, near Pyrgos.

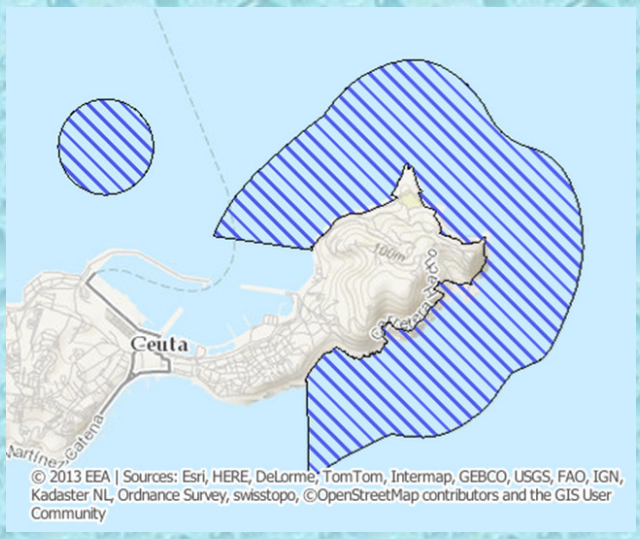


Economic and Social Effects on the Development of Water Tourism

This kind of tourism is related to water, creates a lot of jobs and money because many people want to relax and have a good time near water. Also, there are cities which have grown thanks to their beaches, for example Benidorm in Spain. The main problem of tourist towns is that they are full of tourists and they are not very good places to live in.

The Need to Protect Natural Spaces

In Spain there are many protected places. The Maritime Zone of Monte Hacho is one of them.



It is important to protect places to ensure the biodiversity of the planet. In the future, if we don't protect places we will destroy species.

WATER TOURISM AND TRANSPORT IN SPAIN

Tourism

Water in Spain is very important because it is a very important source of economic development, since our country is a peninsula, which means that it is practically surrounded by water.

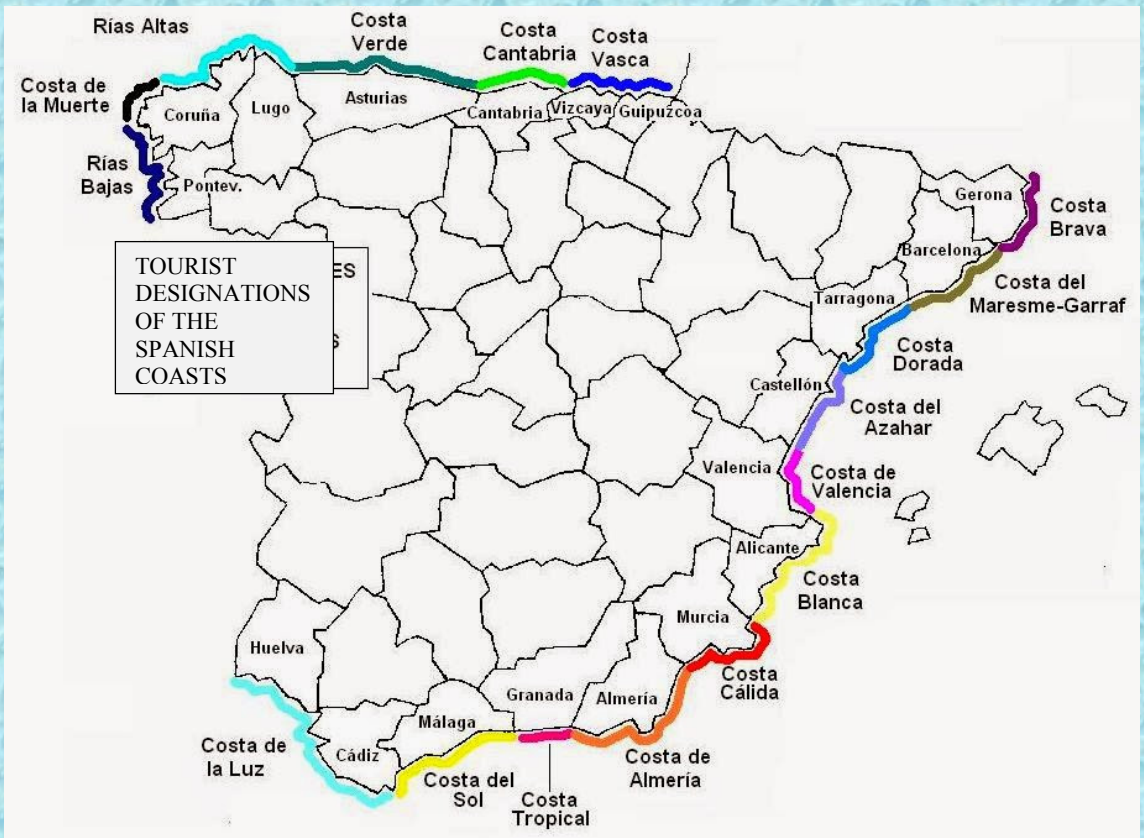
It has about 800km of coast you can choose and there is good weather which attracts foreigners.

Tourism Impacts

Favorable economics	Unfavorable economics
- Creation of employment. - Compensates the Spanish balance of payment deficits. - The arrival of tourists forces to create infrastructures that generally stimulate the economy. - Creates multiplier effects (estate sector, for example). - Stimulates local developments.	-Tourism pulls prices and generates inflation. This is especially noticeable in the hotel and catering sectors. - Seasonality is a drawback for companies and for employment (this last, precarious and seasonal). However, tourist offers for the elderly and other solutions associated with the timeshare (or system of use of apartments) are making seasonality decrease. - Major operators are foreigners and a good part of the business is taken to their countries of origin. - The prevailing model of tourism generates territorial imbalances: 85% of the tourists choose the Islands or the Mediterranean coast as destination.
Favorable demographics	Unfavorable demographics
- At touristic places the active population grows and its population is rejuvenated. - The migration rate is positive.	- Many people see the mass immigration in the tourist places as an inconvenient.
Favorable socio-cultural	Unfavorable socio-cultural
- In the tourist areas it is promoted the exchange of behaviors, habits and ideas, stimulating intercultural respect and tolerance, as well as the learning of languages. Paradoxically, the arrival of tourists may lead to over-nationalism.	- There could be a danger of acculturation (loss of identity in the benefit of the foreign).
Favorable ecologic	Unfavorable ecologic
- It can help to preserve our natural	- Conflicts over land uses: favor the

resources and rehabilitate the historic centers of cities with historic-artistic interest. - The idea of a sustainable tourism has considerably grown.	tourist settlement against the agricultural use of lands. - Alteration of the landscape: massive developments on the beach front with the consequent environmental impact. - Uncontrolled waste discharges. - Waste of water and energy resources. - Noise pollution (mega clubs, which are the night alternative to the daytime beach).

Outstanding Coastal Vacation Areas



Maritime Transport

Between all types of transport the maritime one represents a 0,4% passenger and a 10,8% of freight transport.

The costs of sea-freight transport are not very high (massive merchandise or large volume containers); however, trade is usually made by foreign companies.

All the boats that have to go towards the Mediterranean Sea or go out to the Atlantic Ocean have to go through the Strait of Gibraltar.

Maritime transport has as an advantage that it is the one with more carrying capacity to be transported. But its inconvenient is that it is very slow.

Spain ports

Ports for passenger traffic

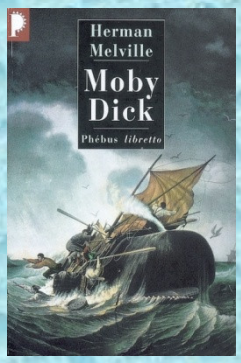
- Routes connecting Africa with Europe: Algeciras, Ceuta and Melilla.
- Tourist traffic: Balearic and Canary Islands.
- Tourism: Barcelona and others.

Ports for merchandise traffic

- Liquid merchandise: Algeciras, Bilbao, Tarragona, Sta. Cruz de Tenerife, La Coruña, Malaga, Cartagena, Huelva and Castellón.
- Coal and minerals: Gijón, Tarragona, Ferrol, Huelva.
- General merchandise (containers): Algeciras, Barcelona, Valencia, Las Palmas and Bilbao.

II.3. Water in Art

A theme is the central idea explored by an artistic work. John Gardner puts it this way: "By theme here we mean not a message - a word no good artist likes applied to his work - but the general subject". From ancient times, in Western culture and worldwide, nature has been an enduring theme in the arts. Water themes in art are the most attractive aspects if we refer to literature, plastic domain or others. In ancient and modern art, water was often represented by stylized curvilinear forms, such as the spiral (as evidenced by the Minoans of Crete) or a horizontal zigzag (as found in the art of ancient Egypt). In the famed eleventh-century Bayeux Tapestry, the English Channel is represented by embroidered wavy black lines. Distinctive indigenous art components include "Oceanic Arts", that is, the visual arts of the southern and northwestern Pacific Islands.



Rivers, lakes, and seas were once the great highways of the world, and much art shows water as a backdrop to everyday life. Royal barges are painted on the walls of Egyptian tombs dating to 1360 B.C. Ships and ports appear on medieval manuscripts and Renaissance frescoes. The brilliant Renaissance painter, sculptor, and inventor Leonardo da Vinci (1452–1519) was fascinated by water, which he described as "vetturale di natura" (the vehicle of nature). He drew it in detail, studied it closely, was in awe of its power (he had witnessed terrible floods and storms), and designed complex canal systems and locks.

II.3.1. Water in Literature

Literature is the grand repository of our dreams and desires and fears, of our longing for meaning and justice and redemption, of our yearning for intimacy and community and solitude, of our unquenchable pursuit of beauty. The great aim of literature is to render in words the nobility and majesty of life. That images of water should play such a prominent and recurrent role as a metaphor in literature is hardly surprising, given the essential place of water in life itself. Western literature was launched upon the waters. *The Odyssey* (together with *The Iliad*, epic Greek poems attributed to Homer, 7thcentury B.C.) details the hero Odysseus's perilous 10-year return across the sea from Troy. Centuries later, arguably the first

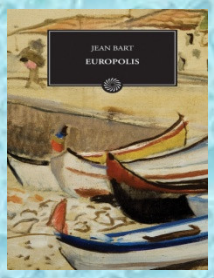
English novel, Daniel Defoe's *Life and Strange Surprising Adventures of Robinson Crusoe* (1719), vividly relates the life of a man marooned on a desert island, and thus the spectre of the everpresent ocean.

Other notable English-language literary works with a water focus include Samuel Taylor Coleridge's (1772–1834) apprehensive ballad, "The Rime of the Ancient Mariner". The English translation of the French writer Jules Verne's (1828–1905) *Twenty Thousand Leagues under the Sea* had enormous popular appeal and anticipated many twentieth-century underwater technological and scientific achievements. Herman Melville (1819–1891) wrote several popular romances of life at sea before creating his symbolic and philosophical masterpiece *Moby-Dick* (1851) about an obsessive whaler's hunt for a great white whale. Mark Twain's (1835–1910) boyhood on the Mississippi River laid the groundwork for what has been called the first modern American novel, *The Adventures of Huckleberry Finn* (1884). This classic work centered on the adventures of a boy and a runaway slave who rafted down the Mississippi.

The contemporary writers adopted the theme of water in their works and explore and challenge our relationship with the water environment include Henry David Thoreau's (1817–1862) journal of close observation, *Walden, or a Life in the Woods* (1854), Henry Beston- *The Outermost House* (1928), Aldo Leopold, *Sand County Almanac* (1949), John Graves's *Goodbye to a River* (1960), Wallace Stegner's *The Sound of Mountain Water* (1969), Annie Dillard's *Pilgrim at Tinker Creek* (1974), and Ann Zwinger's *Run, River, Run: A Naturalist's Journey Down One of the Great Rivers of the West* (1975).

In the Romanian literature, Jean Bart was best known for his water inspired works: *Jurnal de bord*, 1901, *În Deltă...*, 1925, *Peste Ocean - Note dintr-o călătorie în America de Nord*, 1926, *Schițe marine din lumea porturilor*, 1928, *O corabie românească. Nava-școală bricul "Mircea"*, 1931, *Pe drumuri de apă*, 1931. Here is how Jean Bart briefly describes the essence of life port Sulina in the novel *Europolis* (1933): "However, this small port cosmopolitan life is original and interesting. (...) There is a colony life. Levantine trade attracts adventurers from all tribes, who travel here to fish in the troubled waters of the Danube, a mosaic of races: all nations, all types and languages; the small world of the institution - Europe in miniature - with props, scenes and protocol has a separate life; it is

closed, impermeable perfectly sealed and the Commission shall keep it away, hiding under the guise of the weak contact with exaggerated politeness indigenous crowd, which is within the provisional landed here, to the gate of the East".



Also, Mihai Eminescu's poetry is defined as a specific expression of the mode of creation typical of the last great European romantic. It is true, of course, that, with Eminescu, European Romanticism entered its final phase in southeast Europe as well. Space and time both acquire deep emotional colouring in Eminescu's poetry. At any rate, the universe pictured by him is one of the weirdest. The ideal imaginary space built by Eminescu implies a felicitous union of the protecting vegetation of the forest and of the water spring:

Come to the forest spring where wavelets
Trembling over the pebbles glide
And the dropping willow branches
Its secluded threshold hide.

(Longing)

In this sheltering space provided by the forest pool, deep blue (lacul codrilor, albastru) the writer imagines the sacred ceremonial of love. In a small space, a boat stands for the perfect romantic retreat:

And hand in hand we leap aboard,
Charmed by the water"s tiny childe;
The rudder strings slip from my grasp,
The oars into the water slide.

(The Forest Pool)

The model for romantic writers was Victor Hugo, one of the greatest romantic writers of France. A versatile and freethinking personality, he gave a huge impulse to the Romantic Movement as he made his immense contribution to French literature and culture, as a novelist, a dramatist, and a poet. The genius of Hugo lies in the fact that he gained both literary acclaim as well as public

adulation for his enormously popular novels and his intensely lyrical poetry that was characterised by "powerful sounds and rhythms". From 1834 to 1837, Victor Hugo travelled around Normandy, exploring and sketching the region's historic monuments and buildings, wood landscapes and the river Seine.

The stretch of the Seine between Paris and Le Havre was featured in some of his novels, including *Les Misérables*. Here is the image of the ocean in the text *Old ocean* ("J'étais seul près des flots")

I stood by the waves, while the stars soared in sight,
Not a cloud specked the sky, not a sail shimmered bright;
Scenes beyond this dim world were revealed to mine eye;
And the woods, and the hills, and all nature around,
Seem'd to question with moody, mysterious sound,
The waves, and the pure stars on high.
And the clear constellations, that infinite throng,
While thousand rich harmonies swelled in their song,
Replying, bowed meekly their diamond-blaze—
And the blue waves, which nothing may bind or arrest,
Chorus'd forth, as they stooped the white foam of their crest
"Creator! We bless thee and praise!"

So, the romantic literature attains the status of aquatic element as a main topic of the artwork: the American writer Edgar Allan Poe (in the poem *The City in the Sea*), the French Lamartine (in the poem *Le Lac*), Victor Hugo (in the poem *Eclaircie*) or the English John Keats (in the sonnets *On the Sea, To the Nile*).

II.3.2. Water and Music

Water has had surprising prominence in the musical world. It has served as a tool, as inspiration, and even as a performing venue. Water inspired the Musical Tools. The Hydraulis, or Water Organ, was a musical instrument that produced sound using pressure generated by falling water as the energy source. Water Drums exist in various cultures. The native populations of the Americas constructed a

drum within a drum, with the inner instrument being filled with various amounts of water to affect the timbre of the sound. In some areas in Africa and New Guinea, hollow gourds were placed in larger vessels and struck. Water Gong is the name attached to a modern use of traditional gongs and tam-tams. The instrument was struck and then lowered into a tub of water which lowered the pitch. Likewise, it could be struck while suspended in water, and then removed to raise the pitch.

Water has served composers as musical inspiration for a number of reasons: as the backdrop for opera and musical theater, as an image to be represented in musical sound, as a source of natural sound to be imitated in music, and as a cultural icon. Water-inspired classic compositions include works such as Debussy's *La Mer,* Ravel's *Jeux d'eau,* Mendelssohn's *Calm Sea and Prosperous Voyage* and *Hebrides Overture,* Wagner's *Tristan und Isolde,* and Handel's *Water Music.*

Traditional folk music often addresses water-related themes, whether the story telling vehicle is a sea shanty, a minstrel tune, or a ballad. Also, there are many musical works inspired by water. Frederic Chopin, Prelude, op. 28, no. 15, *The Raindrop*, Claude Debussy, *La cathédrale engloutée*, *La Mer*, *Reflets de l'eau*, Ferde Grofe, *Mississippi Suite*, Jacques Ibert, *Escales*, Todd Levin, *Swirl*, Maurice Ravel, *Jeux d'eau*, Ottorino Respighi, *Fountains of Rome*, Richard Rodgers, *Victory at Sea*, Giacchino Rossini, *Overture to William Tell*, Camille Saint-Saëns, "Aquarium" from *Carnival of the Animals*, Virgil Thomson, Suite from "The River", Ralph Vaughan Williams, *Sea Symphony*, Antonio Vivaldi, 2 concerti, RV 253 and 433, "La Tempesta di mare". We know that the music Imitates the Sounds of Water in other works: Ludwig van Beethoven, Symphony No. 6, movement 4 "The Thunderstorm", Jonathan Green, Symphony No. 3, movement 4 "Water", and is a as Cultural Icon in Bedrich Smetana's work, "The Moldau" from Ma Vlast (My Country).Throughout history, composers have been asked to write music to be

“played upon the water”. Venetian musicians composed much brass music for barges.

The most celebrated piece of such music was composed in England, by Handel, for a 1717 party for *George I upon the Thames*.

George Enescu known in France as Georges Enesco, 19 August 1881 – 4 May 1955) was a Romanian composer, violinist, pianist, conductor, and teacher, regarded as one of the greatest composers of the 20th century and Romania's most important musician. He used the theme of water in his work in the maturity period when water appears as a central element. A third stage of full maturity, deeply marked by the catastrophic moments of the two world wars, comprises four papers in which the presence of aquatic element can be identified: *Vox maris* poem, op. 31 (dates back to the period 1925-1929), *Picture Creek* in the 3rd Suite for orchestra “village”, op. 27 (1938), *Paintings* “creek in back of the garden” and “The Tempest the night out” 3rd suite “Impressions from childhood”, *Symphony*.

Pablo Casals described Enescu as *“the greatest musical phenomenon since Mozart”[17] and “one of the greatest geniuses of modern music”*. Queen Marie of Romania wrote in her memoirs that *“in George Enescu’s compositions there was real gold”*. Yehudi Menuhin, Enescu's most famous pupil, once said about his teacher: *“He will remain for me the absoluteness through which I judge others. [...] Enescu gave me the light that has guided my entire existence”*.

II.3.3. Water and Painting

In the visual arts, a theme is a broad idea or a message conveyed by a work, such as a performance, a painting, or a motion picture. This message is usually about life, society or human nature. Themes are the fundamental and often universal ideas explored in a work. Themes are usually implied rather than explicitly stated. Deep thematic content is not required in a visual work; however, some observers would say that all visual work inherently projects some kind of outlook on life that can be taken as a theme, regardless of whether or not this is the intent of the author- J.M.W. Turner – paintings such as *Fisherman at Sea Fishing Fleet*, The *Grand Canal - Venice*, *Slave Ship*, *The Evening of the Deluge*are some examples on which many famous artistsfacets of water exerted a strong fascination.

Impressionism is a 19th-century art movement that originated with a group of Paris-based artists. Their independent exhibitions brought them to prominence during the 1870s and 1880s, inspite of harsh opposition from the conventional art community in France. The name of the style derives from the title of a Claude Monet work, Impression, soleil levant (*Impression, Sunrise*).

The *Water Lilies* is a painting by impressionist Claude Monet painted during his series called Water Lilies. The painting depicts a scene in a French pond showing light reflecting off the water with Water Lilies on the surface. It was painted in 1919 and since 2012 it has been on display in New York's Metropolitan Museum of Art.

Marine art or maritime art is any form of figurative art (that is, painting, drawing, printmaking and sculpture) that portrays or draws its main inspiration from the sea. Maritime painting is a genre that depicts ships and the sea - a genre particularly strong from the 17th to 19th centuries. In practice the term often covers art showing shipping on rivers and estuaries, beach scenes and all art showing boats, without any rigid distinction - for practical reasons subjects that can be drawn or painted from dry land in fact feature strongly in the genre.

Ioannis Altamouras (Ιωάννης Αλταμούρας) (Florence or Naples, 1852 – Spetses, 1878) was an outstanding Greek painter of the 19th century famous for his paintings of seascapes.

Antoni Gaudí was a Spanish Catalan architect from Reus and the best known practitioner of Catalan Modernism. Gaudí's works reflect an individualized and distinctive style. One of Gaudí's largest and most striking works is the Casa Batlló (1904–1906) with a sandstone façade and water-inspired lines.

Viktor Barvitius (March 28, 1834 - June 9, 1902 in Prague) was a Czech painter, representative of modern realism who used the theme of water in his paintings.

Radi Nedelchev (Bulgarian: Ради Неделчев) (born April 1, 1938) is a Bulgarian artist best known as a painter of naive art. His paintings depict mostly landscapes, village life and festivals. He surprised an aquatic element in some of his paintings. Here's one of those creations.

II.3.4. Water and Film

In the movies, water has been a threatening environment, including one that shelters "hostile" creatures. Examples include the shark attacks in *Jaws,* the river itself in *Deliverance,* and the ocean in the fact-based *The Perfect Storm*. Water has been the setting for a post-apocalyptic world (*Waterworld*) or another worldly encounter (*The Abyss*). Conversely, particularly in family films, the welfare of a marine animal may be the central focus, as in *Free Willy, Orca,* and *Tarka the Otter*. Conservation of the water environment also may be a central theme, as in *Turtle Diary* and *When the Whales Came*. Fine art and film may come together, such as with the acclaimed 2000 documentary, *Rivers and Tides,* which celebrates the art of Andy Goldsworthy.

In conclusion, like water itself, arts are not fixed, but fluid and constantly evolving and responding to change. Arts are also an ideal means by which humans explore, understand, communicate and challenge their culture, values, and ethics. The response to art may have philosophical, ecological, social, or political implications upon how societies and individuals live as an integral part of this water planet.

II.4 Water in Transports and Political Issues

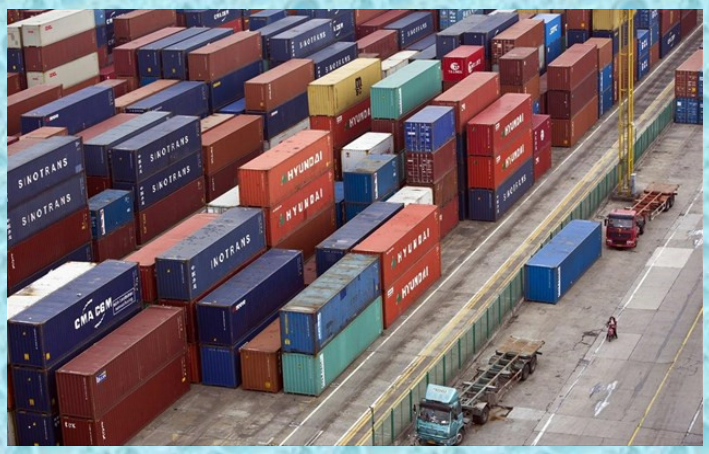
Introduction

Water is everywhere; navigable rivers and lakes, lively commercial ports, much frequented water roads for the transport of people as well as of goods worldwide reveal the key role of water in transport.

Seafaring and Commerce

Commerce plays a great role in the development of the global economy. Sea transports are the safest and the most cost-effective solution for cargo transport as well as the environmentally-friendliest, since big CO_2 quantities are not emitted in the atmosphere.

The cargo capacity and the general capacity of a port are estimated with the TEU unit (Twenty-foot Equivalent Units).



Greece is found among the biggest seagoing leaders in the world and has been playing major role in sea transports, especially during the last three decades. Despite business challenges and the risks, Greek sea entrepreneurship holds a leading position in the global economy. Since 2000 the bonds between the Greek seafaring and the domestic economy have been importantly reinforced, by the approximately 1200 maritime companies that exist in Greece.

BIG PORTS

- **Rotterdam, The Netherlands**

This Dutch port used to be the biggest in the world, before being surpassed by Shanghai and Singapore some years ago. Rotterdam is a gateway for the import of transatlantic-and not only goods- in Europe. Its most important activities are the petrochemical industry and the commercial transshipment of many cargo types. Moreover, it is an important transit station for the transport of raw materials and further goods between Europe and other parts of the world.

- **Amsterdam, The Netherlands**

Amsterdam was established at the end of the 12th century as a small fishing village alongside the banks of the Amstel River, after which it was actually named and which it is still the economic and cultural centre of the country.

The city has one of the biggest historical centers in Europe, dating back to 17th century, the so-called Golden Era of the Netherlands, of which it was the focal point. During that period, a series of concentric semicircular canals, the well-known "grachtens", were constructed around the center of the older city and they still form a characteristic of the appearance of the city center.

- **Antwerp, Belgium**

Antwerp was an economically as well as culturally important city for the states of Benelux and one of the biggest European ports.

After the Second World War the big community of Hassid Jews controlled the commerce of diamonds, an important commercial activity in the city, which happens to be one of international centers of that sector.

- **Marseille, France**

Marseille is the most important city-port in France and also an important European port. It is located in the bay of Lyon, west Mediterranean. Since 1962 it has become the biggest gateway for immigrants in Europe, since at least 1.000.000 immigrants, especially from Algeria, have entered its port.

Nowadays, the new port, constructed vertically to the old one, has a leading position in the economy of Marseille and it is the most important commercial and shipping center of the Mediterranean with 100.000.000 tons of products being transported annually. It mostly imports petroleum, fruit, oil and leather and it exports wine, drinks and food products.

- **Le Havre, France**

Le Havre is a city-port in northern France and specifically in the coasts of the English Channel, in Normandy, at the right bank of the mouth of the Seine. It is the second biggest port in France, after Marseille on the south and it has channels that are 24 kilometers long. The city used to be called the “Gate to the Ocean”. The development and the history of the city go hand in hand with its existence as a

port in the strategic area of the English Channel Sea. During the 12th century, Le Havre started developing thanks to commerce from the West Indies, which started thriving together with the domestic and the European commerce.

- **Hamburg, Germany**

Located in one of the northernmost parts in Europe, really close to Denmark, as well as to the Baltic and the North Sea, Hamburg is the biggest port in Germany and the third biggest port in Europe after Rotterdam and Antwerp.

Almost 13.000 ships from the whole world enter this port every year. From the cruise ships' terminal to the warehouses of the historic Speicherstadt and from the boarding bridges to the modern container port, here one can feel the air of freedom as well as the air of the remote countries. During a lugger tour or a visit to the legendary ships-museums, visitors can experience the reasons why Hamburg is also called the "Gate to the World". It is indicative that during the period from 1850 to 1939 almost 5 million of European immigrants started their journey form Hamburg to the "New World".

- **Bremen, Germany**

Bremen (meaning the port of Germany- "Bremerhaven") is a city lengthwise the Weser, opposite Nodernham city. Although it is a relatively new city, it has a long history as a commercial port and nowadays it is one of the most important German ports. More than 1.350.000 cars are imported or exported every year through Bremerhaven and it is actually the port that imports and exports more cars than any other city in Europe, apart from Rotterdam.

- **Piraeus, Greece**

In the biggest port in Greece the passengers that were transported in 2014 were more than 18 million, according to the passenger, vehicle and cargo traffic data demonstrated by the administration of the Piraeus Port Authority S.A.

Specifically, 18.635.495 passengers, 2.534.893 vehicles, 3.585.155 containers and 359.665 cars were transferred through the port of Piraeus. According to the Piraeus Port Authority S.A., compared to 2013 and the previous years, there is an increase by almost 1 million passengers as well as an increase in containers, mostly due to the contractual obligations of the Piraeus Container Terminal S.A. based on the grant contract.

- **Novorossiysk, Russia**

It is the biggest port in the Black Sea and an industrial city based on the production of steel and metal products as well as on the food industry. The commercial port of Novorossiysk serves the Russian sea commerce activity with other areas such as Asia, Middle East, Africa, the Mediterranean and South America. It is the busiest oil port in the Black Sea and the ending of the oil pipeline from the Tengiz Field to west Kazakhstan.

- **Shanghai, China**

Shanghai is the biggest port as well as the biggest city in China. It plays a major role in the modern economy of China and it is also one of its most important cultural, commercial, economic and industrial centers. Since 2000 it has steadily had the first position in transferring merchandise worldwide.

- **Singapore**

Connected to more than 600 ports in almost 120 countries, the port of Singapore is one of the busiest seafaring centers in the world and thus it is often called the gate to Asia. It competes with many other big ports in the wider area, such as the ports of Shanghai, Hong Kong and Schenzhen in China and Busan in South Korea. At the container terminal of the port of Singapore a daily average of 60 container ships of all sizes enter the port and 91.000 containers are trafficked almost 6% out of which end their voyage at Singapore and the rest are dispatched to their destinations in the whole world.

Water Transport in Anhydrous Greek Islands

The water shortage problems that are observed every summer in the Aegean islands are dealt with by water transport with water tanker ships. According to the General Secretariat of the Aegean and Island Policy, water will be transported to Agathonisi, Leipsoi, Leros, Kastelorizo, Patmos, Amorgos, Donousa, Irakleia, Kimolos, Koufonisia and Schinousa throughout the whole summer and autumn. In August as well as in September water will be also transported to Mykonos that is expecting great numbers of tourists. The cost for the water transport to islands that are facing a water shortage problem is estimated at 3 million Euros.

NAVIGABLE RIVERS

The Danube

The Danube is navigable for transoceanic ships from the Black Sea to Romania and up to Bavaria for riverboats. Since 1992, when the channel of the Rhine, the main and the Danube was completed, the river has been a part of a European water road from Rotterdam to the North Sea up to Sulina city in the Black Sea. In 1994 the Danube was declared one of the 10 European transport roads, to Central and Eastern Europe. The quantity of goods transported to the Danube was increased at 100 million tons in 1987.

The Nile

It is almost 6.650 km long and it drains an estimated area of 3.349.000 square km. Its basin occupies parts of Tanzania, Burundi, Rwanda, Zaire, Kenya, Uganda, Ethiopia, the biggest part of Sudan and the cultivable part of Egypt. Every day, there are many organized cruises along the length of the Nile and many traditional boats that travel there. The Nile is the cheapest means of transporting people and goods in Egypt.

Water and Political Issues

Worrying phenomena as far as water management is concerned have been observed worldwide during the past few years. On the one hand, the development of the scientific and technological achievements has softened the problem, but on the other hand the modern need of the increasing population across the world render the issue of water management as crucial as ever.

Europe

Russia

The pollution in the Volga, Russia, has eradicated the caviar industry and has thus caused a great economic disaster. The economy of Finland is also threatened by the water management in Russia. The Finnish are willing to offer financial backing for the demolition of a dam in Leningrad in order to protect fish farming in the Baltic Sea. That will allow the river to bring new nutrients from the shore in order to increase fish in the Baltic Sea again.

Africa

Africa includes 19 out of the 25 countries in the world that do not have access to clean water. The Nile is the biggest source of the valuable - for this country - water and therefore the claims concerning its water management are extremely intense.

The Nile is the longest river in Africa as well as worldwide. It springs south of the Equator and flowing towards the North through northeast Africa, it empties into the Mediterranean Sea. It is almost 6.648 km long and it drains an area of almost 3.349.000 km^2

The drainage basin of the Nile is a geopolitical area of great importance, as in the anhydrous – because of the Sahara - area of North Africa the Nile waters a huge area of approximately 3.5 million square kilometers, almost 10% of the whole continent. That valuable drainage basin does not limit itself to the countries flowed through by the river, like Burundi - where the most remote spring of the White Nile comes from, Uganda with its huge springs and Victoria Lake, Sudan and Egypt.

Οι καταρράκτες του Μπλε Νείλου στην Αιθιοπία.
Tis Abay - "smoking water" -"νερό που καπνίζει"

Ethiopia, which controls the 80% of the waters that supply the flow of the Nile, is planning to engage a bigger quantity of water; this is also the case for Sudan. Such an action would reduce the water quantity that is available in Egypt that is already facing water shortage problems and it is utterly dependent on the Nile. Moreover, it is expected that only in the next three decades the population of Egypt will be more than one hundred million and this is why the tension among "thirsty countries" will increase.

Another typical example is that of the dispute between Angola and Namibia in 1981-1982, where a series of dams but mostly central waterworks' pipeline systems were strategic targets of both countries resulting in big conflicts and human victims on both sides. The case of the valley of the Omo River in Ethiopia is another typical one. For many years, many of its local tribes have been at war because of their conflict concerning the access to the little water of the area. In

early 2006, at least 12 people were killed and more than 20 were injured in conflicts between the members of Marechen and Matzeretin groups

Asia

Middle East

The war between Israel and the Arabs is not only religious or territory. Water has always been of strategic importance during the long-lasting enmity of the countries that share the drainage basin of the Jordan River.

More specifically, the Jordan River is the only natural border among Syria, Jordan and Israel, and its springs are in South Syria; so the creation of settlements in vital areas with underground water resources is rather reasonable.

The cause of the dispute between Palestine and Israel, concerning water, seems to have been created in the middle of the 1960s. It was then when Israel decided to react to the diversion of the Jordan River that was being planned. According to military historians the Arab-Israeli Six Day War in 1967 is considered the “first big water war”. Israel conducted the war based on a “hydrologic plan”. It conquered territories that supply it with the 90% of its overall needs for water and it also possesses the territory with half the water resources in the area.

The water supply problem appeared again during the discussions with Syria concerning the liberation of the Golan Heights, which are the main source of drinking water in the area. The Syrian- Israeli conflict on water arose in a wider context of discussions for the departure of the Israeli troops from the area.

The situation of the relationships between Israel and Lebanon is similar. Any possible discussion concerning the departure of the forces of Tel Aviv from the occupied zone of south Lebanon collides with the issue of the water management of the Litani River.

The water table near the Yarkon- Taninim River, which is located in the occupied Palestinian territory, has also been a constant cause of tension between Palestinian and Israeli homesteaders in the same long-suffering area.

Turkey

Apart from the Jordan River, the conflict over the waters of the Tigris River and the Euphrates River among Syria, Turkey and Iraq is also very worrying. In that "Eden Garden" the first agricultural civilizations of Asia were developed and it is also where the first wars over water began, since various conquerors used to come here for the water and the fertile land that it used to irrigate.

In 1992 the Atatürk Dam was constructed in Turkey and it is the biggest of the 22 dams that were constructed by the Turkish nation at the Tigris and the Euphrates, and the fifth biggest of its kind worldwide; it is 184 meters high and 1800 meters long. The flow of the river in the Euphrates decreased very fast. With those irrigating works, Turkey can control the flow of the two rivers and captivate Iraq and Syria in a «hydraulic» way.

Additionally, with the South-eastern Anatolia Project - GAP the water of the two rivers will be held within Turkey to a great extent.

Iiisu dam in the Tigris River

Until 2025, if those three nations do not come to an agreement on the flow control of the two rivers, Turkey will reduce the water flow towards Syria by 40% and by 80% towards Iraq respectively. In that case one should take into consideration that Turkey is currently using about 80% of the water it consumes for agriculture. That will allow it to gradually double the irrigable land and expand its agricultural economy. Consequently, the aftereffects on Syria and Iraq will be immediate since 95% of the water used comes from the Tigris and the Euphrates. The problem will get worse in combination with the fact that Syria and Iraq demonstrate an increase in population by almost 3.5%.

Because of the Turkish hydropolitics[1] there has also been a concern in Cyprus. According to Christos Iakovou, Director of the Cyprus Studies Centre (Fileleftheros, 4/3/2015), the decision of the Turkish government on the construction of an undersea pipe for transferring water from Turkey to Cyprus should not be read as a decision of the Turkish Ministry of Forestry and Water Affairs, in order to solve the water problem in the occupied areas, but as a decision that forms part of the general strategic target-setting of Turkey concerning the Cyprus dispute. Ankara may call the project "the pipeline of peace", however the cynic phrasing of the Turk Minister of Forestry and Water Affairs, which calls it "the umbilical cord" that will relate Turkey to the occupied areas, is the strategic bottom line of the Turkish project.

As far as Cyprus is concerned, the pipeline that is being designed will be able to transfer 75 cubic meters of water with the possibility to also transfer electricity. Firstly, the purpose of Ankara is to reinforce the dependency of the occupied areas both by water and electricity. In case the problem is not resolved, that will be translated into an increase of the irrigable land, on the one hand, in order to develop agriculture in the occupied areas, as well as into a cessation of the occupied areas being dependent on the electricity supplying on the part of the Republic of Cyprus. In case it is resolved, though, in the form of a two-zone federation, Turkey will try to take advantage of the water shortage of the Greek constituent state in order to become the basic supplier of water and food as well as of electricity, which will be sold at a low price, to the Greeks. In the long term, according to Cyprus, that will render the constituent Greek state exclusively dependent on Turkey.

1 The use of water becomes a power factor for the foreign policy.

Southeast Asia

The Mekong River springs from the area of the Tibetan Plateau, and traversing the Yunnan Province of China, it forms a small part of the boundaries between China and Myanmar, and further on it forms the boundaries between Myanmar and Laos as well as the biggest part of the boundaries between Laos and Thailand. Then, from the area of Laos it flows on through Cambodia and Vietnam, where it flows into the South China Sea. China and Laos have constructed many dams, and Thailand, at the same time, makes its water diversion. All the above deprive valuable water from Cambodia and Vietnam.

For the coordinated use of the water resources of the Mekong and the management of any possible relevant problems, a foreign commission among Laos, Thailand, Cambodia and Vietnam, called the Mekong River Commission (MRC), was created in 1995. Chian and Myanmar have been participating as "partners in conversations" since 1996.

India

India and Bangladesh lay claim to the Ganges River, without mutual retreats. On the contrary, the exploitation of the Indus River has led India and Pakistan to cooperation, which is not that frequent in the management of the "white gold". The problem, however, has showed up because of the ever-increasing population of India, as Pakistan possesses the 4/5 of the river. In 1960, a treaty was signed between the two countries and it determines the division of the water of the rivers that spring from Tibet. The Indus River Treaty is a very good agreement, which is about to be terminated in 2025.

America

The **Colorado** River is the main river that flows into the southwest United States and northern Mexico. It is about 2330 km long. The river is a valuable water source for the agricultural and the urban areas it traverses where few rainfalls exist. The river and its tributaries are controlled by big dams such as the Hoover Dam, reservoirs and aqueducts, and

it provides almost 40 million people that live inside as well as outside its drainage basin with water. The river is also used for the generation of hydroelectric energy. That situation is a source of tension and long-lasting negotiations between Mexico and the USA.

The Paraná is the most important river in Argentina, the second longest in South America and one of the biggest in the world. It is formed by the confluence of two rivers, the Grande and the Parnaíba in the southeast part of Brazil and as it flows towards the south it becomes the boundary between Brazil and Paraguay and then, between Paraguay and Argentina. It finally flows into the river-bay.

In the 1960s the longest war over water between Brazil and Paraguay took place; it started in 1962 and ended five years later. The main cause was the waters of the Paraná, the claim of which created big war conflicts between the two countries with very adverse consequences and an obvious deterioration in the relationships of the two countries, which lasts up to nowadays.

Moreover, in 1970 the waters of the Paraná were claimed by three countries: Argentina, Brazil and Paraguay, since Argentina considered that the water management of the other two countries caused pollution in the waters of the river it exploited. That resulted in the conflict between the three countries, something particularly rare, since the in the so-far mentioned examples most incidents involve two countries.

II.5. Technical Issues, Industry, Agriculture

Food and agriculture are the largest consumers of water, requiring one hundred times more than we use for personal needs. Up to 70 % of the water we take from rivers and groundwater goes into irrigation, about 10% is used in domestic applications and the rest in industry. Total industrial water use in the world is about 22%, with high-income countries using 59%, and low-income countries using about 8%.

Agriculture

Agriculture is the process of producing food, feed, and fiber by cultivation of certain plants and the raising of domesticated animals. And it is not possible without fresh water. In European Union agriculture took about 80 % of water sources.

Dryland farming is an agricultural technique for non-irrigated cultivation of drylands.

Irrigation makes agriculture possible in areas previously unsuitable for intensive crop production. Irrigation transports water to crops to increase yield, keep crops cool under excessive heat conditions and prevent freezing. The need to irrigate is usually driven by the necessity to meet the water needs of the crop from year to year. In other situations, irrigation is viewed as insurance against occasional drought. In areas where rainfall is plentiful in most years, irrigation can bring benefits by reducing risk, meaning that a farmer is better able to control income fluctuation.

Rainfed agriculture is the most common method of agriculture in developing nations. Rainfed agriculture is used to describe farming practices that rely on rainfall for water. It is typical for low-income countries (Africa, Latin America and Asia). 80% of the land farmed around the world is rainfed and it “contributes about 58% to the global food basket”.

Some techniques in water management for rainfed agriculture include the use of supplemental irrigation and water harvesting techniques, such as rain catchment systems and weirs or sand dams. These techniques help to provide water to areas where rainfall is inconsistent.

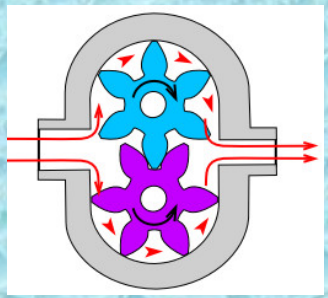
Aquaculture is a part of agriculture too. Raising animals and plants in the water is aquaculture. Practised since ancient times in many parts of the world, aquaculture embraces such diverse activities as the harvesting and processing of seaweed in Iceland, ponds for growing carps in The Czech Republic, the Spanish and Greek farming of marine fish and seafood, oyster and rainbow trout farming in France etc. Romanian aquaculture is still based on the semi-extensive culture of common carp along with the Chinese carps accounting for more than 75 percent of the total production. Bulgaria has fish farming and net cages for trouts too. Aquaculture – or fish farming – will provide close to two thirds of global food fish consumption by 2030.

In agriculture there were always used some water technical systems. The basic were the pumps. Pumps are machines for moving liquids, gases, fluids and oils by mechanical action, main powered with motors. Pumps operate by some mechanism and consume energy to perform mechanical work by moving the fluid. Pumps operate via many energy sources, including manual operation, electricity, engines, human or animal power. There are many sizes, from microscopic using in medical applications to large industrial pumps.

Gear pumps

This pump is the simplest of the rotary pumps. It consists of two meshed gears that rotate in a closely fitted casing. The tooth spaces trap fluid and force it around the outer periphery. The fluid does not travel back on the meshed part,

because the teeth mesh is closed in the centre. Gear pumps are mainly use in the car engine oil pumps and hydraulics. One of the gear is powered by motor, second is not powered.

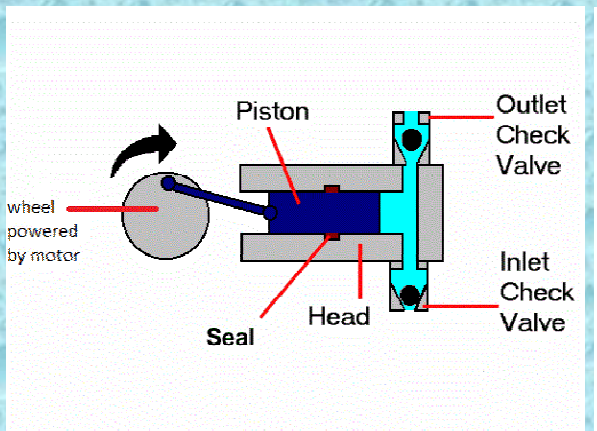


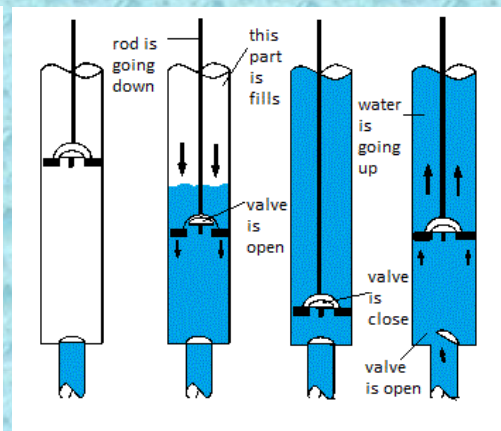
Archimedes screw

It's very simple and old pump, maybe the oldest pump ever used, invented by Archimedes. Archimedes screw is using for the transport water (sand, gravel, mud too) up the hill. This pump was used in Ancient Greece.

Reciprocating pump

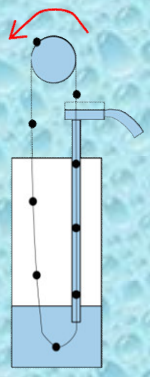
Power for reciprocating pump is based on wheel or force rod powered by human hands (simple hand pump) .This type of pumps were commonly used in the Middle Ages. It is often used where a relatively small quantity of liquids to be handled and where delivery pressures quite large. In reciprocating pumps, the chamber in which the liquid is trapped, is a stationary cylinder that contains the piston or plunger.





Peristaltic pumps are typically used to pump sterile or aggressive fluids. Some common applications include pumping fluids through an infusion device, aggressive chemicals, high solids slurries and other materials where isolation of the product from the environment necessary. It is also used in heart-lunge machines to circulate blood during a bypass surgery.

Rope pump



A rope pump is a type of pump of which the main or most visible component is a continuous piece of rope, in which the rope is integral in raising water from a well. Rope is spinning; vessel takes load and spill water to van.

Maybe you know this pump as a chain or washer pump. It was used by the Chinese after 1000 B.C. In the 1980s Reinder van Tijen, an inventor, created a rope pump and started to give instructions to various communities around the world how to make it from simple available parts using PVC pipesand plastic moldings. He began at Burkina Faso in Africa, continued to Tunisia, Thailand and Gambia among others. In Nicaragua, the technology was rapidly expanded over the whole country and 25% of the rural population in Nicaragua now uses rope pumps. By the end of 2009 more than 4 million people in 20 countries worldwide were using rope pumps for domestic and irrigation water.

Industry

It took about 20 % of the water used in the world. In industrialized nations, however, industries consume more than half of the water available for human use. Belgium, for example, uses 80% of the water available for industry. The annual water volume used by industry will rise from 752 km^3 per year in 1995 to an estimated 1,170 km^3/year in 2025.

Probably every manufactured product uses water during some part of the production process. Industrial water use includes water used for such purposes as fabricating, processing, washing, diluting, cooling, or transporting a product; incorporating water into a product; or for sanitation needs within the manufacturing facility.

Some industries that use large amounts of water produce such commodities as food, paper, chemicals, refined petroleum, or primary metals. For example for making 1 tons of paper you need 240 000 liters of water.

Energy and water are linked, too. Water generates power and it takes large amounts of energy to clean and deliver water.

Hydropower (water) is one of the older electricity generating technologies around. Hydropower doesn't pollute the air but construction and work of the dams can affect natural water systems and also affect wildlife and fish population. A small number of countries, including Norway, Canada, Brazil, New Zealand, Paraguay, Venezuela and Switzerland, produce the majority of their electricity through hydropower. Hydroelectric power station transforms the potential energy of water to electricity. It usually consists of a dam, which collects water and a machine room with turbines and alternators. About 16 % of global electricity is generated by hydropower (some resources say 19 %) - is the most widely used form of renewable energy. Generating methods: conventional (dammed water), pumped-storage (moving water between two reservoirs: when the electrical demand is low, the electricity is used to pump water into the higher reservoir, and when it is higher, water flows back to the lower reservoir through a turbine, which generates electricity), run of the river, tide.

There are only three hydro stations that have capacity over 10 GW: Three Gorges Dam (China, 22,5 GW), Itaipu Dam (between Brazil and Paraguay, 14 GW) and Guri Dam (Venezuela, 10,2 GW). The fourth one, Xiluodu in China, is under construction.

Advantages are for example low power costs, flexibility, many uses of the reservoir and reduced emissions of greenhouse gases. Some hydroelectric projects are created for specific industrial enterprises, for example aluminum electrolytic plants. However, large reservoirs require a big area, so the ecosystems and seats are flooded; in tropical regions, hydro stations produce a lot of methane, which is a greenhouse gas; dam failures result in huge floods etc.

We choose Dlouhé Stráně as an example (it means Long Hillsides). It is the most efficient hydroelectric power station in The Czech Republic. Owing to

ecological aspects, the majority of the station is located underground. About 40 employees work here; the station is remotely controlled from Prague. In a cavern, which has proportions 87,5 × 25,5 × 50 m, are situated two 24 m high machines with reverse Francis turbines, which are the biggest in Europe. Beside there is another room with transformers and substations. The upper reservoir is located on mountain Dlouhé Stráně1350 meters above sea level, its capacity is 2.72 km^3, its maximal depth is 26 m and its surface is 15.4 ha. The lower reservoir is situated on the Divoká Desná River 825 meters above sea level, it has a capacity of 3.43 km^3 and a surface of 16.3 ha. The upper reservoir is connected to the turbine cavern with two canals (one for each turbine), which are 1547 and 1499 m long and their caliber is 3.6 m. To the lower reservoir there is the cavern connected with two tunnels, which are 354 and 390 m long and have caliber 5.2 m. The station started to be built in 1978. At the beginning of the 1980s, the government decided about inhibition of the construction. In 1985, the project was modernized. They decided about completing the construction in 1989; the station started work in 1996.

A water turbine is a rotary engine that converts kinetic and potential energy of water into mechanical work. They are widely used in dams to generate electric power from water kinetic energy. We know e.g. Pelton turbine, Francis turbine and Kaplan turbine which is considered to be the most important one. Viktor Kaplan invented his turbine in our town – Brno. **A steam turbine** is powered by the energy in hot, gaseous steam and works like a cross between a wind turbine and a water turbine. It is often used in power plants to generate electricity, too.

Nuclear power plants

Nuclear power plants are ones of the most sophisticated and complex energy systems ever designed. They have extremely long lifetime during which they produce massive amounts of electrical energy by transformation of the binding energy of atomic nucleuses of heavy elements. This happens due to

nuclear fission in nuclear reactors. Enriched Uranium 235 is used as a fuel for this reaction. Water steam is then used for the sole production of electrical energy.

Important parts of regular nuclear power plant

Reactor hall, cooling tower (some people think that smoke comes out of them but it is not true, only water steam comes out of the cooling towers), reactor, pressurize, steam generator, turbine, generator of electrical energy, the transformation station, secondary circuit capacitor, the pump and of course the primary circuit, the secondary circuit and the cooling circuit.

Nuclear reactor

This is the heart of the power plant. In the nuclear reactor the nuclear fission takes place. The three major objectives of nuclear reactor are: to sustain and control the fission reaction, to remove heat from the fuel and the reactor itself and to ensure nuclear safety under all circumstances. The important parts of the reactor:

- The reactor vessel: This is the outer boundary of the reactor. It has the side openings for enter and exit of the coolant and for other operations.
- Active zone: The inner part of reactor vessel. Here the fission reaction takes place.
- The fuel: Those are the fuel cartridges made of fuel elements (rods). Those rods are thin tubes which can be over four meters long.
- The controlling organs: Mostly in the form of control rods made of a material strongly absorbing neutrons.
- Neutron moderator: For example water, its purpose is to regulate fission reaction.
- Cooler: Its purpose is to drain the heat from active zone and after that from the reactor itself. For this purpose water is used.

Nuclear fission

Because of its amazing potential, this reaction can be used for production of thermal energy, which we use in power plants, or

either for destructive purposes as Robert Oppenheimer and Manhattan project showed to us, however, this is a completely different chapter. In nuclear power plants the most common fuel for reaction is enriched uranium 235 and about this reaction we will speak. The process itself is based on fission of atomic nucleuses. This happens when incident neutron hits the nucleus.

Fission of nucleus follows. During it the nucleus splits into several small pieces which we call fragments and two or three incident neutrons are also emitted. Incident neutrons must be slowed, not fastered, in order to increase probability of crashing with nucleuses. Nuclear fission produces massive amounts of energy, much more than we can get from chemical reactions – burning, for example. However, the problem with fission is that it not produces only energy. Reaction itself emit radioactivity as do fragments of it. Radioactivity is contained by the shell of reactor but for the fragments we must built storages.

Control of fission reaction

It is not so important to begin the reaction as to control it, because otherwise the explosion could happen. For the catching of surplus neutrons the moderator and the absorbing rods are used. The rods are either inserted or pulled out of the reactor, depending on the current need.

Replacement of fuel

This happens when the reactor is stopped after 1 or 1.5 years. During it some fuel cartridges are replaced for newer ones, because their inner structure has changed. Instead of uranium 235, in these cartridges we can find nucleuses of fragments that are radioactive. Changing happens under water. Cartridges that contain used fuel must be cooled in a pool near the reactor for several years because they still produce heat. After that they are relocated into interim storage.

Nuclear accidents

Due to dependence of nuclear power plants on human factor (some say for their complexity), several accidents happened in history. Here are the most famous ones:

- Windscale: 1957, Great Britain
- Jaslovske Bohunice A – 1: 22th February 1977, Czechoslovakia
- Three Mile Island: 28th March 1979, USA
- Chernobyl: 26th April 1986, USSR

- Fukushima I: 11th March 2011, Japan

How many and where?

There are currently 437 operating nuclear reactors in 31 countries. Those reactors are producing about 11% of worldwide energy. 70 reactors are under construction in 14 countries. Construction of 183 reactors is planned. The leader in quantity of nuclear power sources are USA (100) followed by France (58), Japan (48) and Russia (33). We have two nuclear power plants in The Czech Republic, The Dukovany and The Temelin. The Czech Republic has six nuclear reactors generating about one-third of its electricity. Greece has no nuclear reactor. Bulgaria has two nuclear reactors generating about one-third of its electricity. Romania has two nuclear reactors generating almost 20 percent of its electricity. Spain has seven nuclear reactors generating a fifth of its electricity. France derives about 75% of its electricity from nuclear energy, due to a long-standing policy based on energy security. This share is to be reduced to 50% by 2025. Nuclear energy is used to generate around 11% of the world's electricity, with almost no greenhouse gas emissions.

Many countries still cannot afford investment into nuclear energy because construction of nuclear power plant is a really expensive project (even if we do not count corruption) and requires years to complete. On the other hand, the fuel is quite cheap. Here are the largest nuclear power plants sorted by their instaled capacity.

1. Kashiwazaki – Kariwa: Japan, 7965 MW
2. Bruce: Canada, 6232 MW
3. Zaporizhia: Ukraine, 6000 MW
4. Hanul: South Korea, 5881 MW
5. Hanbit: South Korea, 5875 MW
6. Gravelines: France, 5706
7. Paluel: France, 5528 MW
8. Cattenom: France, 5448 MW
9. Ōi: Japan, 4710 MW
10. Fukushima Daini: Japan, 4400 MW

Nuclear power debate

Nuclear power has immersive potential, however, the question is: can we control it? Society is divided between two camps, each with a different opinion unable to coexist with the other one.

For proponents, nuclear energy is a sustainable energy source that reduces carbon emissions and can increase energy security. A nuclear power plant produces virtually no air pollution. For proponents nuclear power is a key to achieve energy independence for most Western countries. Risks of nuclear waste are small and they can be further reduced. Also nuclear safety in Western countries is excellent compared to the rest of the world.

Opponents believe that nuclear power plant proposes an enormous threat to its surroundings and that the nuclear energy will never be a sustainable energy source. Other threats than the power plants themselves are the uranium mining, processing and transport and health or environmental damage that come with them. Another argument is that nuclear power plants will always be viable and prioritized targets in any war conflict and of course terrorism will always be a threat to them. Problem with nuclear waste remains still unsolved too.

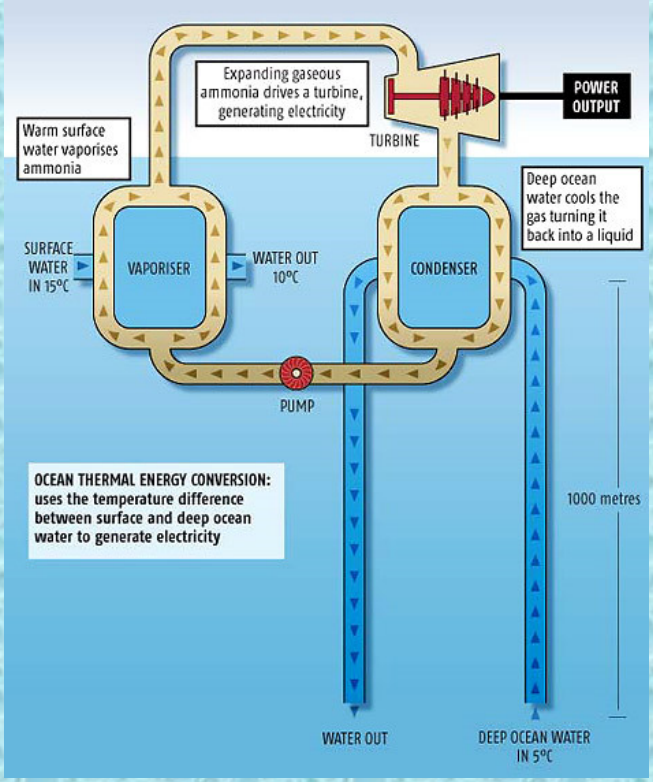
II.6 New Sources of Energy

The ocean thermal energy

Oceanic thermal energy conversion (OTEC) or marethermic energy is a so-called "green" energy. It is produced by exploiting the temperature difference between surface water and Deep Ocean. One common acronym is OTEC, for "oceanic thermal energy conversion". The European Union uses the term hydrothermal energy to mean "energy stored in the form of heat in surface waters".

Due to the area they occupy (80% of the surface of the land), the seas and oceans of the Earth behave like a gigantic solar panel for:

- Solar radiation
- wind energy



Although some of this energy dissipates (current, swell, friction, etc.), much of it warms the upper layers of the ocean. Thus, at the surface, thanks to solar energy, the water temperature is high (it can exceed 25° C in the tropics) and in the deep, deprived of sunlight, the water is cold (around 2 to 4° C). Thus, this temperature difference can be exploited by a thermal machine that needs a heat sink and a heat source for energy production. And thanks to this heat engine one can utilize both water from the depths and the water surface as sources.

http://seawayblog.blogspot.fr/2008/11/ocean-could-be-source-of-limitless.html

Jules Verne is generally credited with the idea of using the differences in the sea temperatures to produce electricity. In his book "Twenty Thousand Leagues under the Sea", he refers to "deep surface waters and oceans to produce electricity" – back in 1869. In the end, it was the French physicist Arsène of

Arsonval who first conceptualized putting together the warm waters surface with cold water depth. But in the 1880s, the technology did not yet exist to make a prototype. It was not until 1920, with the depletion of coal reserves and the need to find new primary energy resources that the French engineer Georges Claude (founder of the Air Liquide Company) proposed to build an ETM factory or electricity generation.

Currently the countries that are the most active in researching this field are the United States and Japan. Marethermic production does not involve combustion, and therefore expels no CO2. Its potential is great, but it is difficult to exploit and implement, and it cannot be implemented in the tropics.

Wave Power

Wave energy refers to the generation of electrical energy from the waves. There are various devices that harness this energy. Many systems are currently under review; some are already on the market, but none has reached a stage of maturity.

There are four technologies to recover wave energy:

- **Floaters**

These consist of a floating articulated structure perpendicular to the waves. This structure consists of steel pipe or pontoons connected by joints containing hydraulic pumps that drive a turbine (power generation).

- **Water columns**

The sea surface acts as a piston pushing the air through a pipe. This air in turn triggers a turbine to generate electricity. This type of device can be installed at sea or on the coast.

- **Breaks system**

The wave breaking on an incline is collected at an elevated point, and then water rolls down the incline, drives a turbine, and returns to the sea.

- **Underwater oscillating walls**

These are rather small devices compared to the size of the waves. They can either vibrate when passing waves or operate a kind of hydraulic cylinder pump.

In terms of implementation, the United Kingdom is a leader in wave power and tidal technologies. They were the first country in the world to launch the marine power generation projects on a commercial scale.

Hydroelectric Energy

Turbines convert the kinetic energy of ocean currents and tidal currents into electricity, just like wind gusts in wind power production. These currents tend to be predictable and strong. Water is around 830 times denser than air, so although these are significantly smaller than wind turbines, they allow comparable production.

The composition of a tidal turbine can differ according to the company that makes it, but in general it consists of:

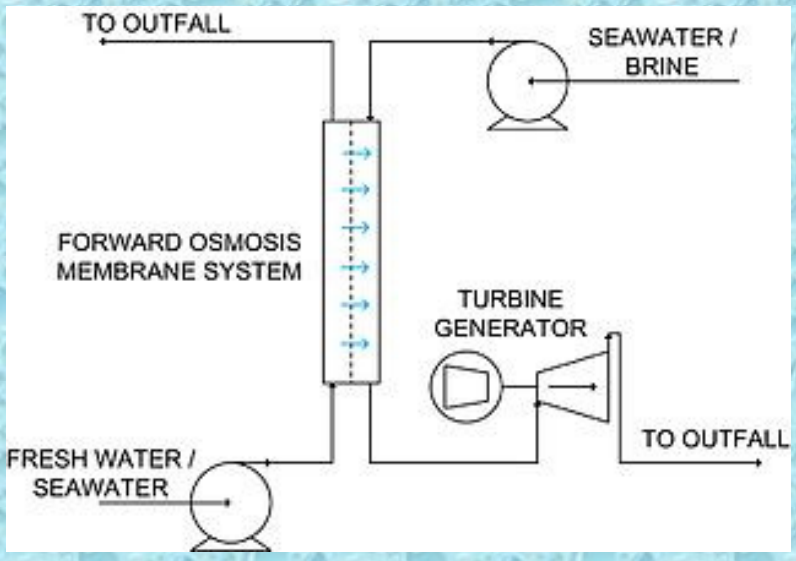
- A turbine that uses the force of the water to catalyze its rotation, which converts the force into mechanical energy to drive a generator;
- A generator that converts mechanical energy into electrical energy;
- A float which allows an exchange of more or less water. The height of water trapped in it should be up to the surface waves;
- A stabilizer which allows a rotation of the blades to agree with the current direction;
- A pole or an anchor that moors the turbine to the ground.

Several British and French companies specialize in this field, but tidal technology is still experimental. The investment costs are high relative to the purchase price of electricity, which remains low. This important parameter has deterred investors.

The most advanced projects so far are by Raz Blanchard in Britain and Scotland, and by Fromveur Passage in France.

Osmotic power

Osmotic power refers to the process of using reverse osmosis in order to generate electricity. By definition, osmosis is the diffusion of material when solvent molecules pass through a semi-permeable membrane separating two different solutions.



Therefore, osmotic energy is energy that can be obtained in the vicinity of estuaries (where the fresh river water mixes with salt water from the sea), exploiting the osmosis that occurs where a semipermeable membrane separates two fluids of different salinities.

In principle, this operation is performed in two different ways.

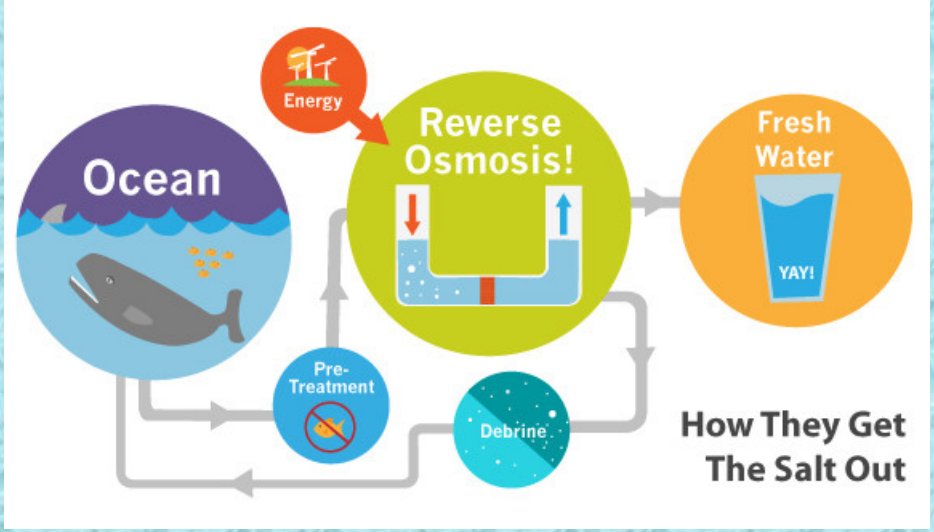
First, if the mass of salt water is greater than that of the fresh water, fresh water becomes briny as the pressure difference strives to remain within its limits (limit theoretical with sea water: 2.7 MPa, 27 bar). The pressure thus created can be used to drive a turbine.

Another possibility is the use of membranes, through which pass one type of ion (positive or negative) and directly produce electricity. In principle, the impact on the environment is null, since the mixing happens naturally.

Countries such as Norway, Korea, the USA, Japan, and the Netherlands are interested in clean energy and especially osmotic power.

Desalination of Seawater

Desalination is a process that provides fresh, potable water from brackish, non-potable sea water.



http://www.thoughtyoumayask.com/picsbtqq/desalination-of-seawater-for-drinking

Very generally, it is easier and cheaper to find and treat sources of fresh water (surface water such as lakes and rivers or groundwater) than to desalinate sea water. However, in many regions, freshwater sources are unavailable or have become insufficient to support population growth and industrial development.

On the other hand, it is often cost effective to combine the production of fresh water with another activity (such as energy production, as the steam available at the output of the turbines, which is lost in a conventional plant, is reusable in a desalination plant).

Desalination of sea water is an important issue for the future of arid regions. For a production cost as low as about 50 cents per cubic meter in recent estimates, it is possible to solve the problem of a lack of drinking water in many countries.

In Europe, the largest desalination plant is located in Spain – Prat del Llobregat, near Barcelona. It opened in August 2009. It produces 60 million cubic meters of potable water per year. It supplies about 4.5 million people with drinking water. In the case of use for human consumption, the desalination of sea water is today as reliable and inexpensive as recycling wastewater. It even becomes profitable developed countries that have enough water, and in certain situations (eg tourist islands). Therefore, the use of this technique is growing rapidly.

Recovering Dew

Dew is the result of atmospheric water condensation into liquid droplets. The phenomenon occurs at night on cold walls and without any energy input.

The potential for condensation depends on local climate and weather. The yields are highly variable. They depend on the state of the air, what the condenser is made out of, and its maximum water recovery ability. Condensers are inclined planes covered with a special film; they collect dew and transport it to a reservoir. It is also possible to use trenches covered with thermal insulation, or the sloping roof of a house. To cause condensation, it is sufficient to cool an area only a few degrees; naturally-cooling coatings have been used.

Dew harvesting is done by equipping surfaces on the ground or on the roof to collect the water droplets formed during the night. The reclaimed water is fit for human consumption.

Such systems have been set up in desert regions where fresh water is most lacking and where it is essential, though production is modest. Devices have been installed in several parts of India, Croatia, Burkina Faso, Morocco, and Israel.

Many hot countries suffer from a complete absence of water. However, the humidity of the air in the atmosphere is sometimes considerable. In these desert regions, the only way to have a little water is by recovering dew from the water vapor. Yields are relatively low, but this water vapor is present everywhere, so it is theoretically possible to have access to this resource over most of the globe.

The populations most impacted by this process are people living in desert areas where rainfall is low or nonexistent.

Smart Irrigation

Agriculture is responsible for 70% of water consumption around the world. Reducing the "water footprint" of agriculture is the goal of smart irrigation

technology, which automatically brings plants the water and fertilizer they need at the right time.

Smart irrigation limits water consumption. To do this, sensors are implanted in the soil to determine the moisture content. When the soil becomes too dry, an automatic sprinkler system is triggered; when the desired humidity level is reached, watering stops.

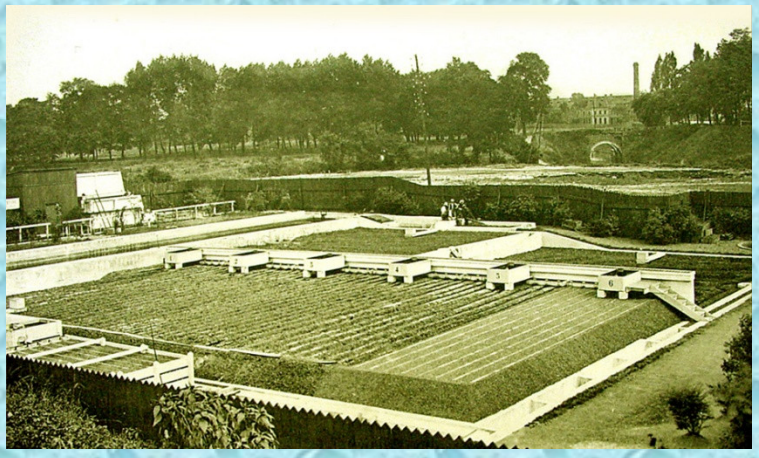
Automatic watering was designed to regulate and adjust watering a garden, a plot, or a vegetable garden throughout different times of day and of the year to supply the soil with a sufficient quantity of water. This relies on several devices. The source of supply is the starting point of the irrigation system. Water is supplied by semi-rigid pipes. The choice of sprinklers is based on plant surfaces and irrigation needs. Actuators regulate the distribution of water; they are connected to the controller, which initiates and regulates the watering period. A humidity sensor or electronic rain gauges complete the installation. The first reports on the state of the soil and adjusts accordingly, the second interrupts watering when it starts to rain. The entire system can be controlled via a computer or a smartphone.

In Africa, there has been great investment in research to find new technologies for computerized irrigation. Egypt reported that water resource management results in better crop yields. In Tanzania, water use is optimized as it moves through irrigation canals is improved.

Currently under development in Abu Dhabi is a project comparing their current water needs with the water needs met by traditional irrigation systems, and with those met by smart irrigation. The overall objective is to develop sustainable agricultural practices.

"Lagooning"

The lagoon is a water treatment system that uses the natural environmental mechanisms, such as various microbial communities, to purify water.



Purification in stabilization ponds is based on the presence of aerobic bacteria-free cultures and algae. The oxygen required for the bacteria to breathe is produced by plants supported by radiant light.

The lagoon is a slow flow of water in shallow, waterproof basins, in which bacteria breed and natural organisms consume organic matter. The number of pathogens in the water is significantly reduced. To this extent, the basins are sealed by the introduction of a synthetic geomembrane, or more rarely, by compacted clay.

These waters pass through three successive pools, each about one meter deep. In the first pool, the bacteria consume oxygen and produce CO_2. Heavy particles accumulate on the bottom of the pond in the form of sludge, which after 10 years can be applied to agricultural land.

In the second basin, wastewater is permeated by nutrient salts, sun, and CO_2. Phytoplankton grow and produce oxygen, eliminating harmful bacteria. Zooplankton develop in the third basin and feed on the phytoplankton produced in the second pool, consuming oxygen. Water clarification can be provided by the introduction of crustaceans to the lagoon.

Chapter III

THE WATER PROBLEMS IN EUROPE TODAY

INTRODUCTION

The third chapter starts with some information about the structure of the hydrosphere and the access to fresh water in Europe and particularly in Bulgaria, The Czech Republic, Greece, France, Romania and Spain as well as the fresh water abstraction in those countries. Even if 2/3 of the Earth‘s surface is covered by water, either liquid or frozen forms, fresh water accounts only 2,5%. Only 1% of the world‘s fresh water is accessible for direct human uses.

Water pollution is a major global problem and affects the entire biosphere as plants and organisms living in it. In this chapter you can find what the sources of pollution are. Industrial pollution, which is due to industry rejecting, wastes into water and this may destroy the aquatic ecosystem. Agriculture increases oil erosion as well as the physical disturbance of soil. This affects the amount of salt and minerals in water. Human pollution and oil spills are not neglected. Water pollution occurs when pollutants are discharged directly or indirectly into water bodies without enough treatment. The excess of phosphates is one of the major causes of the environment‘s eutrophication. The main problem with heavy metals is their recyclable treatment. Pesticides may harm aquatic life and enter drinking-water supply intakes. Another kind of water pollutants is the chemicals from prescription drugs and over-the-counter medications that get into lakes, rivers and streams.

Urbanization and its influence on water is another problem explored in this chapter. Unquestionably the development of cities has unfavorable consequences for the environment. The effects of urbanism on water range from reserve reduction and pollution to physico-chemical conditions of water quality and morphological changes of the bank or changes in water dynamics.

The influence of urbanization on water is not only a scientific and a technical problem but also economic, social with political and legal aspect. Some ways of improving the impact of urbanization are suggested e.g. implementing an integrated urban water management, setting rules regarding the interaction between the underground infrastructure and the aquifer system, establishing some strategic measures for the aquifer water supply.

Among its specific issues we may include fluctuations in the level of groundwater, groundwater pollution.The impact of underground constructions on the environment is more and more pronounced and scientific research is needed to sustainably manage the influence of urbanization on water resources

Agriculture and irrigation and their impact on fresh water is the next section in the chapter. It starts with a brief history of irrigation and irrigation systems. The very first irrigation systems were built in the old Mesopotamia. There is some information about the Grand Canal in China as well as the Romans who made great hydraulic works (pipelines, aquaducts) some of which have survived and are used today.

The systems of irrigation are the different ways to add water to the ground. Nowadays there are 3 ways to add water to the land. Surface irrigation, sprinkling, and watering by drip.

Using a method of irrigation or another depends on many factors such as the physical characteristics of land, its ability to store irrigation water, the type of crops, water availability. On a global scale 95% out of more than 220 million hectares of land are irrigated by surface. However, these figures decreases in developed countries ranging between 60 and 80%. In Spain the percentage of surface irrigation is 59% although it decreases to 42% in Andalucia as a consequence of an increase on drip irrigation.

In this part of the book there are diagrams showing the volume of irrigation water used in agriculture, according to watering techniques, type of plants in the world and in particular in Spain. There is also information about the water storage in Spain. Reservoirs in Spain are more than 350 and the most important are Serena which is the third largest in Europe, the reservoir of Alćantara. The dams are approximately 1,188 and the majority of them were built between the years 1960

and 2000. Some of the most important are the dam of Almendra, „Canalles“ – the third highest dam in Spain.

This chapter examines also the tourism and its impact on the hydrosphere. There is a negative relationship between tourism and the environment. According to the Third European Evaluation of the Environment the direct impact of tourism on people and the environment depends greatly on the number of tourists gathering at a specific destination and the season. Water pollution has reached great extents. Waste from hotels and resorts are transferred through sewage and drainage systems and are dumped into surface water. Pollution strips the oxygen of water and that leads to catastrophic result to most marine life as well as to overdevelopment of plankton resulting in the change of flora and fauna. The area inhabited by different species has been damaged and some of them are in danger of extinction. The tourist industry greatly misuses resources, which may lead to water shortage. Light or manageable tourism is a hope of sustaining tourism and a healthy hydrosphere.

The last part of this chapter is about the effect of pollution on the atmosphere. The green house effect is the process which leads to the warming of the planet. A very dangerous part of the global warming is an increasing temperature in oceans, the sea level rise is caused by the melting of glaciers. Acid rain, snow or fog polluted by acid damages the environment. Floods caused by heavy rainfall or heavy winds pushing the sea up to the coast. Drought may occcur almost anywhere in the world an can last months or years. And many other extreme events has happened around Europe for the last years.

But we can do some little things by ourselves to make a difference - switching off lights, television and computers. Also planting trees is a great way to reduce the greenhouse effect.

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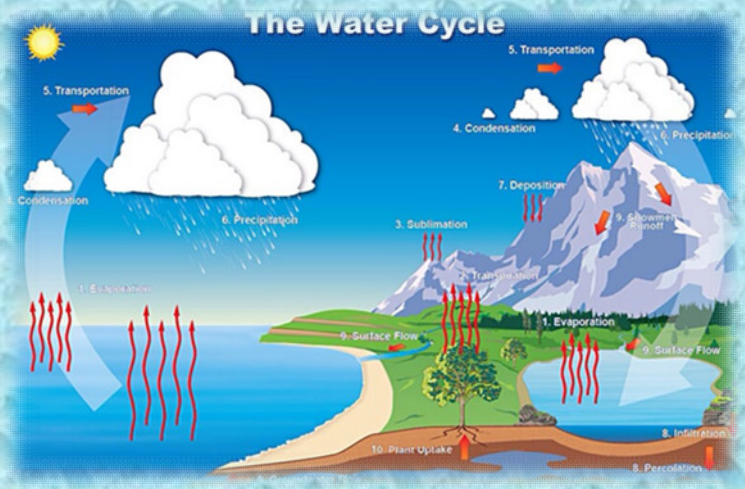


III.1. Hydrosphere - Structure and The Uneven Distribution of The Freshwater In Europe

Water on Earth is basically necessary for life. Since 2/3 of the Earth's surface is covered by water. The Earth is also called the blue planet or the watery planet.

The hydrosphere (from Greek ὕδωρ - hydōr, "water" and σφαῖρα - sphaira, "sphere") in physical geography describes the combined mass of water found on, under, and over the surface of the Earth.

The estimated water resources are 1386 million cubic kilometres of water. This includes water in liquid and frozen forms in groundwater, glaciers, oceans, lakes and streams. Saltwater accounts for 97.5% of total amount of water. Fresh water accounts for only 2.5%. Of this fresh water 68.7% is in the "form of ice and permanent snow cover in the Arctic, the Antarctic, and in the mountainous regions. Next, 29.9% exists as fresh groundwater. Only 0.26% of the total amount of fresh waters on planet Earth is easily accessible. It is found in lakes, reservoirs and river systems, the principal elements of water ecosystems. Approximately 75% of the Earth's surface, an area of some 361 million square kilometers, is covered by ocean. The average salinity of the Earth's oceans is about 35 grams of salt per kilogram of sea water.

The most important cycle in the hydrosphere is water cycle or hydrological cycle. During the process, water transfers from one state or reservoir to another.

Reservoirs include atmospheric moisture (snow, rain and clouds), oceans, rivers, lakes, groundwater, subterranean aquifers, polar icecaps and saturated soil. Solar energy, in the form of heat and light (insolation), and gravity cause the transfer from one state to another over periods from hours to thousands of years. Most evaporation comes from the oceans and is returned to the earth as snow or

rain. Sublimation refers to evaporation from snow and ice. Transpiration refers to the expiration of water through the minute pores or stomata of trees. Evapotranspiration is the term used by hydrologists in reference to the three processes together, transpiration, sublimation and evaporation.

Fresh water availability

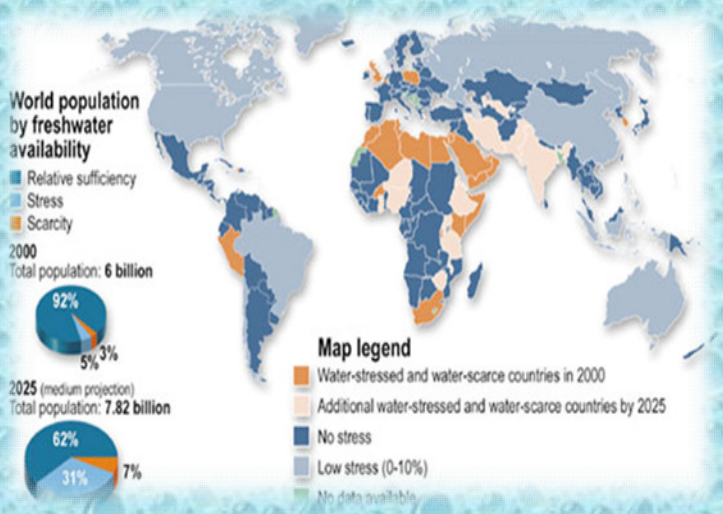
"Water, water, everywhere, nor any drop to drink" - Rhyme of the Ancient Mariner, by Coleridge.

Fresh water resources are unevenly distributed in terms of space and time and can go from floods to water shortages within months in the same area.

The Water Resources of Earth

Over 70% of our Earth's surface is covered by water and it is seemingly abundant. Most amount of fresh water is frozen in the icecaps of Antarctica and Greenland. In other side most of the remainder is present as soil moisture, or lies in deep underground aquifers as groundwater not accessible to human use. Only 1% of the world's fresh water is accessible for direct human uses.

This is the water found in lakes, rivers, reservoirs and those underground sources that are shallow enough to be tapped at an affordable cost. Only this amount is regularly renewed by rain and snowfall, and is therefore available on a sustainable basis.



Freshwater availability

www.nanowerk.com/www.globalchange.umich.edu

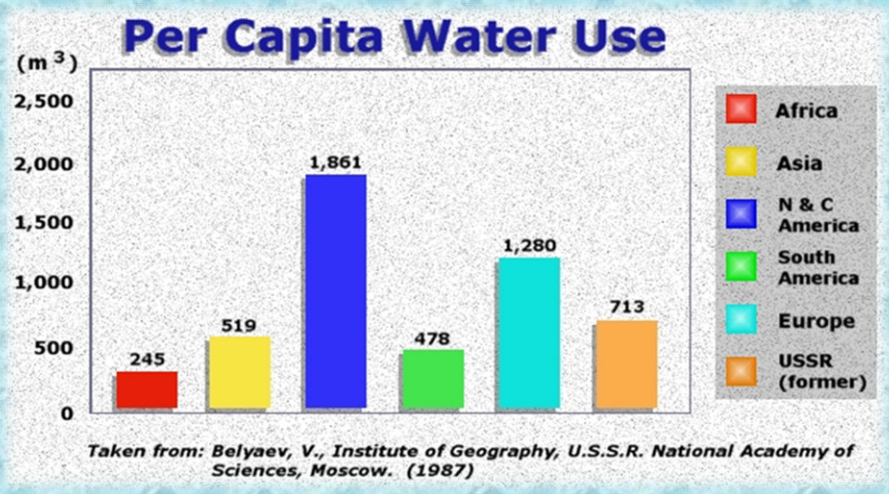
Water as a Resource

Since antiquity, irrigation, drainage, and impoundment have been the three types of water control having a major impact on landscapes and water flows. Since the dawn of irrigated agriculture at least 5000 years ago, controlling water to grow crops has been the primary motivation for human alteration of freshwater supplies.

Today, principal demands for fresh water are for irrigation, household and municipal water use, and industrial uses. Most supplies come from surface runoff, although mining of "fossil water" from underground aquifers is an important source in some areas. The pattern of water withdrawal over the past 300 years shows the dramatic increases in this century.

A timeline of human water use:

- **12,000 yrs. ago:** hunter-gatherers continually return to fertile river valleys;
- **7,000 yrs. ago:** water shortages spur humans to invent irrigation;
- **1,100 yrs ago:** collapse of Mayan civilization due to drought;
- **Mid 1800's:** fecal contamination of surface water causes severe health problems (typhoid, cholera) in some major North American cities, notably Chicago;
- **1858:** "Year of the Great Stink" in London, due to sewage and wastes in Thames;
- **Late 1800s-early 1900:** Dams became popular as a water management tool;
- **1900s:** The green revolution strengthens human dependency on irrigation for agriculture;
- **World War II:** water quality impacted by industrial and agricultural chemicals;
- **1972:** Clean Water Act passed; humans recognize the need to protect water.

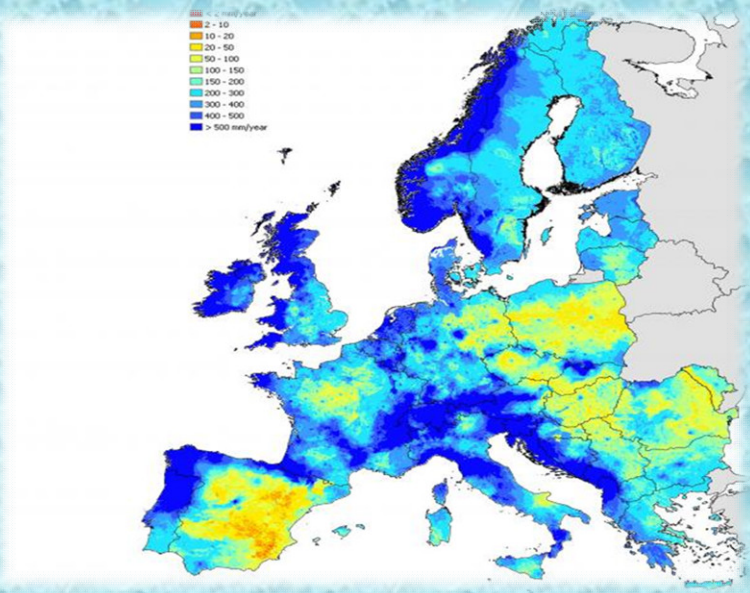


The water usage of different regions of the world per capita in cubic meters 1987

THE ACCESS TO FRESH WATER

Water availability in Europe

Annual average river run-off from rain varies from over 3 000 mm in north-western parts of Europe to less than 25 mm in west-southern parts of the continent.



Fresh water in Europe /www.eea.europa.eu

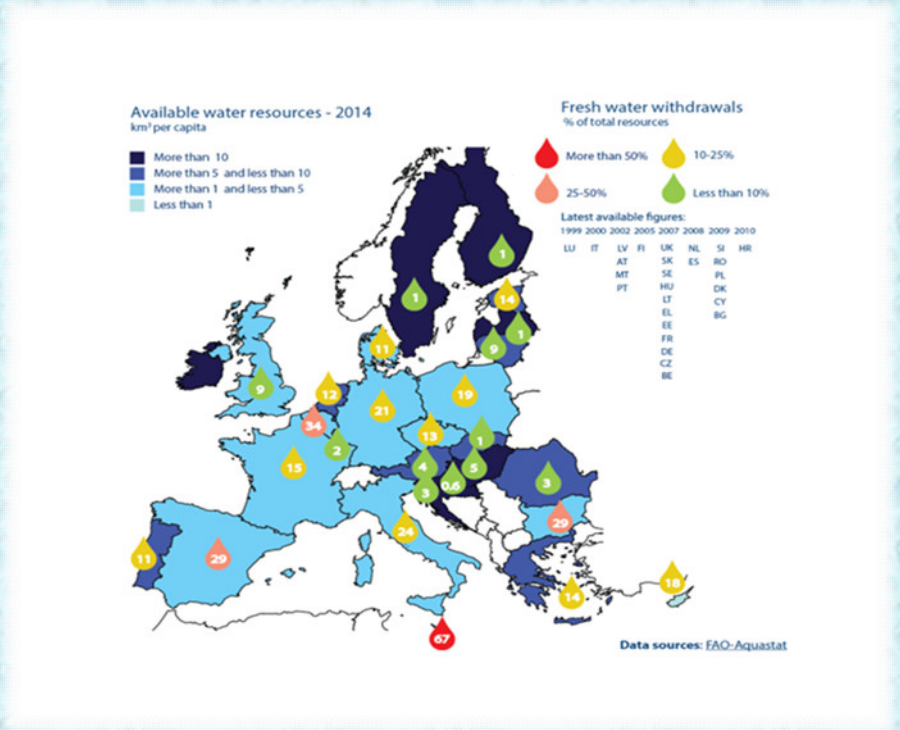
In absolute terms, the total renewable freshwater resource in Europe is around 3 500 km^3/year. The Mediterranean islands of Malta and Cyprus and the

densely populated European countries (Germany, Poland, Spain and England and Wales) have the least available water per capita.

Available water per capita

Fresh water resources in Bulgaria

Bulgaria is scarce in water resources, despite that over 60 rivers flow through the country. The Danube is the biggest one with total length of 470 km on Bulgarian territory. There are also 6 lakes with total area of 87 km² and water volume of 211 million cubic meters, and 23 dams with total area of 376 km² and water volume of 4,571 million cubic meters.

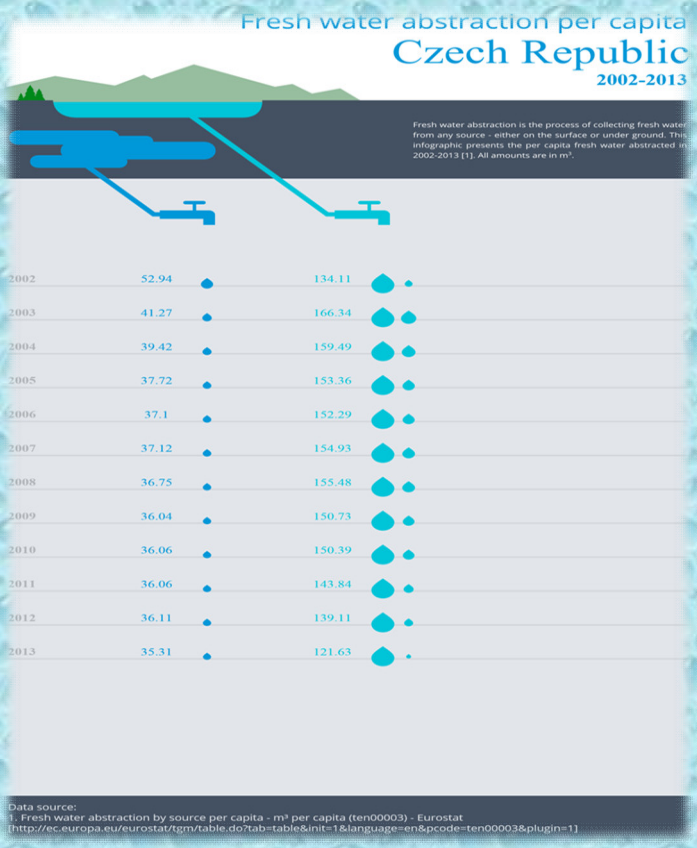


Fresh water resources in The Czech Republic

The divide among the main watersheds of Europe passes through The Czech Republic (the North, Baltic and Black Seas). A vast majority of the territory of Bohemia is drained by the Elbe into the North Sea, a major part of Moravia is drained by the Morava River into the Danube and Black Seas, and part of Moravia is drained by the Odra River into the Baltic Sea. This position on the main European

divide is not favourable from the standpoint of water management. Thus, precipitation becomes the main source of water. The long-term average precipitation equals 693 mm and approximately 30% of this amount flows out of the country in watercourses.

The Czech Republic has limited resources of freshwater. Between 2000 - 2013, abstraction per capita for public supply decreased from 79 m3 to 59 m3. Electricity production abstracted most of the freshwater for cooling purposes. Total abstractions decreased due to less industrial production (as a result of the economy's restructuring), and also to less water intensity within industrial processes.

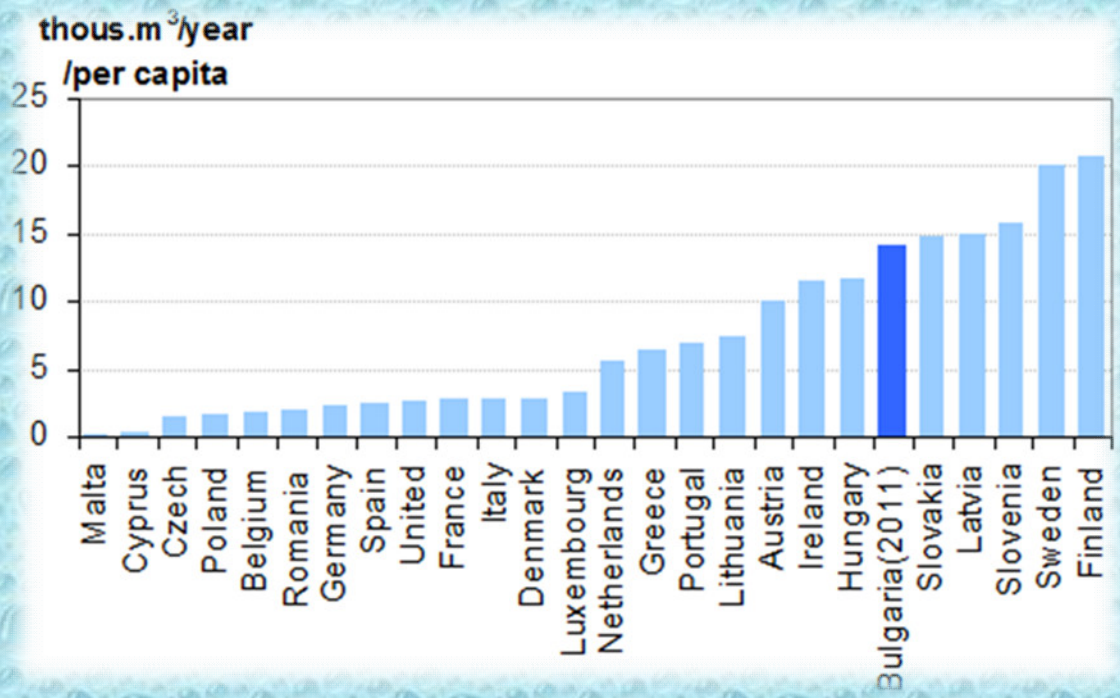


Fresh water resources in Greece

Dozens of drought stricken Greek islands in the Aegean are being forced to import greater amounts of water every year. Faced with a water shortage crisis on its hands, the Greek government is currently trying to tackle the problem by importing millions of cubic metres of water to the islands of Milos, Nisyros,

Amorgos, Koufonisia, Shinoussa, Folegandros, Tinos, Sikinos, Thirasis, Donoussa, Patmos, Symi, Halki and Palionissos.

According to local governors, the problem is not just that there is not enough rainfall to fill up the dams and rivers for irrigation but that the area also suffers from a 70% reduction in the replenishment of the aquifer, and this has had a catastrophic effect on agriculture.

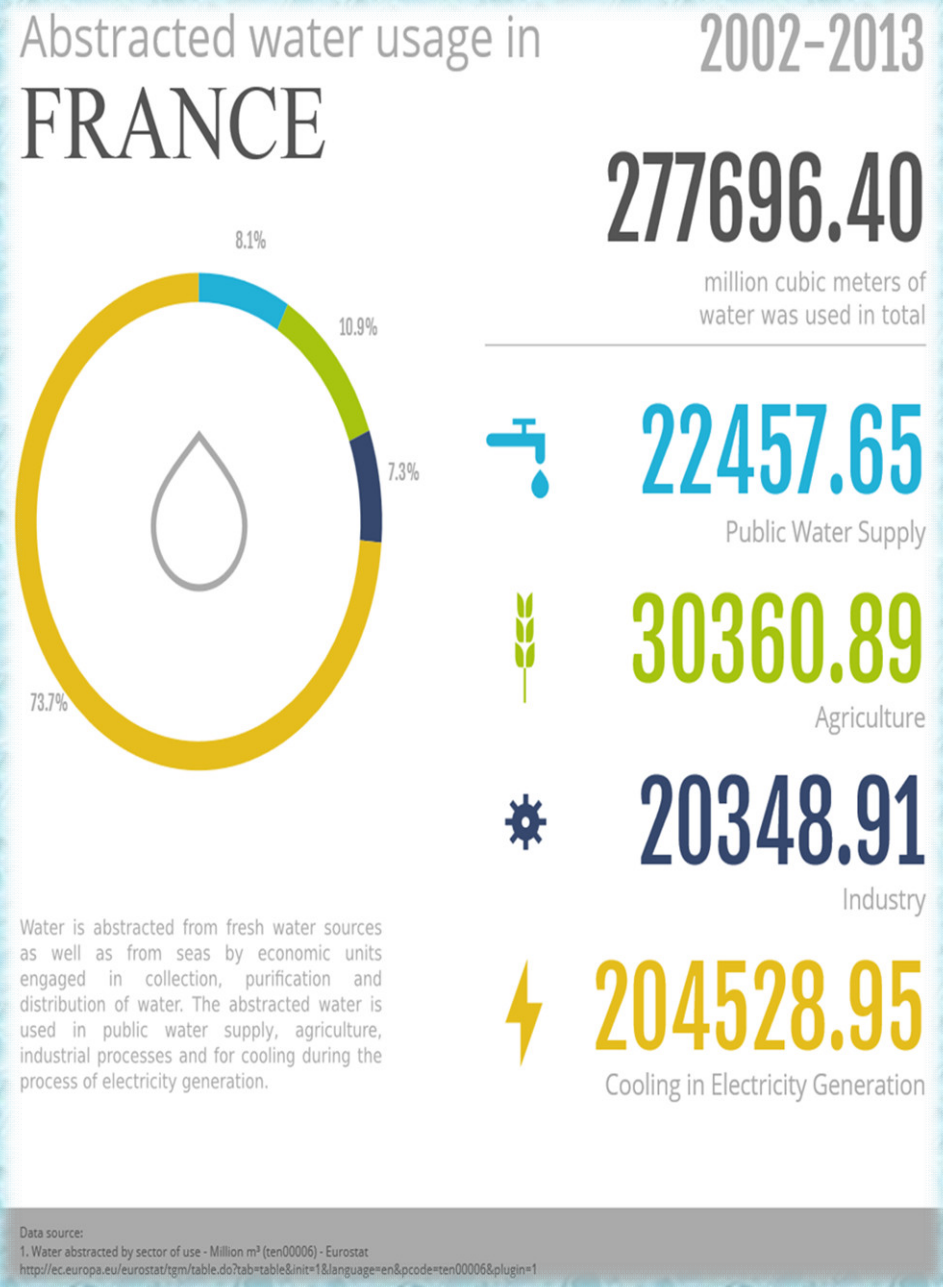


http://eea.government.bg/bg/soer/2011/water/water1_html_m38a61be6.gif

Fresh water resources in France

Access to improved water supply and to adequate sanitation in France is universal. However, not every household has access to water from the network or disposes its wastewater through sewers.

Total domestic water use in France is about 6 billion cubic metres or only about 3 percent of total runoff (191 billion cubic metres). 62 percent of drinking water supply is from groundwater and 38 percent from surface water.



Fresh water resources in Romania

Rivers

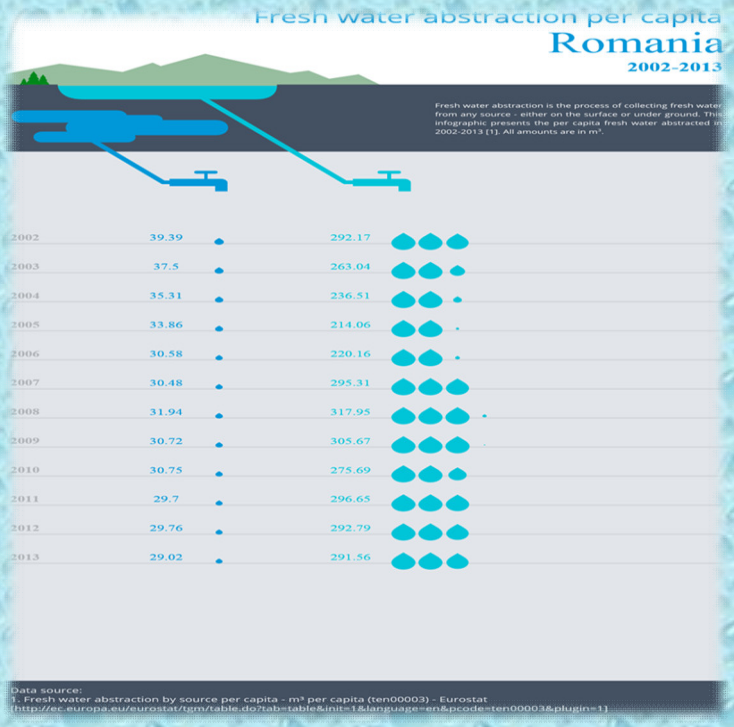
The Danube is the second longest river in Europe (2,860 km), and flows along 1,075 km of Romania's territory and empties into the Black Sea through three arms (Chilia, Sulina, Sfantu Gheorghe) which form the Danube Delta. The other main rivers in Romania are: The Mures (761 km on Romania's territory), The Prut (742 km on Romania's territory), The Olt (615 km), The Siret (559 km on Romania's

territory), The Ialomita (417 km), The Somes (376 km on Romania's territory), The Arges (350 km).

Lakes

Romania has around 3,500 lakes, but only 1% of them have an area exceeding 1 km^2. More important are the lagoons and the Black Sea coastal lakes (Razim 41,500 ha, Sinoie 17,150 ha) and the lakes along the Danube bank (Brates 2,111 ha, Bistret 1,867 ha). Glacial lakes are mostly spread in the Carpathian Mountains (Bucura is the largest of them, 10.5 ha).

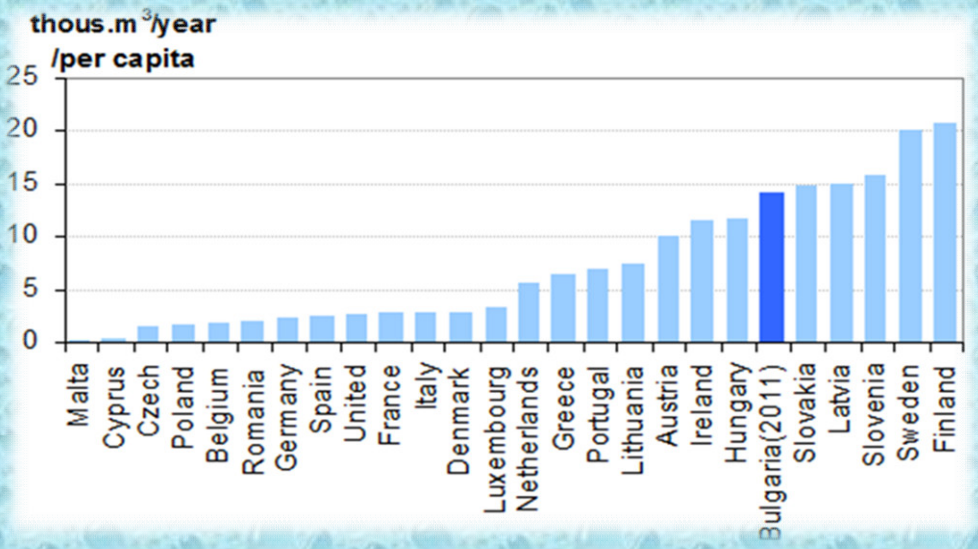
Out of the man-made lakes, the most important reservoir lakes for power generation are those on the Danube, at the Hydro-Power Plants of Iron Gates II (40,000 ha) and Iron Gates I (10,000 ha – with a water volume of 2,400 million cubic meters, which is three times as much as that of Iron Gates II), plus the reservoir lakes of Stânca-Costesti (5,900 ha) on the Prut and Izvorul Muntelui on the Bicaz (3,100 ha).



Fresh water resources in Spain

In Spain fresh water resources are limited and difficult to predict from year to year. The average annual potential water per capita considering the total fresh water resources in 2.700m^3 compared to 7.000m^3 worldwide. Some Spanish regions

have less than 1000m^3 per capita and year, such as the Southeast regions and the Archipelagos.



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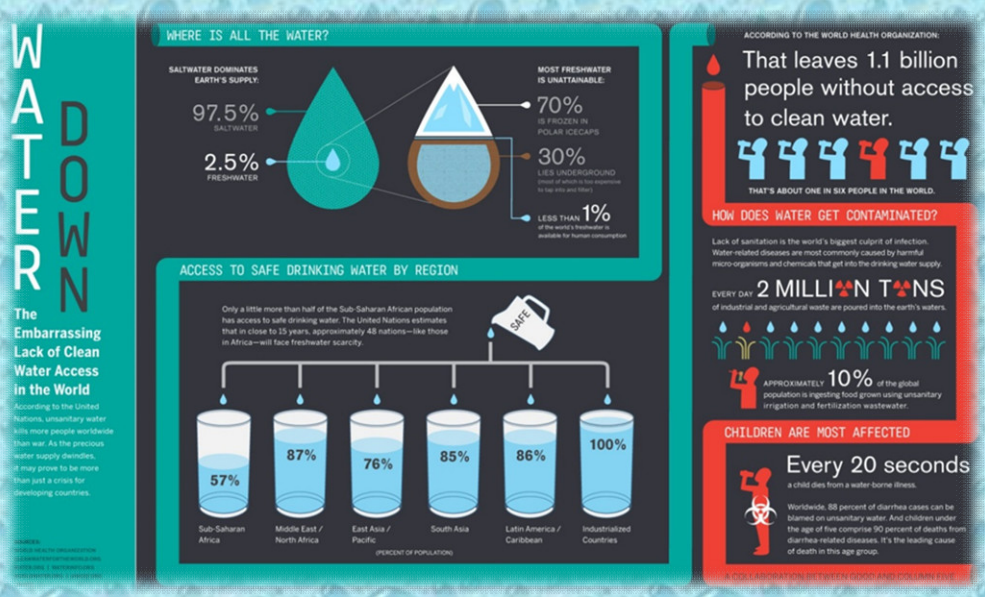


https://waterlessworld.files.wordpress.com/2014/03/lack-of-clean-water-access-in-the-world.jpg

III.2. Water Pollution

Sources of pollution

Water pollution is a major global problem and affects the entire biosphere as plants and organisms living in it. The contamination of water species (e.g. lakes,

rivers, oceans, aquifers and groundwater) occurs when pollutants are directly or indirectly discharged without adequate treatment to remove harmful compounds.

1. **Industrial pollution**

Industrial pollution is the part of environmental pollution directly due to industry when chemicals are present which modify organic cells including radiations (or artificial light when it disturb nocturnal environment) having a more or less important impact on the ecosystem.

Industries are rejecting wastes into the water and these may destroy the aquatic ecosystem. Industrial pollution can affect the water in different ways:

- industrial waste may pollute drinking-water supplies as well as fish, plants and animals.
- industrial pollution may interfere with natural processes and destroy wildlife habitats in oceans, and rivers.
- an impact on people's lives could be possible. For example, the pollution of the sea will affect people who live on fishing and tourism industries.

2. **Pollution and agriculture**

Agriculture increases soil erosion as well as the physical disturbance of soil and vegetation due by ploughing, overgrazing, logging and road building. This affects the amount of salts and minerals in water.

Other problems concerning agriculture are:

- the increasing of nutrients due to fertilisers and excreta, which create worrying amounts of nitrates and phosphates to water supplies (this can cause eutrophication);
- the increase in pesticide use.

3. Human pollution

As human populations increase, more energy is required for human activities such as cooking, lighting, etc. For example, if the energy is produced by coal burning at power stations this results in greatly increased emissions of sulphur and nitrogen oxides into the atmosphere. These gases are the main cause of acid rain.

As more and more people move in the cities, litter cause pollution, disease, and has a negative visual impact. Most water pollutants are eventually carried by rivers into the oceans.

The human being pollutes the water, the water-treatment plants can allow to pass molecules in water and consequently the tap water gets polluted.

4. Oil spill

An oil spill is the release of a liquidpetroleumhydrocarbon into the environment, especially marine areas. Oil spills usually have only a localized effect on wildlife. They can spread for hundreds of nautical miles in a thin oil slick which can cover beaches with a thin coating of oil.

The oil may kill many fish and get stuck to the feathers of seabirds causing them to lose their ability to fly.

Largest oil spill in Europe were:

- On 15th February 1996, the Liberian oil tanker the Sea Empress, loaded with 130,000 tons of crude oil, grounded on the rocks at the entrance to Milford Haven port (Wales, Great Britain).

- On 12th December 1999, the Maltese tanker the Erika was caught in a storm and broke in two off the coast of Brittany (France), with 31,000 tons of heavy fuel oil onboard. Nearly 20,000 tons polluted over 400 km of French coastline, with significant consequences for fishing and tourist industries.

- On 13th November 2002, the Bahamian oil tanker the Prestige, carrying 77,000 tons of heavy fuel oil for Singapore, requested assistance due to damage to her hull. During the following weeks, the remaining fuel polluted more than 1,000 km of Spanish and later French coastline.

Cleanup and recovery from an oil spill is difficult and depends upon many factors, including the type of oil spilled, the temperature of the water (affecting evaporation and biodegradation), and the types of shorelines and beaches involved.

Another source of pollution for oceans is the degassing. The degassing is a current transaction consisting in ventilation of tanks to eliminate hydrocarbon vapors and allow access for inspection or repair work. Sometimes, boats made degassing in a forbidden area.

Pollutants

Water pollution occurs when pollutants (particles, chemicals or substances that make water contaminated) are discharged directly or indirectly into water bodies without enough treatment. Consequently, pollutants get into water mainly by human causes (or factors).

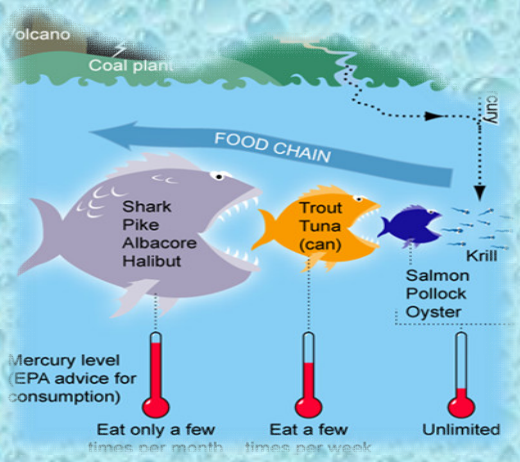
1. **Phosphates or eutrophication's phenomen**

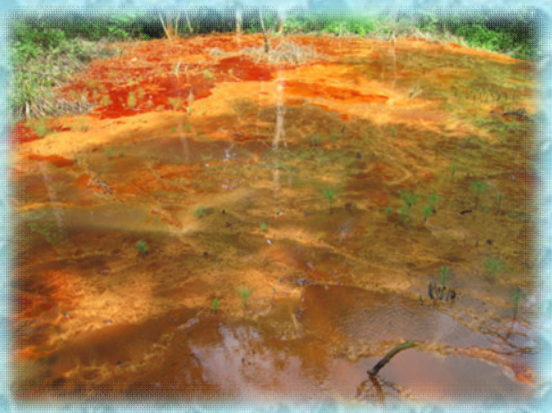
If phosphates are normally present and useful in small doses in the water and the grounds, their excess is one of the major causes of the environment's eutrophication. They contribute in particular to the problems of color's changing - water becomes green.Eutrophication is a common phenomenon in coastal waters.

The radioactive phosphate may penetrate into some membranes: for example, inside the eggs of some aquatic bodies and affect their development.

2. Heavy metals

Heavy metals (for example: mercury, lead, zinc) are very toxin and it is forbidden to reject them in nature and of course in water. Moreover the main problem with heavy metals is their recyclable treatment because each heavy metal can't be recyclable in a separate way.





3. Plastic waste

The accumulation in the ocean environment of floating plastic debris - fragments bags, bottles, cans and other packaging, but also industrial pellets - routed land by winds and rivers, or discharged into the sea from ships, has been known since the late 1990s.

Huge convergence zones, called “ocean gyres”, were discovered:

- in the North Pacific where a mass of 3.4 million km2 known as the "Great Pacific Garbage Patch" or "trash Pacific high" ;
- in the South Pacific;
- in the North and South Atlantic;
- in the Indian Ocean.

Unfortunately, all the world's seas are polluted: plastics and microplastics are present throughout the world's oceans. The oceans, which cover 70 % of the surface of the planet, are a huge dump in the open, where plastic wastes of humanity are accumulating.

4. Chlorine and detergents

Soaps and washing detergents contain both natural and chemicals. The detergents that we use at home are just as poisonous so we have to use only biodegradable products.

5. Fertilisers and pesticides

Some chemicals like fertilisers are made of substances that are to be found naturally in the environment, but only in small amounts. When too much fertiliser is washed from farmlands into a river, that water also gets polluted as well.

Pesticides are chemical and biological substances intended to control pests, such as insects, weeds, bacteria, and algae. Pesticides are heavily used on farmland, but in urban areas, the main usage is on residential and commercial

properties. Whenever storms hit, the runoff from yards and roadsides carry pesticides into local streams, where they may harm aquatic life and enter drinking-water supply intakes.

Insecticides are easily washed by the rain into streams and groundwater where they poison fish and domestic animals. Many insecticides are stored for a long time in the bodies of animals and may end up in the meat, fish, egg and milk that we eat. Fruits and vegetables that have been sprayed with insecticides also remain poisonous for many days afterwards and must be washed carefully before eating.

6. Medicine

For a few years, we have been confronted with a new type of pollution: that of the medicinal residues. Once ingested, the medicine finds itself in saddles and urines, and joins water-treatment plants. Now, water-treatment plants do not degrade totally medicine and a part finds itself in rivers then in the water that we drink.

But water quality experts and environmental advocates are increasingly concerned about another kind of water pollution: chemicals from prescription drugs and over-the-counter medications that get into lakes, rivers, and streams. Water also gets contaminated by perfume, cologne, skin lotions, and sunscreens that wash off people's skin.

Drug pollution or pharmaceutical pollution is the pollution of the environment with pharmaceutical drugs and their metabolites, which reach the marine environment (groundwater, rivers, lakes, and oceans) through wastewater. Drug pollution is therefore mainly a form of water pollution.

7. PCB contamination

The PCB, or Polychlorinated biphenyls, more known in France under the name of Pyralenes, has contaminated rivers and surface water fish since decades. A particularly firm pollution: these chlorinated chemical by-products, for a long time used in the industry for their qualities of electric insulation, lubrication, are little biodegradable persistent organic pollutants. Not soluble in the water, they

concentrate in grounds and river sediments and accumulate in the whole of the food chain. Today, the PCB is omnipresent in the environment.

8. Hydrocarbons

Traffic accidents, overflowing of tanks during the filling, leaks of chemicals, in fact there are so many situations that may end up in water pollution. Some products are harmful in water: one liter of hydrocarbons (gasoline, diesel, mineral oil, etc.) pollutes 1,000 m^3 of water.

III.3. Urbanization And Its Influence On Water

Introduction

Throughout history man has seen an ascending evolution, making newer descoveries all the time. As a result, the dominant feature of this century is the continuously rising level of the knowledge of mankind, and, consequently, nowadays its living standards in civilized countries, has reached its peak (this being determined by the implementations of the discoveries in the research and development department).

The increasing tendency in the development takes on an explosive character due to the growth and diversification of production, the productivity of rising economic activity, the more and more competitive methods, techniques and technologies which are used.

But, we must not forget the fact that the first factor which led to human development was the environment: water, air, soil, subsoil, vegetation, and fauna, from which man has been extracting incessantly, sometimes draining the resources completely – raw materials: wood, salt, iron, copper, coal, petroleum, water, chemical substances – without which we couldn't have recorded the progress that characterizes humanity today. In its evolution, this scientific and technical progress materialised in a mechanised andchemicalized agriculture, in an automated and robotic industry, in faster and faster, more and more efficient and comfortable means of transport, man settling its habitat firstly in rural settlements, then in cities which developed both horizontally and vertically.

These days, there is a direct connection between the scientific and technical progress and the notion of "urbanism": the progress has led to the development of cities and intensifying of the economic and social activities. Urbanism represents an activity of general interest, continuous by nature, that runs throughout the national territory, being based on the principle of sustainable development – sustainable growth – that is, the current generation's decisions have to ensure the development of the society without compromising the right of future generations to existence and development.

Urbanization is a process often associated with industrialization, modernization, and development. It also refers to the percent of the number of citizens that live in cities, versus the population of a country. Developed countries (the U.S.A., Western Europe) are more urbanized than developing countries.

1. The historical evolution of urbanism

Ancient Urbanism represents an array of experiences gathered over time by man, regarding organizing the spaces destined for civil, religious, military, productive and recreation usage, from the oldest times to the end of the Middle Ages. The first cities developed in Mesopotamia, Egypt, Syria, Central Asia, India and China.

Roman Urbanism used in a creative way the experience of the predecessors, applying in the urbanistic achievements norms and rules still valid today.

Medieval Urbanism was highlighted by physical structures which prove the assertion of Christianity in the West: castles, churches, and monasteries.

Modern Urbanism appeared in the 18th century in England and led to the depopulation of the villages and overpopulation of the cities.

2. The effects of urbanism on the environment

Unquestionably, the development of cities has unfavorable consequences for the space and the environment, for the quality of people's lives. A specific and dramatic effect of the proces of urbanization is connected to the transformation of the ambient medium in a manner and at a scale never seen before. Urbanization is the current phenomenon with the deepest implications for the scale and patterns of consumption, which leads to a growing demand of energy and natural resources. The city, taken as a whole, behaves like a body that "absorbs a lot, but transforms and throws equally".

The changes that have affected the environment, especially after the Second World War, created the so-called "environmental issue" and generated "environmental alert" of the last decades . When talking about progress or poverty we are talking, in fact, about the environment which characterizes our planet at a given moment, because all these and pollution, water and air quality degradation,

the threat to the ozone layer, desertification, toxic and radioactive waste and many others are closely interdependent .

The main “disturbing phenomena” related to urbanization are:

• the use of space with an impact on the ecosystem by deforestation, drainage, erosion, changes in the ratio between the population and habitat;

• the unrestricted exploitation of natural resources, especially the non-renewable ones, raw materials, water, timber;

• the polluting effects of large cities which addresses the issue of urban waste, pollution and degradation of green spaces, climate change, the effect on wildlife etc.;

• the increase of auto and air traffic and air pollution with highly toxic substances;

• the increase of the amount of fluid untreated or incompletely treated, discharged into the environment;

• the fragmentation of natural ecosystems through excessive expansion of the anthropic barriers such as highways, major industrial sites etc.;

• the effects on people's health by increasing mental illness, cardiovascular diseases, etc.

3. The impact of urbanization on water

Water is a fundemental condidion for the civilised life. It ensures economic activity, and, equally, comfort, hygiene, and recreation. Water is a cheap way of communication, trade and an inexhaustible source of energy. Earth’s Ocean contains numerous mineral and food resources, representing at the same time an important freshwater resource.

The need of freshwater for mankind increases from year to year. 100 years ago people used about 4 billion m^3 of water per year. In the coming years it is estimated that the demand for freshwater will exceed 8 thousand billion m^3 per year. Although it covers three quarters of the Earth’s surface, water represents less than 7% of its mass.

Table 1. The effects of urbanism on water

Disturbing factors	Urban causes	Impact
1. Urban housing and settlements	• Inadequate urban planning; • Outside build-up areas expansion • Holiday home areas – increasing the demand for water, increasing the amount of wastewater	• Reserve reduction • Decline in water quality • Fragmentation of natural habitats by organizing capture / discharge
2. Commercial and industrial areas	• Inadequate technology • Located in floodplain	• Pollution with suspensions • Pollution with persistent chemicals
3. Infrastructure for recreation and tourism	• Inadequate urban planning • Withing the built-up area expansion • The change of land usage	• Decreasing water quality through pollution • Pollution by sewage • Eutrophication
4. Dams, hydrological management and managing water resources - drainings	• The transformation of the flowing water enviroment into stagnant water, through the excessive density of reservoirs in the chain. It requrires maintenance (after a few decates, dams must be unclogged)	• The emergence of stagnant water favours the elimination of flowing water species, and stagnant water species start to appear. Interrupting connectivity, migratory fish species extinction because of the absence of fish scale, changing the physical parameters of water, draining.

5. Wastewater from households and urban sewers	• Pollution generated from the discharge of domestic wastewater from households, and animal husbandry into streams • insufficiently treated urban wastewater discharge (lack of modernization of wastewater treatment plants)	• The modification of physico-chemical quality of water
6. Wastewater and sewage from the facilities in the protected area (e.g. tourist facilities, toilets, etc.)	• Lack of infrastructure for wastewater • Deficiencies in the approval process (custodian, the competent enviroment/water authorities) – a must for installing wastewater treatment microplants	• Changing the physico-chemical conditions of the water quality
7. Wastewater discharges and discharges from industrial mining or military sources	• Bad planning • Accidents • Lack of national priority investments	• Changing the physico-chemical conditions of the water quality, including acidification
8. Flood prevention constructions (construction of protective dams, meanders cutting, reprofiling/recalibraton bed constructions, etc.	• Inadequate urban planning • Expanding suburban areas, holiday home areas • Increasing turbidity during the executions	• The loss and damage of aquatic habitats • Death of aquatic organisms (during these activities) • Groundwater lowers, so dead branches drain

	of these constructions	along rivers
9. Garbage and solid waste	• Inadequate inspection activities • Low population awareness • Seepage and leakage from non-waterproof rubbish dumps	• Water and their banks pollution with non-biodegradable solid waste (plastic/rubber packaging: bags, bottles, tyres) • Groundwater pollution in the rubbish dump areas • Rivers and riverbanks landscape degradation • Damage to fauna
10. Atmospheric pollutants	• Outdated technology • Lack of filters for air emmisions	• Changing the physico-chemical conditions of the water quality
11. Erosion and/or clogging	• (hydrotechnic) constructions or constructions that trigger or accelerate erosion/silting (e.g. incorrectly stabilizing a shore can lead to sharp erosions on the opposite bank)	• Morphological changes of the bank or bottom habitat, or changes in water dynamics

3.1. The quantitative impact of urbanization on underground water

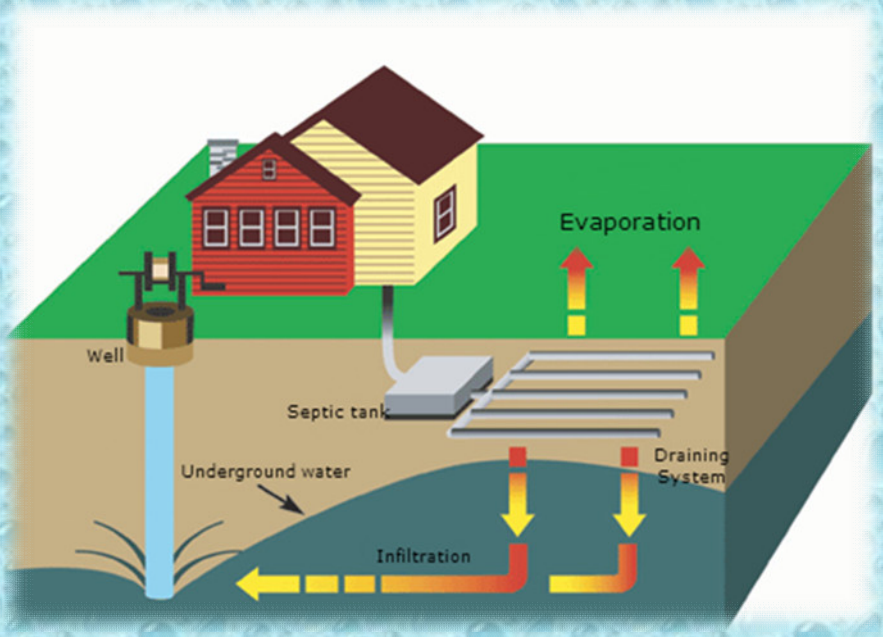
Urban development usually is accounted for raising the underground water levels, which affects urban structures that have been planned, and constructed during the period when the groundwater level was low, without acknowledging the possibility that the level could rise (e.g. problems in many European cities: underground, railway and subwaytunnels, underground car parks, basements of buildings, etc.).

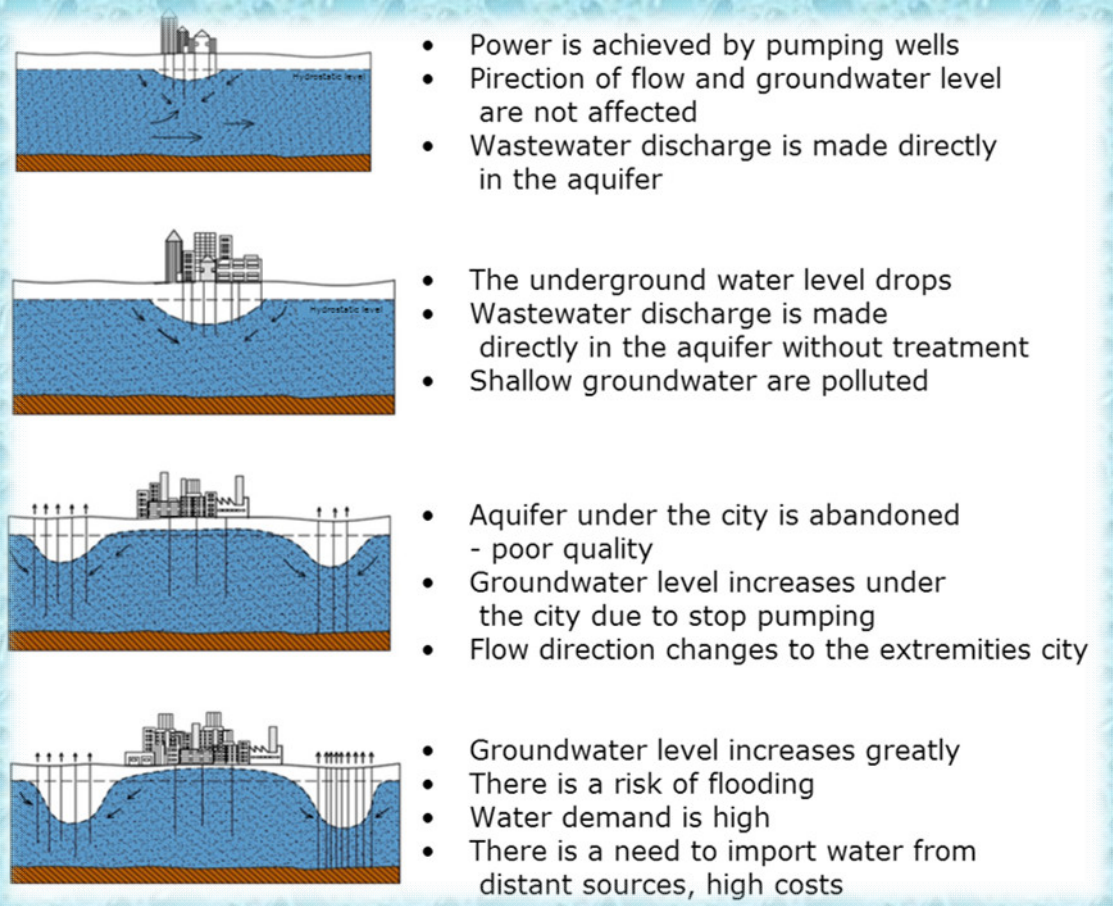
Groundwater is the “invisible bond” between various elements of the urban infrastructure.

The main sources of groundwater pollution

- Losses from septic tank or sewage systems (due to the deteriorating transportation infrastructure and wastewater collection). These losses can deteriorate the quality of groundwater by contaminating it with substances such as nitrates, nitrites, phosphates, chlorides, bacteriological contamination and contamination with other substances.
- The exchange between surface water and groundwater. In general surface water shows a much weaker quality than groundwater. This is more pronounced in urban areas because of waste discharges and storm, municipal and industrial water.
- The anthropic communication between aquifers leads to the pollution of aquifers at a greater depth, aquifers which are superior to those at a lower depth (mainly due to improper execution of wells).
- Infiltrations through the landfill (rubbish dumps). The lack of waterproof garbage dumps, or their deterioration affects the quality of groundwater by contaminating it with heavy metals (Cd, Cr, Fe, Pb, Cu, Zn), microbiological substances, and others.

Sources of groundwater pollution

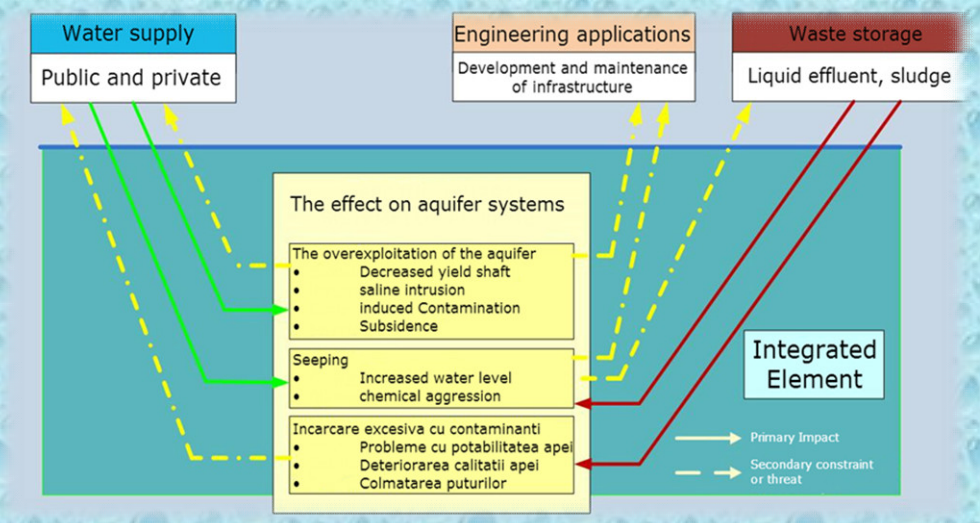




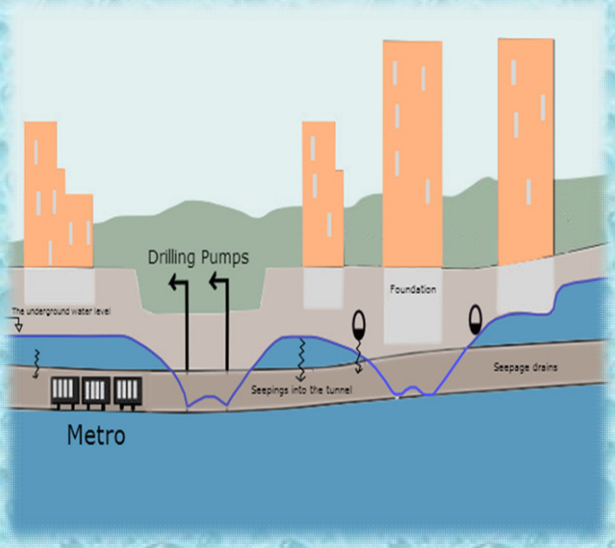
Situations regarding the impact of urbanization on groundwater

Urban water circuit

Understanding the behavior of aquifers requires knowledge of water flows: their size, their relative importance and their dependence on hydrological parameters.



The influence of underground construction on groundwater flow regime

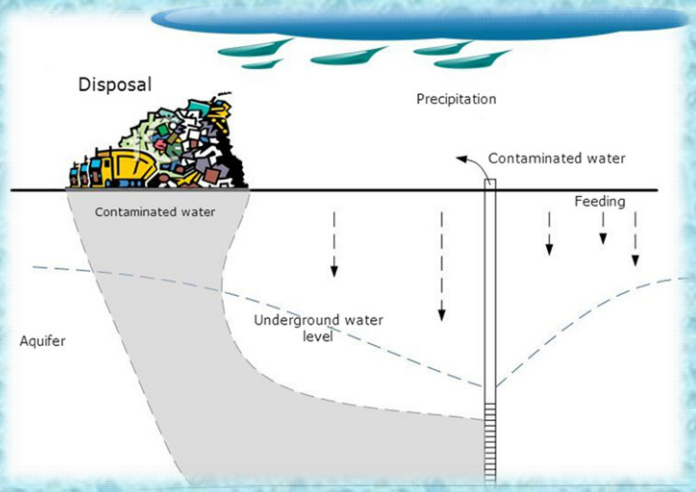


The interaction between groundwater and underground structures (underground, deep foundations of buildings, underground parking, water mains and sewer), and their effect on the piezometric level.

Qualitative effects:

They increase substantially the contaminant load as a result of:

- Loss of water from sewer systems (or others), reinjecting insufficiently treated water coming from the community or individual treatment systems;
- Improper storage and handling of community waters and substances used in the chemical industry;
- Improper storage and disposal of solid and liquid waste;
- Hydraulic connection with surface water (rivers, lakes);
- Anthropic hydraulic connection between surface and depth aquifers layers.



Problems caused by rubbish dumps

Quantitative effects:

Urban processes interact with groundwater through:

► Changing groundwater re-supply process due to:

- Reducing this after waterproofing the land surface;
- Exfiltration in water supply and seweragesystems (stormwater, wastewater or mixed) in groundwater (it compensates the reductions in natural refueling);
- Making anthropic hydraulic connections between aquiferlayers.

► Drainage of groundwater by:

- Transport networks (subway, railway, auto tunnels, etc.)
- Underground constructions (deep foundations, car parks, etc.)

► Stopping the flow of water (barrier effect) by:

- Elements of transport infrastructure (tunnels and metro stations, railway, auto, etc.)
- Underground constructions (deep foundations, car parks, etc.)

It is important to mention that urban structures have a waterproof barrier effect on the flow of the groundwater flow.

Water pollution, in addition to natural factors, technical-industrial development, side by side with the demographic explosion, raises dramatically the problem of deteriorating water quality through pollution.

Physical pollution can be the result of discharging some insoluble materials, radioactive contamination, hot wastewater resulting from the technological cooling processes.

4. Improving the impact of urbanization on water

As we mentioned before, one of the biggest problems of big cities is water deficit. It is expected that this will intensify during the 21st century because of the world population growth, economic growth and climate change.

Ways of improving the impact of urbanization on water:

- Implementing an integrated urban water management that integrates a more efficient and sustsainable groundwater exploration schedule;
- Management measures of water demand to stop inefficency, waste, and to reduce unaccounted usage;

- Setting rules regarding the interaction between the underground infrastructure and the aquifer system;
- Enstablishing some strategic measures for the aquifer water supply (in some cases as a last strategic reserve);
- Correctly applying the concepts and the methodologies in defining the protection areas for groundwater captation, based on the time of transfer of the contaminants;
- Defining and applying the concepts of aquifer vulnerability in protecting groundwater resources.

Conclusions

The influence of urbanization on water is not only a scientific and a technical problem, but also economic, social, with a political and legal aspect.

Among its specific issues we may include: fluctuations in the level of groundwater due to anthropogenic activities, groundwater pollution, changing the water cycle or altered flow patterns in urban built environment.

In addition, urban new works should not affect existing buildings, especially field-induced deformation (compression, movement) throughout the period of execution and operation. Many current urban areas are extensions of towns in old, abandoned industrial areas, where there are deposits of industrial waste, demolition debris or old quarries or mining areas that have underground voids left behind which lead to subsidence phenomena.

In urban areas, the underground space is used more and more for underground constructions (tunnels, deep basements, drainage galleries, utility lines, etc.). That is why, the impact of these constructions on the environment is more and more pronounced, and the scientific research is needed to sustainably manage the influence of urbanization on water resources.

III.4. Agriculture And Irrigation - Their Impact On Fresh Water

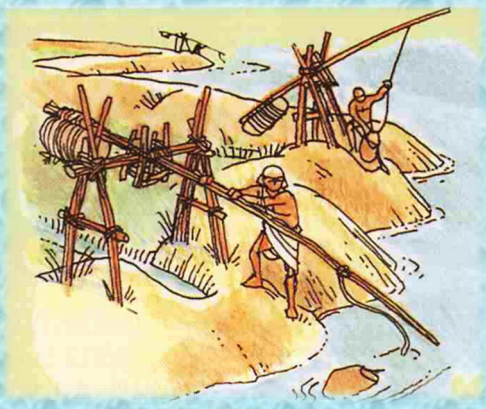
The Beginning of Irrigation

The irrigation is the action of watering a piece of land dedicated to farming. We do not know exactly where the irrigation started, but there are some facts we know about its origin:

- In the Neolithic period, people began farming the land and to mate animals.
- Despite it, agriculture is a recent activity, and so is irrigating. The first attempt to irrigate was two thousand years ago after the developing of farming.
- The first use of the irrigation was in the nearby lands next to the Tigris River in the Sumerian time, and later, the Chinese people started irrigating in the Hoag Hon valley about four thousand years ago.
- But it is essential to know that the modernization of the irrigation depended on the efforts and progress from some old nations that studied and learnt to use the floods of the rivers to develop agriculture, like the Egyptians.
- In America, we have found traces of old irrigated areas in the Inca Empire and in the Olmec civilization (in the Gulf of Mexico), as well as in populated areas by Salt River Valley (Arizona) where old Native Americans lived.
- We must remember the important and numerous works for driving the water built by the Roman and Arabic people. These two cultures are in the origin of the best irrigation systems because they constructed ditches in the most fertile plains of the country.
- In the classical Greece we have found remains of a more than 1 kilometer long tunnel built for driving water to Samos, crossing the Monte Castro.
- Later, the two most important constructions were, undoubtedly, the Valencian irrigation systems and canals made by the Romans.
- Since its origins irrigation has suffered a lot of changes that made it more effective. This way, the new systems of irrigation like drip irrigation, have been of great help and benefit in the last century.

Irrigation in The Tigris River

The very first irrigation systems were built about 5.000 years ago in the old Mesopotamia, from the Persis Golf up to the city of Ur where the Tigris, Euphrates, and Karum rivers run into the sea. There, the farmers of Sumer and Akkad cultivated wheat with waters from the Tigris and Euphrates thanks to many channels. Besides, it is known that the cities of Unima and Lagash also used the water from the Euphrates for cultivation, but after some problems, Lagash had to give up using water from the Euphrates and made a canal to bring the water from the Tigris, taking so much water that the excess reached the water table that was brackish and eventually polluted the soil, making it unsuitable for cultivation.



Irrigation in the Yellow River

In China, around the year 2200 BC, large tracts of land were irrigated. Just remember that the Chinese call the Yellow River "Hoang-Ho" ("River of Life"). That is why a whole civilization dependent on water was established in their margins and supplied a growing population by planting large areas. At the time of the Sui Empire (681-589) it was built the so-called Grand Canal, about 1,200 km long.

Grand Canal of China

Irrigation and the Romans

The Romans made great hydraulic works (pipelines, aqueducts, and baths), some of which have survived and they are used today. They repaired and improved the hydraulic systems governing irrigation in Egypt, and built huge irrigation works in all regions of the Empire devoting great new areas of land to agriculture, as it happened in Valentia where large areas of orange and tangerine trees are still cultivated.

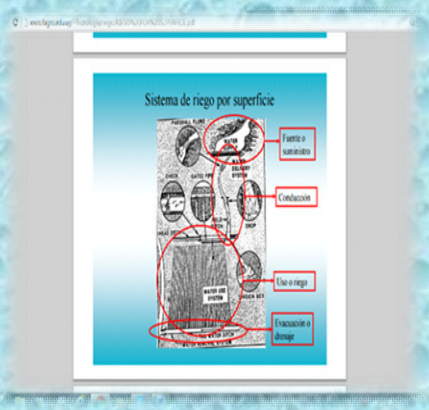
The Different Ways to Water and Systems of Irrigation

For a right development of the cultivation, you need to water the necessary amount of water. In the agricultural system of non-irrigated land the rain waters the crops, which is not frequent in dry climate areas.

Watering tries to complete the need of water in the crops. The systems of irrigation are the different ways to add water to the ground. They have developed along history, from the first civilizations, that used the river, looking all its waterspout and increases, to the technological automatic irrigations, used by agronomy.

Nowadays there are three ways to add water to the land:

Surface irrigation



Surface irrigation is the oldest way of watering, but it is the most used in Spain.

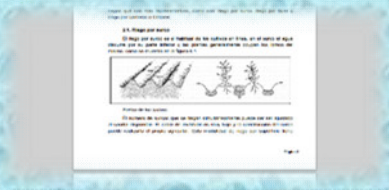
Nowadays we water in this way the 14.5% out of the 60% of useful land in Spain, about 3,500,00 hectares. It is a system of watering influenced by gravity. We use the surface of the land to distribute the water.

Disadvantages:

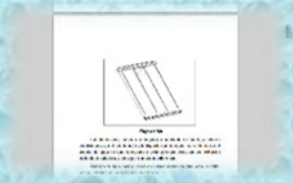
- It is easy to lose water because the surface overflows.
- The plot needs to be straight.

Advantages:

- Its simplicity in its installations and its infrastructures.
- It has got an easy maintenance. It does not need skilled workforce and energy.
- There are three types of surface irrigation: flood, fajas and furrows.



(by furrows)



(by fajas)

(by flood)

Watering by sprinkling

Irrigation systems try to imitate the rain. The irrigation water is sent to the plant through pipes and sprayers, called sprinklers and, thanks to a certain pressure, the water rises to the fall spray or as drops on the surface that you want to water.

Advantages:

- It uses less water than flood irrigation systems;
- It has a great adaptability to uneven terrain, with large height differences on the surface;
- It allows dosing the water with good accuracy.

Problems:

- It damages leaves and flowers, requires a significant investment, wind can increase spread of diseases and mushrooms because the plants are always wet;
- It is used in the implementation of plant hormones and to avoid freezing.

Watering by drip

It is an irrigation system that is characterized by a slow application of water and focused on the plant. In this way, we reduce the cost of unnecessary water which can be found in other irrigation systems.

The elements used to empty are called droppers, the flow is very small. These droppers are usually inserted into a polyethylene pipe. This pipe covers the crops. In general the facilities are fixed and automated; this allows the frequent use of irrigation and water use of poor quality.

Advantages:

- Few water losses by overflows;
- Low power consumption;
- Complete automation;
- Water is always in the place the plant needs;
- Decreases bad grass because we apply water directly on the ground;

- Reduction of pest problems in the leaves. Because the dropper emitting water directly to the root of the plant;
- It can be installed on any type of terrain. As most of the elements used are made of plastic, they can be molded as needed in any space.

Problems:

- It can be more expensive in its installation;
- The droppers can be tamponade;
- You cannot cultivate the land, because the watering by drips is fixed.

Factors to Choose the System of Irrigation

Using a method of irrigation or another depends on many factors:

- The topography and the shape of the plot, the slope, length and width, if there are roads, canals or other elements that could interfere with irrigation.
- The physical characteristics of the land, its ability to store irrigation water should be made available to the plant roots.
- The type of crop, which is necessary to know its water requirements to generate maximum production, as well as their behaviour when there isn´t water enough.
- Water availability, most relevant aspect as may be necessary to schedule irrigation.
- The availability of worforce that guarantees the implementation of all necessary elements for crop development, in particular those for irrigation.
- The cost of installing each irrigation system in particular.
- The effects on the environment, especially in the efficient use of water, the water quality of overflow and floor erosion.

Percentages of each system in Spain and in the whole world

On a global scale, 95% out of more than 220 million hectares of irrigated land are irrigated by surface, however this figure decreases in developed countries ranging between 60 and 80%. This is mainly because the sprinkler and localized methods are needed technology and more advanced than surface irrigation material.

In Spain the percentage of surface irrigation is 59%, although it decreases to 42% in Andalucia as a consequence of an increase on drip irrigation.

Irrigated area in the world:

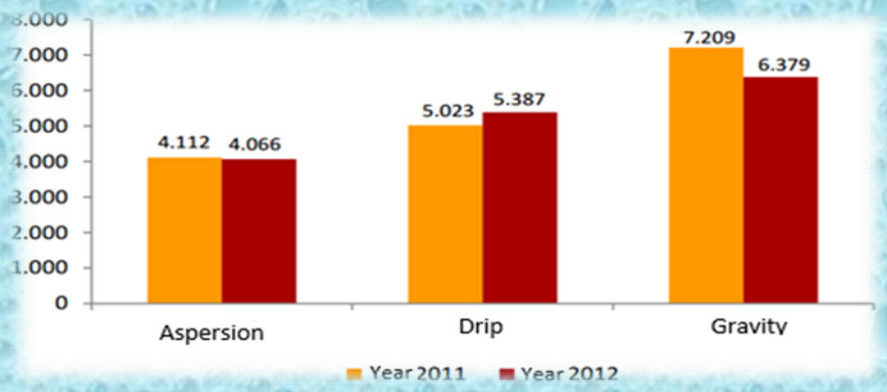
Region	Area (10^6Ha)
India	57
China	54
Pakistan	19
Asia	188
USA	22
Other regions	67
World	277

The volume of irrigating water used by farms reached 15,833 cubic hectometers in 2012, a decrease of 3.1% over the previous year.

If we consider the different irrigation techniques, the amount of water used in dropwise farming (drip irrigation) increased 7.2%. On the other hand, gravity irrigation decreased by 11.5% and the use of water sprinklers fell 1.1%.

Volumes of the water according to watering techniques

Watering techniques	Year 2012	% over the total	% yearly variation
1. Aspersion	4,066,180	25.7	-1.1
2. Drip	5,387,090	34	7.2
3. Gravity	6,379,445	40.3	-11.5
National total	15,832,715	100	-3.1



Unit: thousands of m^3

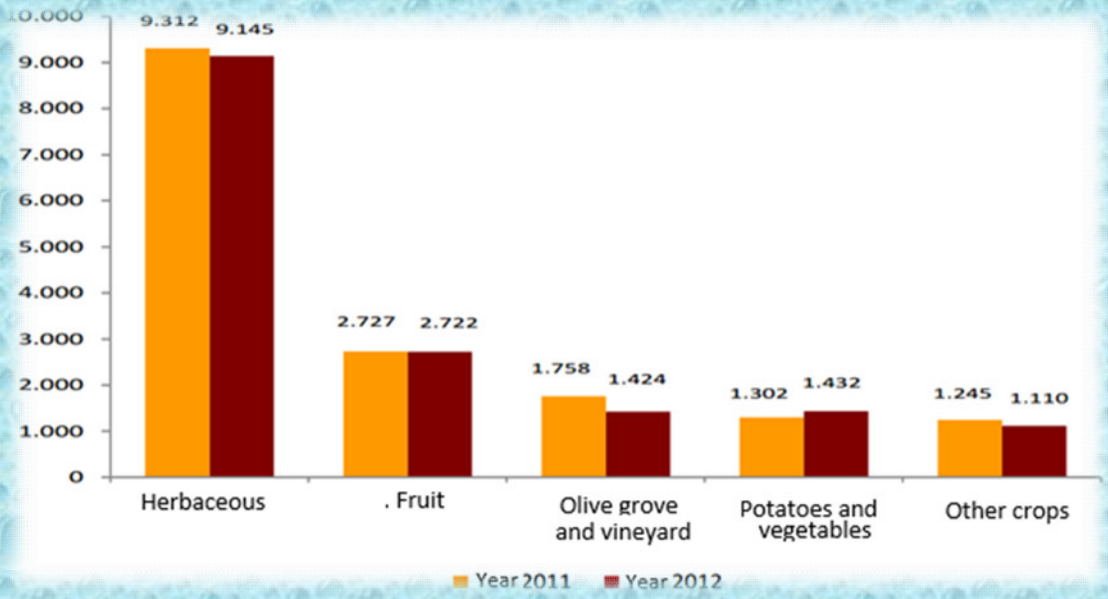
According to the type plants, herbaceous crops (cereals, pulses, rice, maize and fodder crops) that accounted the 57.8% of the total volume of irrigation water used in agriculture, water use decreased by 1.8%.

Some crops experienced the largest decrease in water use, like olive groves and vineyards, 19% less than the previous year, representing 9.0% of the volume of irrigation water used in 2012.

Volumes of water according to types of plants (in cubic hectometres)

	Year 2012	% over the total	% yearly variation
1.Herbaceous	9,145,114	57.8	-1.8
2.Fruit	2,721,754	17.2	-0.2
3.Olive grove and vineyard	1,423,888	9	-19
4.Potatoes and vegetables	1,432,206	9	10
5.Other crops	1,109,753	7	-10.9
National total	15,832,715	100	-3.1

Volumes of water according to types of plants Spain: Results by autonomous communities



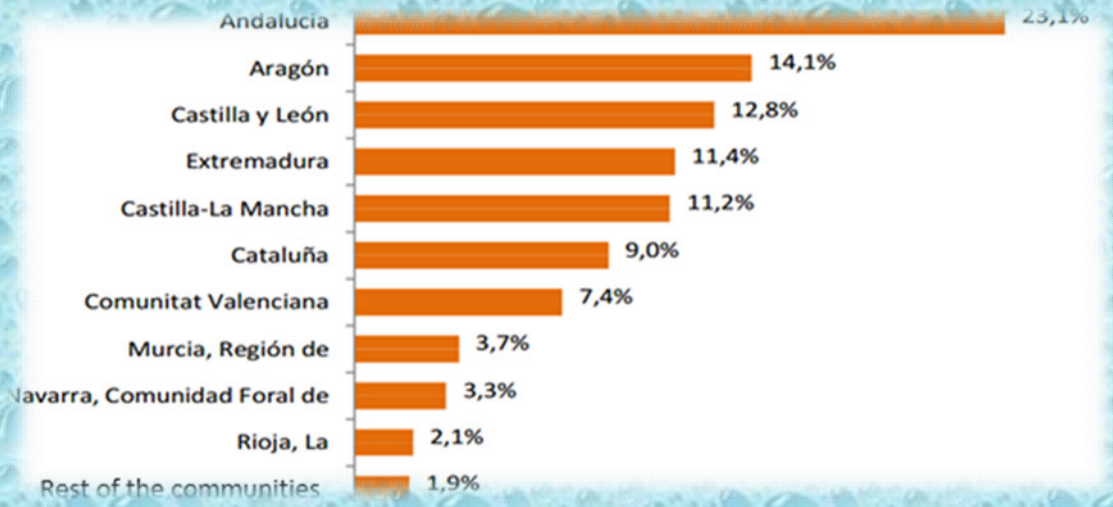
The communities that increase the volume of irrigation water used in 2012 more were Castilla-La Mancha (21.7%), La Rioja (7.4%) and Murcia (2.3 %). On the contrary, the ones that reduced the volume of irrigation water more were Cataluña (-17.4%), Aragón (-14.0%) and Extremadura (-8.5%).

Distribution of irrigation water volumes in Spain by Region

Unit: thousands of m^3	Year 2012	% Over the total	% yearly variation
Andalucía	3,658,241	23.1	1.8
Aragón	2,234,915	14.1	-14
Castilla y León	2,023,903	12.8	0.4
Castilla-La Mancha	1,774,25	11.2	21.7
Cataluña	1,428,834	9	-17.4
Comunitat Valenciana	1,169,453	7.4	-5.8
Extremadura	1,802,378	11.4	-8.5
Murcia, Región de	587,658	3.7	2.3
Navarra, Comunidad Foral	515,902	3.3	-6.8
Rioja, La	329,528	2.1	7.4

Rest of communities	307,478	1.9	1.3
National total	15,832,715	100	3.1

Percentage distribution of irrigation water volumes in Spain by Region



According to irrigation techniques, the region that uses more water volume by using sprinkler irrigation was Castilla y León. Using drip irrigation, the largest volume corresponds to Andalucía and by gravity Aragón was the community that spends more water using gravity irrigation.

Volumes of water by autonomous community and irrigation technique. Year 2012

Unit: thousands of m^3	Sprinkling	Dropping	Flooding	Total
Andalucía	309,192	2,634,495	714,554	3,658,241
Aragón	708,468	156,444	1,370,003	2,234,915
Castilla y León	1,202,198	52,623	769,082	2,023,903
Castilla-La Mancha	860,596	764,777	149,052	1,774,425
Cataluña	218,613	210,038	1,000,183	1,428,834
Comunitat Valenciana	4,677	587,065	577,711	1,169,453
Extremadura	333,440	378,499	1,090,439	1,802,378
Murcia, Región de	14,692	422,526	150,440	587,658
Navarra, Comunidad Foral de	167,668	37,145	311,089	515,902
Rioja, La	147,628	67,224	114,676	329,528

Rest of the communities	99,008	76,254	132,216	307.478
National total	4,066,180	5,387,090	6,379,445	15,832,715

- Availability of water:

76.9% of the volume of water available for irrigation in 2012 was superficial. In On the other hand, 21.5% had underground origin and 1.6% was taken from other water or regenerated sources, like desalinated water (sea or brackish) or from wastewater treatment stations.

Water volumes according to the origin

Unit: thousands of m^3	Year 2012	% over the total
Superficial water	15,120.576	76.9
Undergroundwater	4,225,883	21.5
Other hydraulicsresources	312,090	1.6
TOTAL	19,658,549	100

Water Storage in Spain

Reservoirs

We call reservoir the accumulation of water produced by a blockage in the river bed of a stream that is totally or partly closed. Reservoirs can be artificial or natural.

In Spain there are more than 350 reservoirs with a storage capacity of 54,000 cubic hectometres, which means 50% of the flowing waters.

The most important reservoirs or dams in Spain could be:

- The reservoir of Serena, in Badajoz, with a capacity of 3,220 cubic hectometres. It is the 3rd largest in Europe.

- The reservoir of Alcántara, in Cáceres, with a capacity of 3,162 cubic hectometres. When it was built it was the 2nd largest in Europe
- In Aragón we can highlight the reservoir of Mequinenza, Spain's 5th largest, also called "The Sea of Aragon".

Dams

They are used to keep water in the reservoirs. They are a barrier of concrete or other materials. They are usually built on cliffs. There are approximately 1.188 dams in Spain; the majority of them were built between the years 1960 and 2000.

Some of the most important in our country are:

- The dam of Almendra, in Salamanca. It is the highest (202 metres).

- The Dam of Canales, in Granada. It is the second highest in Spain being 156 metres high.


- The third highest dam in Spain is in our region. It is called “Canelles” and it is in Huesca (151 metres tall).

Transport of water in Spain

Aqueducts

In the old times, they were used to bring water from the mountains to the cities, but now we do not use them, so they are like a historical monument. The most important aqueducts in our country were made by the Romans. They are in Segovia and in Tarragona.


Aqueduct of Segovia Aqueduct of Tarragona

Irrigation canals

We call a canal an artificial water bed which takes water to irrigate the fields. They were introduced in Spain during the time of Al-Andalus, under the influence of the Arab culture. Sometimes they were quite complex and had small dams or gates to control the flow of water.

III.5. Tourism and Its Impact on the Hydrosphere

The Consequences of Tourism on the Hydrosphere

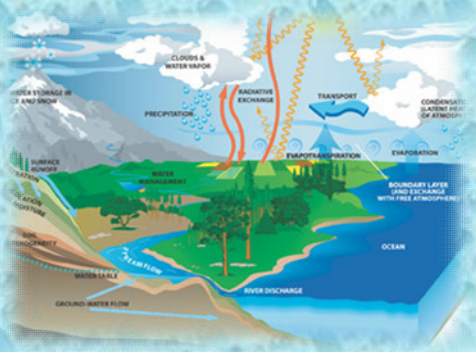
Introduction

Nature comprises a key element in tourism as it is directly connected to its quality and configuration therefore defining its forms and affecting its competitiveness. A reciprocal negative relationship between tourism and the environment can be seen in our days. As tourism increases, the devastating effects on the environment rise as well. According to the Third European Evaluation of the Environment (European Environmental Organization, 2003) the direct impact of tourism on people and the environment, depends greatly on the number of tourists gathering at a specific destination and the season.

We can concur with the statement "Tourism contains the seeds of its own destruction. Tourism can kill tourism, destroying the exact elements for which tourists are drawn to a specific area to enjoy" (Glasson, Goodey and Goodey, 1995:27)

As it is well known, $^{3}/_{4}$ of the Earth's surface is covered by water. The total amount of water reserves existing on Earth are characterized as hydrosphere, meaning oceans, seas, lakes and rivers, the total amount of groundwater, as well as that composed of vapor in the atmosphere. When defining the word "hydrosphere" we include whatever is composed of water (ex. fog, ice, etc.) and whatever includes precipitation and retention.

All the above elements are connected through the well-known, perpetual "hydrologic cycle" or "cycle of Water" which is illustrated at the following picture. It is worth to mention that during this "cycle", huge quantities of energy are transferred from one place of the Earth to another, through the procedures of evaporation, sublimation and condensation, that is through the transformation of water from one form to another. For example, when a cumulonimbus cloud gives a thunderstorm of a moderate intensity, the energy that is released to the surrounding atmosphere, during the



procedure of condensation, is more than the nuclear energy that was released from the atomic bomb that destroyed the city of Hirosima.

Environmental consequences of tourism on the hydrosphere

Tourism and any other activities performed in excess have negative consequences on the hydrosphere. Water pollution has reached great extents. Waste from hotels and resorts are transferred through sewage and drainage systems and are dumped into surface water (streams, rivers, lakes, seas) or groundwater. Where water passes, so does pollution.

Therefore, when surface water becomes polluted with contaminated waste containing substances that are broken down from organic matter, it strips the oxygen of water which is necessary for plants and marine life, naming one of the many detrimental effects. Consequently, this proves catastrophic to most marine life as the majority of species are faced with suffocation. Moreover, waste water leads to overproduction, meaning the overdevelopment of plankton resulting in the change of flora and fauna in the water, turning the water greener and slimier, so making it unsightly.

More specifically, the building of hotels and other resorts often lead to increased pressure on sewage treatment facilities due to the fact that many destinations often have a greater number of tourists and inhabitants during peak

season than during off-season. Sewage treatment plants are often designed in such a way making them unable to withstand the dramatic increase in waste matter due to the tourist period. Sewage water has polluted seas and lakes which surround tourist destinations and have destroyed the flora and fauna of the area. In hydro-eco-systems, a low percentage of oxygen means 2-3mg per liter of water (mg/1). The immediate result of hypoxia causes not only fish to die but also the reduction in the valuable number of fish reserves, thus destroying the ecosystem but even more upsetting, damaging the local tourism. What is more, changes in the salinity and sedimentation of the water and seabed may have wide scale effects on coastal environments.

Construction activities regarding the building and functioning of tourist resorts, ports, marinas and transportation services (airports, infrastructure – roads) as well as the location of those near shorelines, have consequences on the way natural ecosystems function but also on how species communicate and move about because their natural habitat has become limited due to deforestation, noise, the movement of vehicles, the presence of people and so on.

Moreover, leisure activities of tourists (cruises, scuba diving, sailing and engine run water sports) affect the habits and mobility of existing species and disrupt reproduction processes of the existing animals resulting in the reduction of the population of rare species.

A characteristic example is that of the Greek island of Zakynthos. There, the extensive and uncontrollable rise of shoreline construction of hotel resorts and the increased demand of water sports has brought about significant damage to the areas where the turtle Careta-Careta and the green turtle Chelonia Mydas inhabit. These species are in danger of extinction from this mass wave of tourism which surges into the areas where they inhabit and reproduce. Beaches where they lay their eggs are dramatically shrinking due to the residential increase of the area and tourist activities. More specifically:

A) Glaring lights on beaches, not only disorient the females reaching the shore to lay their eggs, but also the hatchlings which try to reach the sea.



B) Passing vehicles which compress the sand may disturb the flow of air and the way the eggs absorb it.

C) Beach umbrellas and deck chairs on beaches where eggs are laid often form a barrier turtles cannot break through hindering their access to the area of the beach where they reproduce.

D) The planting of trees and the setting up of beach umbrellas result in excessive shading over the nests thus lowering the temperature of the sand and affecting the hatching of the eggs.

E) The presence of people on beaches at night, frighten sea turtles which want to lay eggs. Sand castles or tire tracks may trap hatchlings on their way towards the sea.

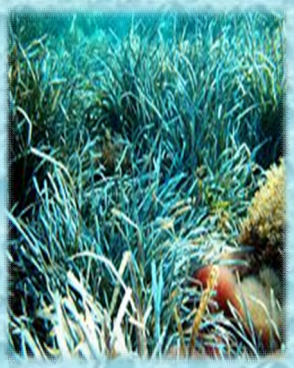
Furthermore, tourists while on holiday leave behind plastic bags and litter defacing the beauty of the area. Most importantly, however, is the fact that the ecosystem is contaminated. A particular example is the fact that many sea turtles confuse plastic bags for jellyfish leading to their death after they accidentally consume them.

Water, especially fresh water, comprises one of the most important natural resources. Generally, the tourist industry greatly misuses resources to the advantage of hotels but also for the tourists' personal use. This may lead to water

shortage and the reduction of water supplies but also the production of a greater amount of sewage waste matter.

For instance, the average water consumption in the town of Antalya (Turkey) is 250 liters per person daily, though the average water consumption in the tourist area of Antalya exceeds 600 liters. In Majorka (Spain) water consumption in agricultural areas is 140 liters per person daily, in urban areas 250 liters, though the average consumption of water for tourists is 440 liters or even 880 liters in the case of a luxurious resort or facility (European Environmental Organization, 2001).

The transporting of tourists to their destination, getting them there and returning them to their initial homeland entails one more hazard to the environment and hydrosphere. Roads, air and railway transportations are constantly increasing, along with the rising number of tourists and their mobility. As far as air travel is concerned, it comprises 60% of today's means of tourism and for this reason it is responsible for a significant percent of gas emissions such as carbon dioxide (CO_2). Emissions due to transportation and emissions resulting from the production of energy are related to acid rain, the exacerbation of the greenhouse effect and local air pollution.



In addition, the development of ports, yachts, breakwaters and other coastal constructions may cause changes to the distribution of sediment due to the currents, resulting in shoreline erosion. The exposure of construction materials from coastal areas and adjacent shores may harm forests on the mainland as well as underwater species as is the case with the marine species Posidonia (Posidonia Oceanica), thus resulting in increasing erosion.

Light or manageable tourism, a hope of sustaining tourism and a healthy hydrosphere

We can conclude that the consequences of tourism on the hydrosphere are many and often complex. Light or manageable tourism is connected with the hope of combining the conservation of the environment with the viability of tourism.

Alternative forms of tourism must be carried out under strict conditions regarding viability.

These conditions must assist in the distribution of tourists regarding where and when they will visit an area, while strengthening the local economy and offering a different holiday idea, one differing from the usual "sun, sea and beach." Alternative tourism focuses on the increasing need people exhibit for adventure and taking part in activities and not just leisurely enjoying a destination. Such forms of tourism include agricultural tourism, visits to thermal spas, spiritual tourism, cultural enlightenment, hiking, skiing, and sessional tourism associated with a convention. For instance in Greece, the economy of which is based on "Water" tourism at a huge degree, there are numerous examples of such forms of tourist destinations which meet the concept of viability and sustainable tourism.

Such is the case of the National Woodland Parks of Dadias-Lefkimis-Soufliou (see photo on the right), or the revival of the village Milies in the prefecture of Hania at the island of Crete. As far as the islands of Greece are concerned, viable tourism can only be maintained by controlling the consequences of mass tourism, as it has been well accomplished by the island of Sifnos.

To sum up, it is our overall responsibility to reduce the number of these consequences as the environment is our home, whether it is aquatic or not. We must wholeheartedly voice a "No" to the industrialization of nature and a great "Yes" to the conservation of the ecosystems not only to improve the quality of our life but also to ensure and protect the life of every species that inhabits the Earth.

III.6. "The Sky Is Angry" Greenhouse Effect, Acid Rain, Drought, Flood, Melting of Ice in Alps, Greenland

"The sky broke like an egg into full sunset and the water caught fire."

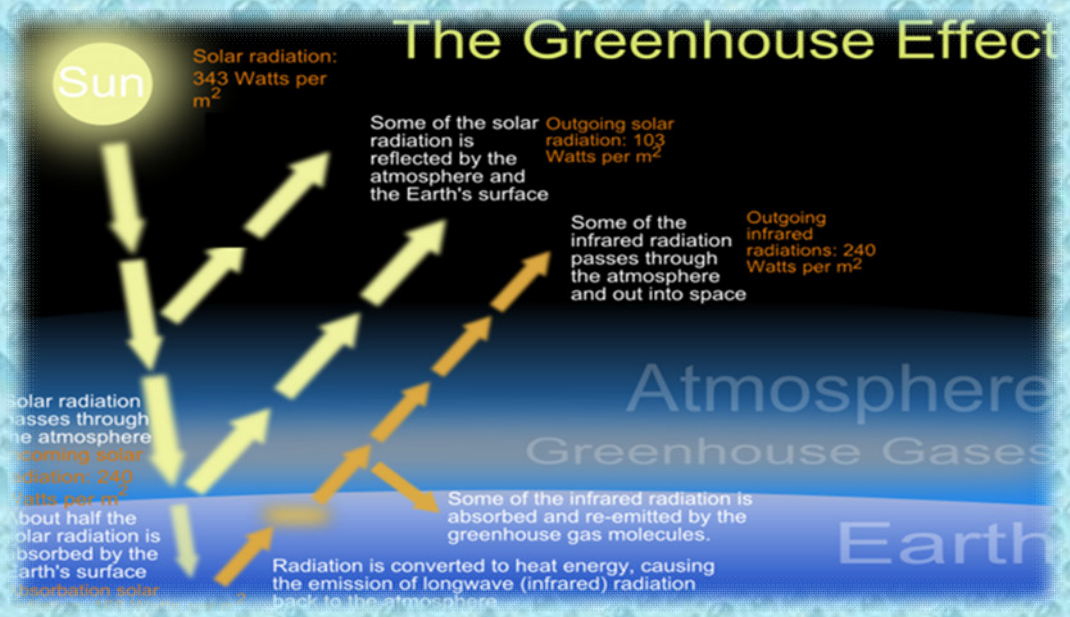
P. H. Johnson

Water is fundamental to life on Earth. The atmosphere is important to Earth, too because: it protects the Earth from burning space objects, provides oxygen and carbon dioxide for living things, traps heat to keep the Earth warm, filters out harmful rays from the Sun, and brings moisture that has been evaporated from water to dry land. Our atmosphere is very susceptible to change due to the activities of humankind. As our society has grown and advanced, its effects on the environment and the atmosphere have become more and more polluted.

Greenhouse gases. Greenhouse effect.

Atmosphere consists from 78% nitrogen, 21% oxygen, and 1% other gases like water vapor, carbon dioxide and ozone. The greenhouse effect is the process which leads to warming of the planet. On the Earth´s surface is land radiation and a certain part leaving of our planet.

Scheme greenhouse effect



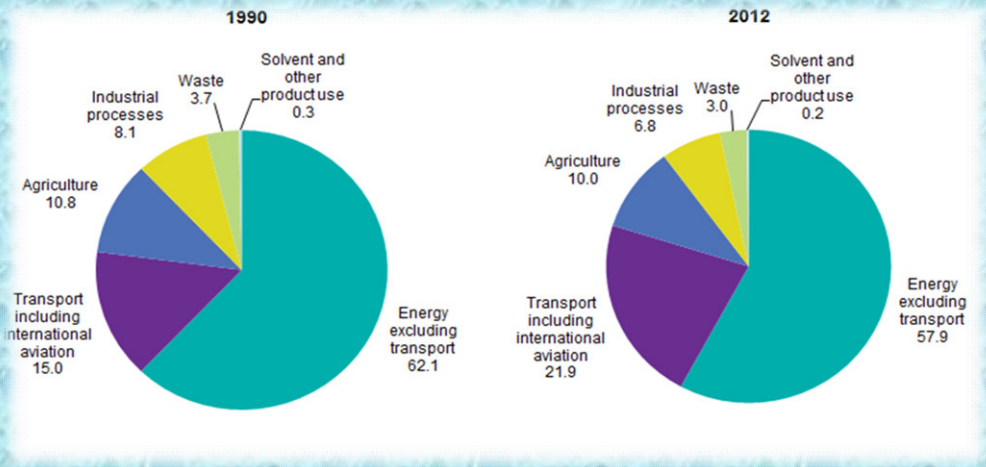
Source: https://upload.wikimedia.org/wikipedia/commons/d/d5/The_green_house_effect.svg

Leaving radiation takes two forms: the reflected sun radiation and thermal radiation.

Thermal radiation when leaving our planet from the capture of greenhouse gases

The water vapor causes about 60% of the Earth´s natural greenhouse effect. Carbon dioxide causes about 26%. Methane, nitrous oxide and ozone cause about 8%. Accumulation of thermal radiation is getting the planet warmer.

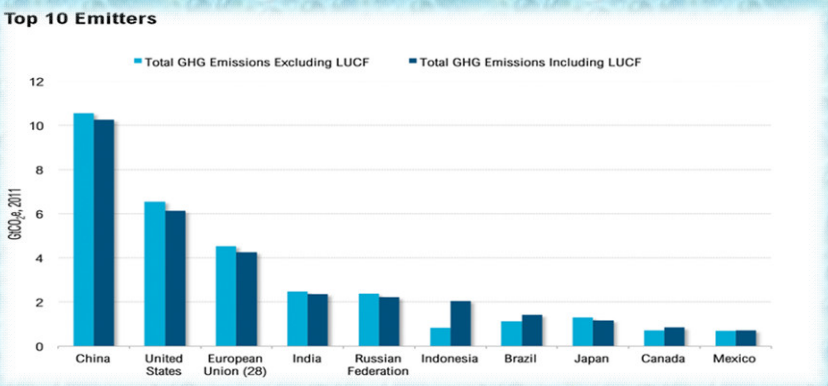
The greenhouse effect is causing global warming. The number of greenhouse gases is increasing. For example: production of 1 kg of beef produce the same amount of Carbon dioxide as 100 km by BMV 118. Between 1990 and 2012 the EU-28's greenhouse gas emissions fell by 19 %. In this graph you can see the production in EU by sector.



Source: November 2015

http://ec.europa.eu/eurostat/statisticsexplained/index.php/File:Greenhouse_gas_emissions,_by_source_sector,_EU-28,_1990_and_2012.png

In this graph you can see Top 10 emitters of greenhouse gases in the world.



Global warming

Each greenhouse gas has a different capacity to cause global warming. A climate change represents a change in long-term weather patterns. They can become warmer or colder. Annual amounts of rainfall or snowfall can increase or decrease.

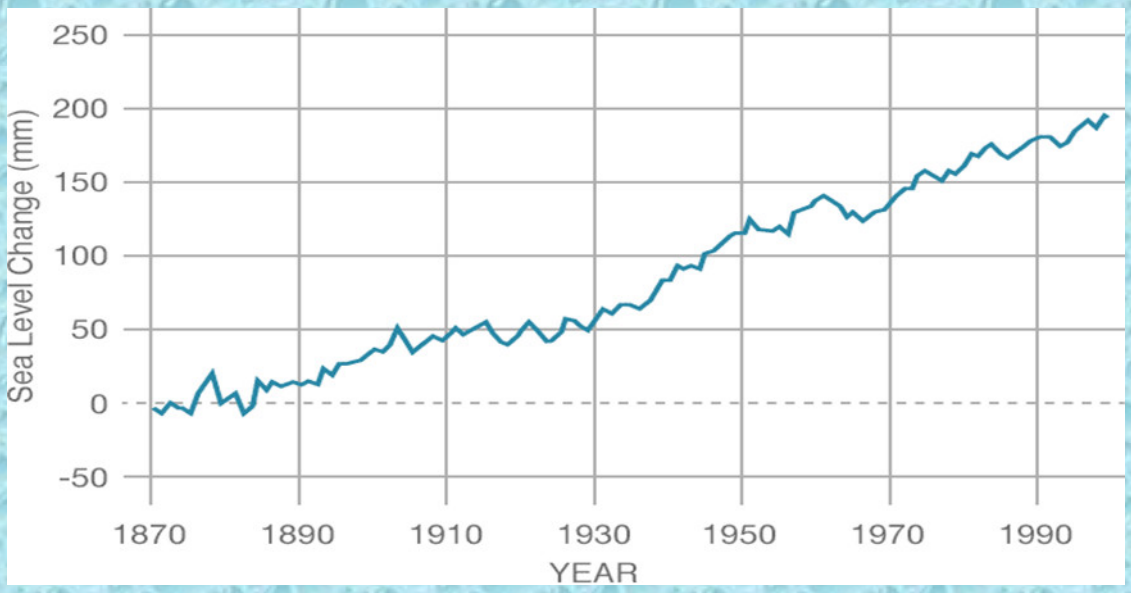
The climate change is an important and constant change in statistics of weather realitionships ongoing in between one decade and many milions years. That can go about change in a normal climate condition or change extreme weather effects.

These are the factors of changing climate: biological trials, changes of sunshine falling on Earth, changes of tectonic boards and vulcanic eruptions. We call today´s climate changes a global warming. They are faster and caused by human society.

Today, we use the term global warming for the last warming. That have been since 20th century. We are watching the grow of normal temperature climate system of Earth. People influence this climate system. This warming has been in the oceans (90%) since 1971. The temperature of air and water is about 0,6 – 0,8°C warmer. Earth is warmer than before.

The ten warmest years in the 134-year record all have occurred since 2000, with the exception of 1998. The year 2014 ranks as the warmest one on record (NASA, 2014).

A very dangerous part of the global warming is an increasing temperature in oceans, because here we catch 93% grow temperature energy in the climate system of Earth. The sea level rise is caused by two factors related to global warming: the seas grew up in the years 1961 – 2003, because temperature in the seas is higher and glaciers are melting. The level of oceans is changing by 3.24 mm per year now (NASA, 2015).



Source: http://www.cmar.csiro.au/, http://climate.nasa.gov/vital-signs/sea-level/

The other changes in oceans

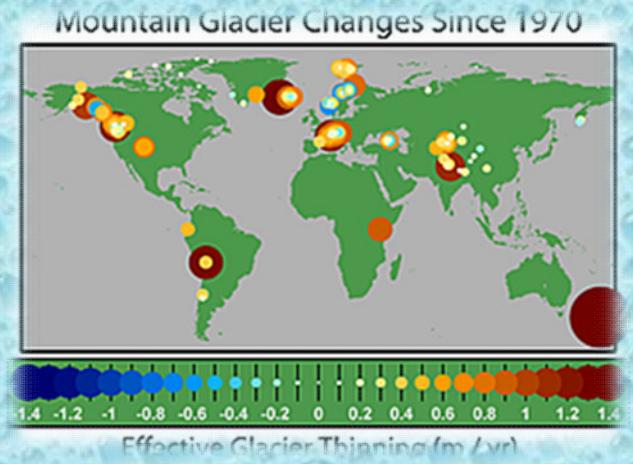
El Niño is a climate pattern where the water in the Pacific Ocean near the equator gets hotter than usual and affects the atmosphere and weather around the world. El Niño climate conditions occur every few years, and they are not predictable. El Niño is Spanish for The Little Boy. It refers to the Christ child and was named by Mexican fisherman, who noticed the climate pattern often formed around Christmas time.

In 1982-83, and in 1997-98, we experienced the strongest El Nino effects in the 1900s. El Nino has been responsible for floods, droughts, thunderstorms, extreme rainfall, milder Canadian winters, lowered cyclone and hurricane activity, and dryer-than-normal monsoons. In recent years, however, the Pacific has cooled thanks to a corresponding ocean phenomenon, known as La Niña (Spanish for "the girl"). It depresses sea surface temperatures and has played a key role in limiting global warming since the turn of the century.

As a result, global temperatures have been prevented from rising above their 1998 record level. That cooling has now stopped, however, and a new El Niño warming period has just started in the Pacific. This climate pattern can influence more than fifty percent of the world climate.

The melting of ice

The polar regions of the Earth are where climate change is having the most visible and significant impacts. Sea ice and freshwater glacial ice are melting, the permafrost continues to thaw and release even more greenhouse gases and many species are find it increasingly hard to adapt to the escalating changes.



Source: http://d2ouvy59p0dg6k.cloudfront.net/img/glacier_mass_balance_map_359248.png

A vast expanse of the Arctic is made up of permanently frozen ground, called permafrost. This frozen ground supports roads, pipelines and buildings. As the temperatures increase, the permafrost thaws and the infrastructure becomes twisted and unstable.

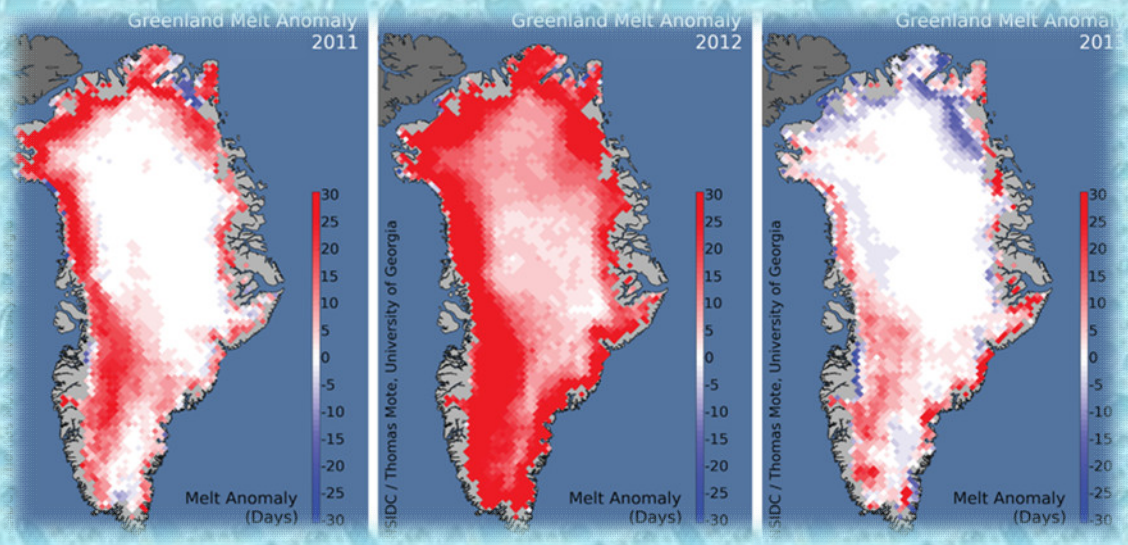
“Drunken forests”, where the trees fall over as the ground beneath them thaws, has become a more common sight.

The last twenty years we are watching decrease of glacier in Greenland and Antarctica. Glaciers are melting away of all places on the Earth and snow is disappearing on the northern hemisphere in spring months.

Since 1850 the glaciers of the European Alps have lost about 30 to 40% of their surface area and about a half of their volume. The glacier melting has accelerated in the European Alps since 1980, and 10 to 20% of glacier ice in the Alps were lost in less than two decades.

Arctic glaciers have been receding, with the exception of Scandinavia and Iceland where they increase in precipitation resulted in glacier growth.

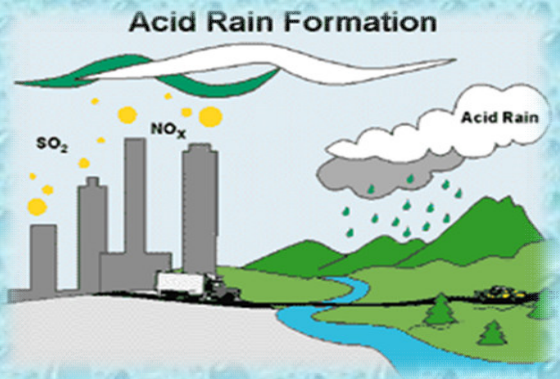
Greenland itself contains 12% of the world's ice; entire portions of the Greenland ice sheet appear to be sliding towards the sea. For example, the meltdown of the Greenland ice sheet could done at a temperature increase of 2-3°C.



Source: http://nsidc.org/greenland-today/files/2014/05/GrnToday_Fig2_15May.jpg

New studies confirm that the melting of glaciers near the Earth's poles and the resulting rise in sea level is slowing down the Earth's rotation and making each day a little longer.

Acid Rain

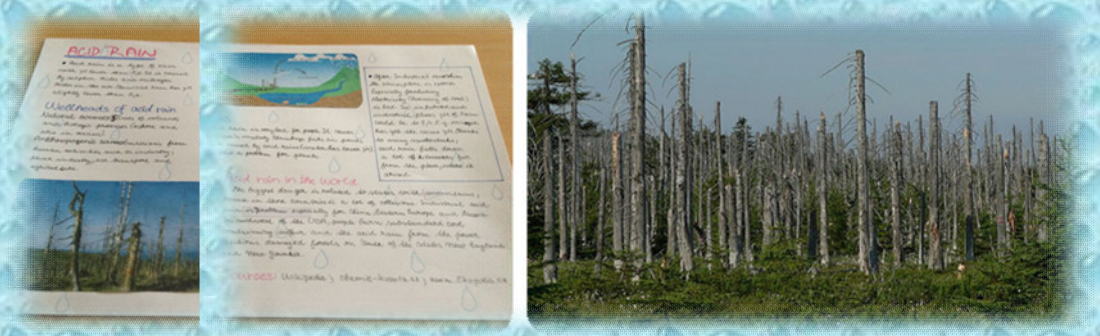


Acid Rain is rain, snow or fog that is polluted by acid in the atmosphere and damages the environment. Two common air pollutants acidify rain: sulphur dioxide and nitrogen oxide.

When these substances are released into the atmosphere, they can be carried over long distances by prevailing winds before returning to the Earth as acidic rain, snow, fog or dust. When the pH levels drop below 6, the water then starts to become more acidic and its properties change. Acid Rain, however, looks, feels, and even tastes like the normal rain. Acid Rain is not only found in the form of rain, but also in the form of a very dense smog. When the environment cannot neutralize the acid being deposited, some damage occurs.

In The Czech Republic we have big problems with acid rain. The damage of our woods is the biggest in Europe. Even most of this acid rain is not even caused by The Czech Republic itself but rather by pollution carried in from nearby

factories and power plants in other parts of Europe. The Black Triangle region is the border region shared by The Czech Republic, Germany, and Poland characterized by extremely high levels of pollution. For example, in the Jizera Mountains or Krušné hory of Czechoslovakia (till 1989), acid rain has had a devastating effect on the waterways. Acid rain in the Jizera Mountains caused that many lakes and streams had much lower pH levels in the 1980s, around 4 to 5 (normall is clouse to 6.5).



„Acid rain woods1" od Nipik 22:01, 10 July 2006 (UTC) – Vlastní dílo. Licencováno pod Volné dílo via Wikimedia Commons https://commons.wikimedia.org/wiki/File:Acid_rain_woods1.JPG#/media/File:Acid_rain_woods1.JPG

Extreme Weather & Climate Events in Europe

A flood is a covering by water of land not normally covered by water. Flooding is a common natural disaster, and also very common in many places where rains fall. We can recognize different types of floods: flash floods, rapid on-set floods, slow on-set floods, coastal floods, ice-jam floods etc.

The floods are caused by rivers overflowing their banks after heavy rainfall, the sea flooding the land, as a result of heavy winds pushing the sea up against the coast, volcanic eruptions under the sea causing a huge wave, called a tsuanami.

Floods can damage bridges, roads and other transport links. Infrastructure such as buildings, cars and houses can be left saturated or completely taken by the waters. While sewage systems and power grids can be destroyed. A mere 0.7 m of water can float a large vehicle or a bus. This is why you should never drive through flooded roads. Just 0.15 m of rapidly moving flood water can knock a person down.

The Yellow River (Huang He) in China has had the deadliest flood events in world history. The floods of 1931 resulted in 1 to 4 million people being killed. The 88,000 sq km of land were flooded, leaving 80 million people without homes

Flooding has a long history throughout Europe. For example, back to 2002,

week-long floods damaged parts of Europe, and its magnitude was said to be one in a century. Areas affected in the 2002 flood included Germany, Austria, Slovakia, Czech Republic, Romania, Hungary, Poland, and Croatia.

The biggest floods in Europe in last five years.

Year	Countries
2015	France, Great Britain, Norway, Spain, Greece, Portugal, Italy etc.
2014	Bulgaria, Bosnia and Herzegovina, Croatia, Serbia, Romania
2013	Germany, The Czech Republic, Austria, Switzerland, Slovakia, Belarus, Poland, Hungary
2012	Romania, Great Britain and Ireland, Russia
2011	Ireland, Italy, France
2010	Albania, Poland, Hungary, France, Slovenia

Charles Bridge in Prague during 2002 floods. Photo was taken two days before the flood culmination, when water was even a few meters higher

Source: https://upload.wikimedia.org/wikipedia/commons/b/bc/CharlesBridge2002floods.JPG, Creative Commons 2015

A drought is a period of below-average precipitation in a region, resulting in shortages in its waters supply, whether atmospheric, surface or ground water. It can last months or years too. Drought may occur almost anywhere in the world. Types of droughts are meteorological (lack of precipitation), agricultural, (lack of moisture in the soil where crops grow), hydrological (low levels of water in lakes

and reservoirs), and socioeconomic (water shortages in drinking and running water).

Areas in Europe with the lowest soil moisture content since 1990 in July 2015 (in red) and in July 2003 (in blue).

Source: JRC-EDEA database (EDO), European Drought Observatory (EDO) Drought News August 2015,http://edo.jrc.ec.europa.eu/edov2/php/index.php?id=1050

Much of the European continent has been affected by severe drought in June and July 2015, one of the worst since the drought and heat wave of summer of 2003.

The drought, which particularly affects France, Benelux, Germany, Hungary, the Czech Republic, northern Italy and northern Spain, is caused by a combination of prolonged rain shortages and high temperatures.

Some other examples of extrem events around Europe in last years

2013

- The shortest recorded period between the last ice day and the first day of summer. In Vienna, Austria, the time period between the last ice day and the first day of summer (25 days) is the shortest since record-keeping began in 1872.
- The smallest May snow cover in Eurasia since records began. In Eurasia, May snow cover extent is the lowest on record for the month. Record-keeping began roughly 45 years ago.
- The fourth-lowest snow coverage in Northern Hemisphere. Snow cover in the Northern Hemisphere is the fourth-lowest since 1967, following the three years with the lowest recorded snow cover in 2012, 2010, and 2011, respectively.
- Scotland has its wettest December on record, which lasts more than a century. Precipitation is 181 percent of the monthly average.

- The cold lasts for three weeks and is accompanied by heavy snowfall. More than 650 lives are lost as a result, with the majority of deaths occurring in Russia, Ukraine, and Poland.
- All-time record number of storms over the British Isles in winter 2013-14

2015

- The Czech Republic has been hit with a severe heat wave. Currents of hot air coming from north Africa via France and southern Germany raised temperatures by to a new record of 40.4 degrees Celsius. Germany's all-time heat record was toppled July 5 in Kitzingen, topping out at 40.3 degrees Celsius.

International cooperation

The adoption of the Kyoto Protocol at the Earth Summit in Rio de Janeiro, Brazil, in 1992 was a milestone in the international negotiations on tackling climate change. Adopted in 1997 and in force since 2005, the Kyoto Protocol set binding greenhouse gas emissions targets for developed countries for the period 2008-2012. The protocol was renewed and extended until 2020.

United nations conference on climate change
COP21/CMP11

There was 21st Conference of the Parties to the United Nations Framework Convention on Climate Change (COP21/CMP11), from 30th November to 11th December 2015 in Paris. The goal of COP21 is to reach a new international agreement on climate that is universal (agreed by and applicable to all countries), keeping global warming below 2°C etc.

And our project took part in it: http://www.agence-erasmus.fr/evenement/360/cop21-deux-conferences-debats-sur-lengagement-de-la-generation-erasmus.

But we can do some little things by ourselves too to make a difference.

This will help to reduce the amount of fossil fuels going into the atmosphere. Whenever you use electricity, you help put greenhouse gases into the air. Switching off lights, televisions, and computers. Also, planting trees is a great way to reduce greenhouse gases. Trees absorb carbon dioxide, a greenhouse gas, from the air.

Finally, don't forget about recycling (our school is recycling papers and plastic too).

CHAPTER IV

IDENTIFYING SOLUTIONS TO SOLVE THE WATER PROBLEMS

INTRODUCTION

This fourth chapter is strongly linked to the third one. Whereas the previous one refers to the main problems affecting water in all its features, this one focuses on how we can solve these problems. It is very important to be able to notice that solutions can be run at a big scale but also in our daily lives.

Unit one presents how we manage water resources, making the point on the age of water, its cycle and utilisation. But it also talks about water as an element that is used and re-used and how to manage water resources properly, namely in the EU countries. For that purpose, Blueprint strategy has been created to offer a variety of tools to monitor and manage this precious resource. Other strategies and tools, with the example of Bulgaria, are shown in this part.

The second unit is about preventing and mitigating the negative effects on water due to urbanization. This process is one of the oldest in the history of mankind, and also the one whose impact on water resources is bigger. Urban water management, as well as new challenges to use and re-use water, are presented here, highlighting systems that integrate all the phases of water consumption, treatment and sewage in order to make all the processes more sustainable. On a closer scale, new technologies to obtain water (e.g. desalinisation) and to treat it (e.g. membranes) show the way to the future methods of dealing and managing water resources in urban environments.

In the third unit we go green finding solutions against water pollution and how to reduce pollutants: using clean energies, treating liquid waste, etc. In this task, our daily lives are also involved: using less plastic and no littering, using collective transports and changing, little by little, our household habits. The main objective is that everyone should make water conservation a commitment.

Agriculture and its problems with water is the topic of the fourth unit. Agriculture is probably the oldest water-consuming economic activity, and its development has been deeply linked to the development of water supply and irrigation systems. So, we have two main sources of problems affecting water: on the one hand, the overexploitation of water resources (lakes, rivers, aquifers) due to inefficient watering systems; on the other hand, the pollution of water caused by the use of chemicals on crops and pollution related to cattle raising. New measures and techniques are presented not only to avoid water looses and pollution, but also to increase precipitations (e.g. with big masses of vegetation that would favour this process).

The fifth unit explains different ways to handle the consequences of tourism on the aquatic environment. It is very important that, once again, we present different measures to take at different scales: governments, tourism enterprises but also single tourists. With some examples from Greece, this unit tells us about the newest solutions as Ecotourism, *Green Hotels* and the campaign of Greenpeace aiming to protect the oceans by creating a worldwide network of marine reserves, which will cover 40% of the marine areas.

The last unit gets us to know that the motto “think globally, act locally” has never been so in fashion and so necessary as it is nowadays. Global warming is a dramatically urgent and serious problem. We do not need to wait for governments to find a solution for it: each individual can bring an important help. Each of us can do some little things to help our planet. With a list of simple actions in order to fight against and reduce the Global warming phenomenon that can be carried out in schools, families, etc, this chapter ends reminding us that “every drop counts”.

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IV.1 MANAGING WATER RESOURCES

Are we still drinking water that dinosaurs drank?

Water evaporates from the oceans, forms clouds, falls as rain (or snow), and returns in rivers to the ocean. The places it stays longest are in the deep ocean and in deep ground water, locked in for up to 10000 years. However, water is also destroyed chemically in photosynthesis (plants convert carbon dioxide and water to sugars and oxygen) and recovered again in respiration (basically the reverse of photosynthesis to make energy and CO2). We can calculate how much water remains from the dinosaur age from the total amount of water on the planet and the amount of water taken up in photosynthesis per year. Based on this, we can say that it would take about 100 million years to destroy chemically most of the water. Dinosaurs lived 65 million years ago. So, some of the water we drink is the same water, but more than half is different water.

Access to good quality water is essential for people, nature and economic activities. Large amounts of water are required to produce energy, grow food and manufacture everyday goods. Restoring waterways to their natural state is essential to ensure that fish, birds and animals get the food and habitats they need.

Under Europe's central piece of water legislation – the Water Framework Directive – river basins are systems to be managed in a coordinated way. The aim of the legislation is to ensure good quality water around the EU.

A healthy marine environment is also vital. Marine pollution often comes from land, but it can come from sea-based activities or from the atmosphere. The Marine Strategy Framework Directive adopts a coordinated approach to managing human activities that have an impact on the marine environment. It

aims to have marine waters healthy by 2020. Other EU legislation safeguards drinking water and bathing water.

To manage water resources properly, quality needs to be monitored closely. Member States check the state of their waters and draw up plans showing how they will clean them. These plans are stored in a central database calledWISE (Water Information Systems for Europe).

It is clear that we need to do more to improve the quality and quantity of Europe's water resources, and make sure that people use it wisely. The steps we need to take are set out in a Blueprint for safeguarding Europe's water resources to 2020. The aim is to make sure Europeans enjoy sufficient supplies of good quality water for the foreseeable future.

Environment: Commission presents Blueprint to safeguard Europe's waters.
The Commission has launched a Blueprint to Safeguard Europe's Water Resources, a strategy for ensuring that enough good quality water is available to meet the needs of people, the economy and the environment.

EU waters are not doing well in terms of quality, despite improvements in recent years. Water quantity is of equal concern with water scarcity spreading in Europe and extreme events (like floods) increasing in too many Member States.
We must step up our efforts in order to deal with old and emerging challenges, including water pollution, water abstraction for agriculture and energy production, land use and the impacts of climate change. Strengthened measures are needed to help the EU protect its water resources and become more resource (including water) efficient.

Environment Commissioner Janez Potočnik said: "This Blueprint shows we have a good understanding of the problems we face and a solid platform to tackle them. The time has come to take action to deliver the full benefits of our legislation and create opportunities for innovative solutions in water policy and the water industry. What is needed is a sustainable balance between water demand and supply, taking into account the needs of both people and the natural ecosystems they depend on."

A STRATEGY FOR ACTION

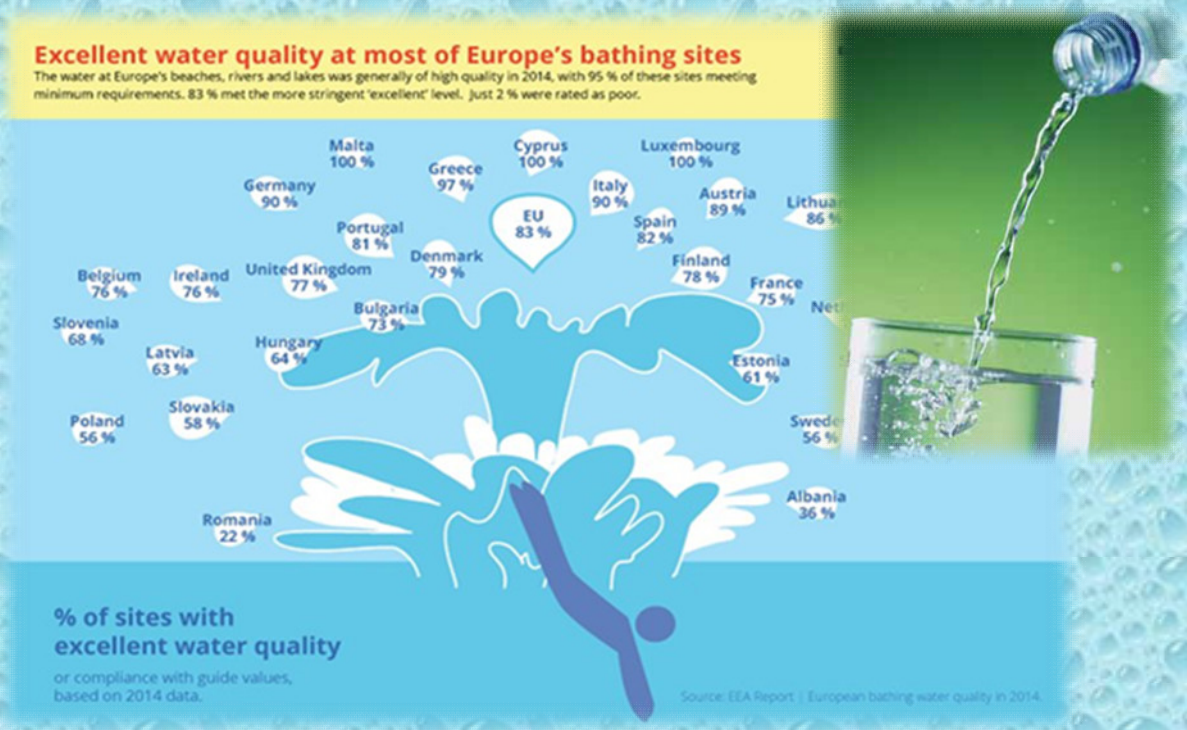
To achieve the already existing Water Framework Directive objective of good water status by 2015, the Water Blueprint sets out a three-tier strategic approach:

- Improving implementation of current EU water policy by making full use of the opportunities provided by the current laws;
- Increasing the integration of water policy objectives into other relevant policy areas such as agriculture, fisheries, renewable energy, transport and the Cohesion and Structural Funds;
- Filling the gaps of the current framework, particularly in relation to the tools needed to increase water efficiency. In this regard, the Water Blueprint envisages water accounts and water efficiency targets to be set by Member States and the development of EU standards for water re-use.

The Blueprint does not put forward a "one size fit all" strait jacket, but rather proposes a tool box that Member States can use to improve water management at national, regional and river basin levels.

The Water Blueprint highlights that preserving water is not only about environmental protection, health and well-being. It is also about economic growth and prosperity. It is a way of ensuring that the EU water industry develops fully its growth potential and that all the economic sectors that depend on the availability of water of a certain quality can prosper thereby creating growth and job opportunities. The Blueprint is supported by the Innovation Partnership on Water launched in May 2012.

In preparing for the Blueprint, the River Basin Management Plans of EU Member States and the EU policy on water scarcity and droughts have been assessed. The assessment revealed some remaining gaps in the current water legislation, as well as significant weaknesses in its implementation. It also identified conflicts between water policy and other policy objectives that need to be addressed.



EU at the forefront to protect bathers' health!

The latest EEA report confirms that bathing waters in Europe are of high quality, with 95 % of these sites meeting minimum water quality standards set out in EU legislation.

Bathing water policy is one of the success stories in EU water policy and important to protect human health and the environment.

The Bathing Water Directive (BWD) also complements other environmental policy: Every year the Commission and the European Environment Agency publish a summary report on the quality of bathing water, based on the information provided by Member States. The report tracks the water quality at more than 21 000 bathing sites across the EU, Switzerland and Albania.

Drinking Water

High quality, safe and sufficient drinking water is essential for our daily life, for drinking and food preparation. We also use it for many other purposes, such as washing, cleaning, hygiene or watering our plants.

The European Union has a history of over 30 years of drinking water policy. This policy ensures that water intended for human consumption can be consumed

safely on a life-long basis, and this represents a high level of health protection. The main pillars of the policy are to:

- Ensure that drinking water quality is controlled through standards based on the latest scientific evidence;
- Secure an efficient and effective monitoring, assessment and enforcement of drinking water quality;
- Provide the consumers with adequate, timely and appropriate information;
- Contribute to the broader EU water and health policy.

COMMON AGRICULTURE POLICY (CAP)

In the field of agriculture, the Commission's proposal for reforming the CAP, which are currently under discussion, provide scope for funding to improve irrigation efficiency in ways that are consistent with the WFD (Water Framework Directive) objectives and prevent the rebound effect. This includes minimum water use reductions. This is important as agriculture accounts for 24% of water abstraction in Europe and, although that might not sound like much compared to the 44% abstracted for cooling water in energy production, its impact on reserves is much greater (in energy production, almost all cooling water is returned to a water body but for agriculture the figure is often just third).

ILLEGAL ABSTRACTION

On the issue of illegal abstraction, while it is for the Member States to use all means to enforce EU and national law, reliance on satellite imagery and derived information, could considerably help them identify areas that are irrigated well beyond what is allowed by national permits or even without permits. The Commission proposes to work together with the Member States that face the problem of illegal abstraction with a view to proposing GMES (Global Monitoring for Environment and Security) services that make a full use of the information held at a Member State level to detect illegal abstraction.

CHEMICAL STATUS AND POLLUTION OF EU WATERS

While there have been improvements in the chemical quality of water bodies over the last thirty years the situation as regards the priority substances is below expectations. Monitoring is clearly insufficient and inadequate in many Member States in particular where not all the substances are monitored, where the number of water bodies monitored is very limited.

The Directive on the Sustainable Use of Pesticides was identified in the Commission's proposals for CAP reform for possible inclusion in the cross-compliance mechanism. Effective enforcement of this Directive could complement the measures taken under the legislation on plant protection products and help to further reduce water pollution from the plant protection product use.

WASTEWATER. WATER TREATMENT ACROSS EUROPE

1 Inlet channel
2 Screening building
3 Sand trap
4 Sedimentation tank
5 Biological treatment
6 Lagoons for sedimentation
7 Stormwater tanks
8 Drainage channel
9 Operations centre
10 Sludge digestion tanks
11 Sludge dewatering building
12 Gas tanks
13 Sludge thickener
14 Phosphate precipitation

Wastewater treatment plant Duisburg-Kaßlerfeld (Germany)

Europe has made enormous progress in treating wastewater in the past 20 years, but there is still room to improve. We need to get better at keeping harmful products out of our wastewater in the first place, develop more advanced treatment methods and keep costs as low as possible. Wastewater will make its way to the sea, where any contaminants that have not been removed during the treatment process will add to the existing pollution in the marine environment. These include pesticides and fertilisers washed off the land as well as products of industrial dumping and litter, particularly plastics.

CLEANING SEAS AND OCEANS

The issue of marine litter is being addressed under the EU's 2008 Marina Strategy Framework Directive. Member States are required to ensure that their seas achieve „good environmental status" by 2020 drawing up a strategy for monitoring and to achieve targets

WATER STRATEGY IN BULGARIA

Generally the data for Bulgaria show that there is low water stress. Nonetheless, there are areas that experience water scarcity in dry summers. Parliament approved a National Strategy and Action Plan for water management and Development in 2012. This strategy outlines the overall vision for the water sector at large, including water resources management, hydropower, flood protection, irrigation and water supply and sanitation which provides for a more active role of the public authorities in developing and managing the sector. The Water Strategy has four main objectives:

- Guaranteed water supply to the population and business under climate change conditions leading to droughts;
- Protecting and improving the status of surface and ground waters;
- Improving the efficiency of integrated management of water as an economic resource;
- Decreasing the risk of damage from floods.

Bulgaria has strengthened water management efforts in recent years. Over the past decade there has been considerable improvement in the quality of

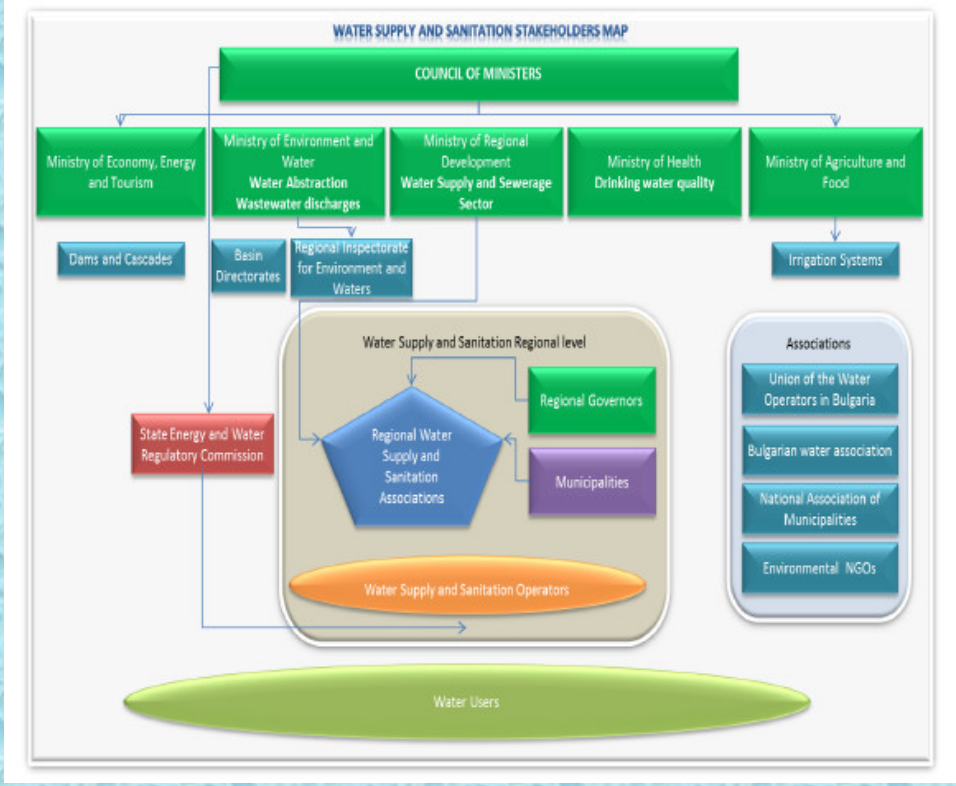
drinking water. However, overall problems of water quantity and quality remain severe.

Water supply services largely meet standards, but water losses are high and water supply systems maintenance insufficient. Coverage of the water-supply system in Bulgaria is very high, and drinking water quality typically meets standards. More than 5,000 towns and villages have central water-supply systems. This represents 99 percent of the overall population, which is a high coverage by European standards. Drinking water quality meets standards more than 95 percent of the time in all large water supply zones, although problems remain with regard to compliance with standards in relation to water quality and seasonal modes of consumption, especially in the smaller water-supply zones.Investments in water supply are far below the level needed to sustain good quality and uninterrupted service in the long run.

Breakages and water losses are at a much higher level than other EU countries. The levels for breakages and water losses (non-revenue water) are extremely high. This is caused by the fact that most of the water supply systems are obsolete, built of poor quality material or incorrectly installed, combined with a lack of preventive maintenance. It is estimated that the total length of the water transmission and distribution network exceeds 75,000 kilometers, of which approximately 30,000 kilometers dates prior to 1970. Actual investments in water supply have been less than BGN 200 million annually since 2007. This indicates that network replacement and renewal takes place, but at a slower pace than needed.

WASTEWATER COLLECTION AND TREATMENT

Nationally about 670 000 people living in agglomerations greater than 2000 person equivalents (PE) need to be connected to wastewater collection and as many as approximately 1 800 000 people need to be connected to a wastewater treatment plant in order to comply with regulations. Bulgaria has to increase both wastewater collection and the connection to urban wastewater treatment plants.


WATER SUPPLY AND SANITATION STAKEHOLDERS MAP
COUNCIL OF MINISTERS
Ministry of Economy, Energy and Tourism
Ministry of Environment and Water
Water Abstraction
Wastewater discharges
Ministry of Regional Development
Water Supply and Sewerage Sector
Ministry of Health
Drinking water quality
Ministry of Agriculture and Food
Dams and Cascades
Basin Directorates
Regional Inspectorate for Environment and Waters
Irrigation Systems
Water Supply and Sanitation Regional level
Regional Governors
Regional Water Supply and Sanitation Associations
Municipalities
Water Supply and Sanitation Operators
State Energy and Water Regulatory Commission
Associations
Union of the Water Operators in Bulgaria
Bulgarian water association
National Association of Municipalities
Environmental NGOs
Water Users

IV.2. PREVENTING AND MITIGATING THE NEGATIVE EFFECTS OF URBANIZATION ON WATER

Urbanization has always been and still is a process with a major impact on water quality and on its distribution in space and time.

The process of urbanization is a process started in Antiquity in the Near East, South Asia, East Asia, and then expanded and continued over the entire surface of the Earth. So, when they searched for favorable dwelling places, people took into consideration the presence of this vital resource, necessary for hydration, food preparation, livestock raising, food supply, agricultural crop irrigation, transportation, recreation, etc.

Urban water management is now on the verge of a revolution in response to radical changes in urban hydrographic networks as a result of rapidly escalating urban demands for water leading to failure and depletion of resources as well as the need to make urban water systems more resilient to climate change. The rapid growth of urban population, competition, conflicts, shortages, waste and degradation of water resources are imperative to rethink the concepts of conventional and switching from an approach that attempts to individually manage different aspects of the urban water cycle to an integrated approach supported by all the factors involved in the process. The challenges which most cities are facing nowadays are discouraging and the management of available water resources is one of the most serious concerns. Drinking water from pure sources is rare, other sources of water must be treated to high cost, and the volume of wastewater is increasing. People living in urban areas in many parts of the world lack good

quality of water and get sick because of water-related diseases. While cities search for new water sources upstream and discharge their tributaries downstream, the people living nearby take the effects and the hydrological cycle and water systems, including vital ecosystem services, are disrupted.

This is the situation today; tomorrow will bring intensified effects of climate change and the continuous development of cities. Extreme weather events, from extended drought to violent tropical storms, are ready to overwhelm urban water infrastructure and cause extreme suffering and environmental degradation.

All these effects can be prevented and avoided only by integrated management solutions of urban water that promises a better approach than the classical system, where the water supply, sanitation, rainwater and sewage are managed by isolated entities and all four are separated by the land use planning and economic development. Such an integrated system requires aligning urban

development and water management in order to achieve the sustainable economic, social and environmental objectives.

Urban water management process must begin with clear national policies on integrated water management, supported by legislation currently in force, to guide urban administrations, including all aspects of water management: environmental, economic, social, technical and political.

These integrated modern systems of urban water management include ratings to determine the quantity and quality of a water resource, estimate current and future requirements and anticipate the effects of climate change. They have the ability to recognize the importance of water use efficiency and economic efficiency, without which the water operations may not be sustainable. They also have the ability to recognize that different types of water can be used for different purposes: sources of fresh water (surface water, groundwater,

rainwater) and desalinated water can supplies domestic use, for example, and wastewater (black, brown, yellow and gray waters) can be treated properly to meet the requirements for agriculture, industry and environment. With new efficient desalination technologies, seawater has become an accessible source of water.

Water recovery and reuse close the loop between water supply and wastewater elimination in cities. The integration of these two functions of water management requires a planning perspective, an institutional support, coordination of infrastructure and facilities, public health protection, technology of wastewater treatment and appropriate locations for end uses, reliability of treatment, administration of water public services companies, public acceptance and participation. The options are the new technologies for wastewater treatment and new business models such as public-private partnerships and cooperation with the private sector.

MODERN TOOLS AND STRATEGIES IN URBAN WATER MANAGEMENT

WATER AUDITS AND EFFICIENT USE

In a modern and efficient approach, these integrated water management systems examine not only the sources of surface water and groundwater, but also previously overlooked sources such as rainwater and wastewater. In Perth, Australia, for example, the local authority (Tamala Park Regional Council) has decided to integrate urban approaches to the cycle of water management in a new urban development. Using water balance modeling has allowed authorities to design a water system which minimized the water import demand and maximized water reuse.

Domestic supply systems often lose 50% of water through leakage. Reducing water losses involves changing the design, construction, operation and maintenance of systems and users' behavior. They also include the introduction of water-saving measures. In Zaragoza, Spain, water saving has been a primary target since 1996. The municipality has improved the management of water loss with water-saving devices and monitoring flow rates and pressures with a data acquisition and supervisory control system connected to a geographic information system and a simulation model.

Singapore performed a significant reduction in inventory for water and now has one of the highest volumes of available water. The laws prohibiting illegal connections to the water supply systems have been strengthened, the existing works have been improved and new water supply infrastructures with quality material shave been designed. A sophisticated system has been created, which detects leaks and pipes are repaired promptly and defective flow meters are also replaced. Collectively these measures reduce both losses and operating costs.

WATER RECOVERY AND REUSE

Water recovery and reuse are essential elements of any strategy of sustainable urban development. Wastewater is collected and treated to different standards of quality for reuse in agriculture, industry and other sectors.

That is why, cities can improve public and environmental health, supporting economic activities the same time and recycling creates a multiplier effect, through which a certain given volume of water can be more productive.

In some peri-urban areas, treatment and reuse of recovered water for food production is an option for increasing food security. Farmers receive a number of benefits from the use of wastewater for irrigation; It is a trusted source, which is usually free and easily accessible, available close to their urban market areas. What is more, wastewater tends to contain significant levels of nutrients, thus reducing the need for chemical fertilizers. The use of wastewater in agriculture supports the livelihood of farmers, traders and other players along the agricultural value chain, reconcile public health and the interests of the protection of

environmental resources of a city with the desire of the local farming community to maintain a way of agricultural life.

Wastewater can be reused in aquaculture and irrigation of parks, green spaces and golf courses and other urban areas. It can recharge groundwater and can contribute to wetland restoration. The flow of wastewater from Mexico City has led, in time, to accidental recharge of aquifers downstream. These new sources of supply from groundwater can help meet the water demands of the 21 million inhabitants of the city.

Wastewater can also be used in industry (in cooling towers and boilers, and as process water) and for toilet water. The technological innovations enable recovery and water reuse in new ways. Advanced membranes and nanotechnologies are becoming more and more efficient in terms of cost and in terms of energy, being even possible for reclaimed water to become drinking water.

Indeed, in many parts of the world, direct potable water reuse is expected to be the most economic and reliable means to meet the demand for water in the future. Wastewater, which was treated through conventional means is further treated to remove any remaining suspended and dissolved matter, including organic trace; once purified, it enters the water treatment plants or go directly into water distribution systems. Windhoek, Namibia, has practiced direct reuse of water since 1968, by using to high-level treated wastewater mixed with other water sources. The waters which were recovered represent nearly 35% of the drinking water of the city. Drinking water reuse, despite potential difficulties anywhere else, is an indispensable element of Windhoek's water system and has proven to be a reliable and sustainable option. A case study of Southern California shows that its used water is water resources for a large urban population and an important agricultural region; it creates energy savings ranging from 0.7 to 1 terawatt / hour per year; and it saves about 50-87 mil dollars annually.

RAINWATER MANAGEMENT

Rainwater management can reduce events caused by intense precipitations and may increase the local sources of water. The cities that suffer from floods have more options for urban rainwater management, such as using retention

basins, permeable areas, infiltration trenches and natural systems to slow down the flood waters. Lodz, Poland and Belo Horizonte, Brazil, both cities use such systems, and Birmingham, England experiments with green roofs to achieve the same effect. Green areas take the water and offer services for ecosystems at lower cost than rainwater drainage conventional systems where the urban rainwater become polluted and need to be treated.

Collecting rainwater can address the water shortage at the household level and can be implemented easily and efficiently in terms of costs. Collecting water from roofs offers a direct source of water and can reload the groundwater, reducing the flood at the same time. Such measures can be an immediate solution to accompany long-term improvements to the water supply and sewerage infrastructure. Until today, a complete documentation of the design criteria, costs, benefits, the impact and constraints of widespread adoption is missing and it would be necessary to assess the viability of expansion.

Desalination

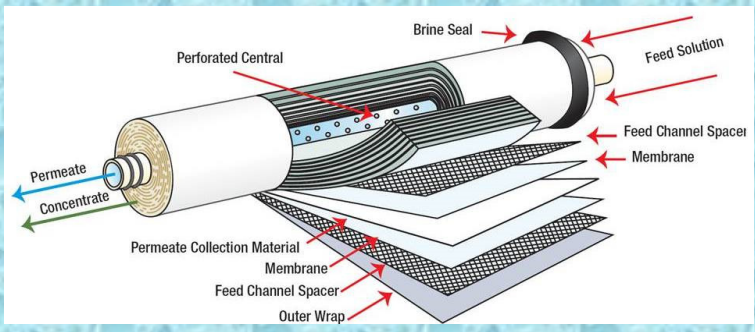
Desalting brackish water and seawater is becoming more and more economical, due to the membrane advanced technology and to the increase of energy efficiency.

The estimated production cost of desalinated water is between 0.60$ - 0.80$ per cubic meter. In the countries that have exhausted the most of renewable water resources, desalinated water satisfies the demand of both potable water and the industrial one. Although its utilization in agriculture remains limited, the desalinated water supports more and more the cultivation of highly evaluated cultures in greenhouses.

TECHNOLOGIES THAT SUSTAIN MODERN SYSTEMS OF URBAN WATER INTEGRATED MANAGEMENT

THE MEMBRANES

The advanced technologies of processing are more and more the favourite choices for treatment of water, wastewater and rainwater. They help keeping strict standards, the consolidation of the capacities (so reducing their prints) and they address the contaminants that can't be managed with the conventional technologies. Owing to the capabilities and the better performances, the technologies based on membranes and membrane bioreactors penetrate the markets in many of the regions with water deficit because these allow wastewater recycling and the use of alternative sources (such as brackish water and seawater).



The cost of the membrane systems has lowered dramatically in the last decade. The robust and lasting materials are developed for the membranes, such the systems of membranes with reduced energy consumption (in a few cases,

gravity-operated). Other technologies, such as photovoltaic systems with a renewable energy source (solar energy) and the oxidation processes, which can be improved with catalytic processes combined with membrane systems, come on the market. This tendency will allow the public services to modernize their systems.

Nanotechnologies and microbial fuel cells

Concepts with nanotechnologies are examined for more performant membranes, with properties which generate less scent, hydraulically improved conductivity, and with a lot more selective characteristics of rejection/transport. Microbial fuel cells, a developing potentially revolutionary technology, are a technology that will be capable of capturing the electrical energy directly from the organic matters present in the process of microbial activities. Although these technologies are still at an early stage of development and meaningful progress is necessary in the process of efficiency, demonstration, and production at the commercial scale, these have the potential of improving the process of treatment, the performances and the efficiency of the use of the resources.

Natural treatment systems

Natural treatment systems (NTS) use natural processes to improve water quality, to maintain the natural ambiance and to recharge exhausted underwater sources. For example, NTS are more and more used for treating and keeping rainwater, wastewater and the fluxes of drinking water. NTS have the advantage of being capable of eliminating a big variety of contaminants at the same time, which makes them a treatment system totally on their own. They are more and more used for water recovery.

Separating waste stream sources

The key to applying the newest treatment technologies is the separation of the different wastewater fluxes according to their pollution degree. Most of the dangerous contaminants in wastewater are found in the black water. For example, the biggest part of the organic and microbial contaminants are generated by the faeces (which represent only 25% of the household waste), while the biggest part

of the contaminants with azote, such as the active pharmaceutical composites and the composites which affect the endocrine system, are present mainly in the urine.

The new technologies, such as vacuum sewerage systems and toilets with urine separation, which reduce the biggest part of the azote and identify the organic contaminants, have made possible the administration of a small and concentrated quantity of waste. These technologies create opportunities for the reuse of grey water at the source and for the recovery and reuse of the nutritive substances. They also reduce the cost of the extended sewerage systems and minimize (even avoid) the use of clean water to transport the waste.

FINDING A SUITABLE SCALE

Putting these technologies into practice at a suitable scale allows the urban systems of water management to obtain the maximum from any drop of water. In the semi-centralized systems water is captured, used, treated, reused and evacuated on short distances. The semi-central systems encourage the advanced technologies for wastewater treatment, which allow the recycling of grey water, as well as black water loop closure in a decentralized framework.

The key to applying the newest treatment technologies is the separation of the different wastewater fluxes according to their pollution degree. For the domestic users, the brown water (faces), the yellow water (urine), the grey water (wastewater from the sinks, showers, washing machines, etc.) and rainwater (precipitation overflow) are managed independently.

Semi-centralized systems have the potential to saving drinking water of up to 80 percent of fresh water consumption. Therefore, semi-centralized systems can help solve problems arising from water scarcity and from rapid urbanization. In addition, the technologies which allow minimizing energy demand for water transport and energy recovery from wastewater (such as grey water heat recovery and biogas production from brown water) can be used. The concepts of semi-central treatment systems are already implemented in Qingdao, China and Hanoi, Vietnam.

URBAN WATER SYSTEMS, FLEXIBLE AND ADAPTABLE

Taking into consideration the various uncertainties and pressures associated with population growth and climate change, cities need flexible systems that are able to cope with the unpredictable and to adapt to new requirements or change. The key is the building of the "flexibility options". These options can refer to the technical aspect of the concept that enables the system to adapt to the environment or to management decisions during the system planning and operation.

A modular approach to urban water system design increases the number of possible configurations of a given set of inputs (complex adaptive systems). Thus, one can develop a diverse repertoire of alternative options for urban water systems which have internal degrees of freedom which optimizes its flexibility and durability over time. For example, regarding rainwater management, the small decentralized measures such as infiltration devices have the ability to respond at changes in boundary conditions.

In relation to flexible sanitation systems, there is a gradual shift from the mixed centralized systems to decentralized systems based on source control and separate treatment of concentrated and diluted wastewater fluxes. In terms of process technologies for water and wastewater treatment, using natural systems becomes more and more popular. Some of the main characteristics of these natural systems are their adaptability to almost all possible applications, improved renewal and realignment opportunities (essential for flexibility).

Therefore, we conclude that there is not a crisis caused by the reduced volume of available water but there is a crisis linked to the ability to efficiently and flexibly manage urban waters. Human response should consist in creating modern, flexible systems of integrated and efficient management of all water resources in cities and in their surroundings.

IV.3 SOLUTIONS TO WATER POLLUTION AND HOW TO REDUCE POLLUTANTS

IMPROVING THE ENVIRONMENT AND USING GREEN ENERGIES

In European countries, for keeping water clean and uncontaminated there are a number of factors that can be implemented.

Firstly, for beginner factories, construction sites, chemical waste facilities and other large buildings that create large amounts of pollution should make sure that their waste is being disposed of properly. Proper disposal/containment of toxic chemicals/materials before they have an opportunity to reach our oceans and lakes would go a long way towards improving the current condition of our water.

Secondly, by implementing renewable energy sources to run these large operations companies can obtain their energy from eco-friendly sources that do not harm or pollute the atmosphere.

For example solar energy, wind turbines and hydro power are all pollution free methods of obtaining power from the earth natural resources without harming the earth existing natural resources to obtain this energy.

Thirdly, eco-friendly chemicals should be used to replace toxic cleaning chemicals, sprays and other supplies. These chemicals are extremely helpful as they do not contaminate the water they come into contact with so if they go down a drain pipe or sewage drain there is little or at least less negative consequence.

Fourthly, toxic fumes created from industrial zones should be filtered, rerouted and cleaned before making their way to the atmosphere. In fact the use of renewable energy sources can help eliminate the creation of toxic fumes and provide better airflow. Toxic fumes may also contribute to water pollution as they

can be carried to different areas by the wind and heavy rainfall can help spread the toxic debris into various water systems.

Fifthly, companies that develop products and goods should focus on developing materials that are eco-friendly and recyclable. The more recyclable components are in the products they sell.

Sixthly, reduce, recycle and reuse. Companies can find better ways to reduce the amount of materials they use to create their products, recycle left over materials and reuse or re-purpose materials that may not work with their existing products.

These are just some of the steps companies and organizations that produce toxic waste and pollutants can take to reduce the amount of pollution that hits our waters.

USING ORGANIC FERTILIZER IN AGRICULTURE

When we use chemicals and pesticides for our gardens and farms, we have to be mindful not to overuse pesticides and fertilizers. Natural and organic fertilizer differs from chemicals in that they feed our plants while building the soil. As a consequence, this will reduce runoffs of the chemical into nearby water sources. Adding a light treatment of granulated, non-chemical, organic fertilizer, decompose and release nutrients more gradually than chemical equivalents, feeding the grass more steadily and over a longer period of time.

By the way, applying fertilizers in the proper amount, at the right time of year and with the right method can significantly reduce how much fertilizer reaches water bodies.

There are many ways that agricultural operations can reduce nutrient pollution, including:

• *Watershed efforts*: the collaboration of a wide range of people and organizations often across an entire watershed is vital to reducing nutrient pollution. Governments, farm organizations, conservation groups, educational institutions, non-profit organizations, and community groups all play a part in successful efforts to improve water quality.

• *Nutrient management*: applying fertilizers in the proper amount, at the right time of year and with the right method can significantly reduce the potential for pollution.

• *Cover crops*: planting certain grasses, grains or clovers can help keep nutrients out of the water by recycling excess nitrogen and reducing soil erosion.

• *Buffers*: planting trees, shrubs and grass around fields, especially those that border water bodies, can help by absorbing or filtering out nutrients before they reach a water body.

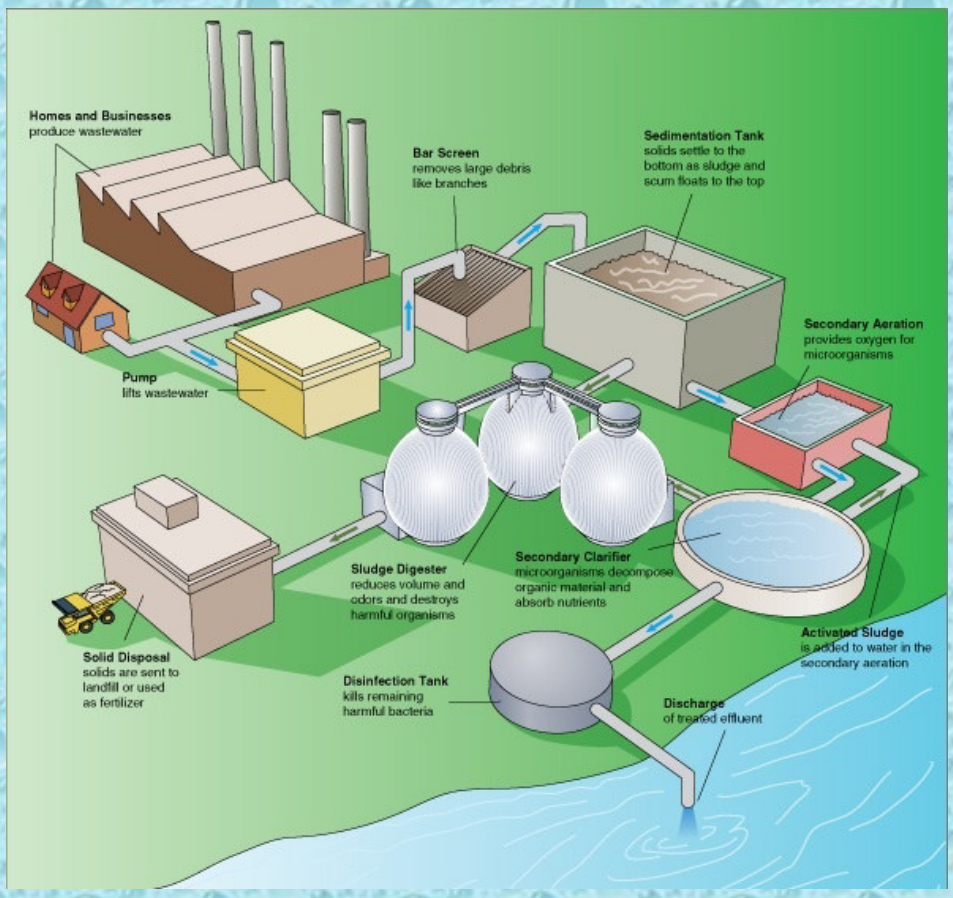
• *Conservation tillage*: reducing how often fields are tilled reduces erosion and soil compaction, builds soil organic matter, and reduces runoff.

• *Managing livestock waste*: keeping animals and their waste out of streams, rivers and lakes keeps nitrogen and phosphorus out of the water and restores stream banks.

• *Drainage water management*: reducing nutrient loadings that drain from agricultural fields helps prevent degradation of the water in local streams and lakes.

HAVING A LIQUID WASTE (SEWAGE/WASTEWATER) TREATMENT

Wastewater (liquid waste) from flushing the toilet, bathing, washing sinks and general cleaning goes down the drain and into a pipe, which joins a larger sewer pipe under the road. The larger pipe also joins a major pipe that leads to the treatment center.



- Stage one: bar screen

Screening is the first stage of the wastewater treatment process. Screening removes large objects like, diapers, nappies, sanitary items, cotton buds, face wipes and even broken bottles, bottle tops, plastics and rags that may block or damage equipment.

Special equipment is also used to remove grit that gets washed into the sewer.

- Stage two: sedimentation tank

This involves the separation of organic solid matter (or human waste) from the wastewater. This is done by putting the wastewater into large settlement tanks for the solids to sink to the bottom of the tank. The settled solids are called 'sludge'. At the bottom of these circular tanks, large scrappers continuously scrape the floor of the tank and push the sludge towards the center where it is pumped away for further treatment. The rest of the water is then moved to the secondary treatment.

- Stage three: secondary aeration/secondary clarify

The water, at this stage, is put into large tanks. These are called aeration lanes. Air is pumped into the water to encourage bacteria to break down the tiny bits of sludge that escaped the sludge scrapping process.

- Stage four: disinfection tank

Next, the “almost” treated wastewater is passed through a settlement tank. Here, more sludge is formed at the bottom of the tank from the settling of the bacterial action. Again, the sludge is scraped and collected for treatment. The water at this stage is almost free from harmful substances and chemicals. The water is allowed to flow over a wall where it is filtered through a bed of sand to remove any additional particles.

After all these treatments, the filtered water is released into the river.

USING FRIENDLY DRIVING

Nitrogen deposition from air pollution is a big part of the nutrient pollution problem and of the water pollution. Many factors contribute to pollution: how much we drive, how large a vehicle we have. As a consequence we have to be conscious of the emissions that our car spews out and keep our car well maintained.

Firstly, a solution is to use a hybrid or electric car if we drive a lot of miles every day, or use a bike for our usual ways.

Secondly, we can use public transportation more often. Driving less is something we can all do better at, and all of the relatively small differences each person makes will add up when summed across millions of drivers.

USING LESS PLASTIC – DO NOT LITTER

At the rate we are going, the growing impact of plastic pollution on our oceans will be one of the big disaster stories of this century.

In order to reduce water pollution we can use less plastic, especially plastic storage bags. This type of plastic is easy for wildlife to swallow and eventually causes death. Plastic factories also deliver much of the pollution that is not bio-degradable.

Another solution to having less pollution is to simply say no to bottled water! As we know it is convenient, but the environmental impact of bottled water plastic is huge. Some people drink bottled water because they think it is better for them than water out of the tap, but that's not true.

People love the convenience of bottled water. But maybe if they realized the problems it causes, they would try drinking from a glass at home or carrying water in a refillable steel container instead of plastic.

Unfortunately, for every six water bottles we use, only one makes it to the recycling bin. The rest are sent to landfills. Or, even worse, they end up as trash on the land and in rivers, lakes, and the ocean. Plastic bottles take many hundreds of years to disintegrate.

A much healthier and less expensive solution to bottled water is to invest in refillable glass or BPA-free plastic water bottles or stainless steel water bottles and fill them with filtered drinking water.

CHANGING OUR HOUSEHOLD HABITS

Each of us has an impact on our local water supplies, both in terms of water quality and the amount of water we use. And we can help to protect and conserve water quality.

Use fewer chemicals to clean our home. It's an easy switch that makes a big difference. Using toxic chemicals like bleach and ammonia to clean our home is not only bad for the water supply, it's not necessary. Natural cleaners are just as effective at getting the house clean, and we don't have to worry that we're contributing to water pollution when we use them.

So, we can choose from a list of cleaning products (as well as a variety of other products) the ones that are considered "green," meaning they will not pollute the water supply.

Common household supplies like white vinegar and baking soda can be used for everything from washing windows to scrubbing bathroom tiles, and they are completely nontoxic.

Turning off the water tap while we are brushing our teeth may seem just a drop in the sea; however, small and seemingly insignificant water saving measures can conserve huge amounts of drinking water but only under condition, that everyone makes water conservation a commitment. If everyone turned off the water tap while brushing teeth, almost several million litres of water would be saved. But drinking water is not only wasted literally for nothing if left running while we are brushing our teeth. Thousands of litres of water are lost due to leaky pipes as a dripping pipe can waste as much as 5,000 liters of water per year. Then there are unnecessary toilet flushes wasting millions of liters of drinking water, while gardeners can use as much as 1,000 liters of water per hour for sprinkling. And these are only a few examples of wasted drinking water that could easily be saved.

Saving water does not require change of lifestyle nor affects the quality of life. On the contrary, by stopping wasting water we can save a lot of money and spend it on other things which will improve quality of our life. We should choose companies who are eco friendly who use water saving techniques. But the most important effect of water conservation is reduced pressure on drinking water supplies which brings further financial benefits for us as an individual as well as the entire community. As soon as water supplies will dangerously decline, its prices will begin to rise which means that we will be paying even higher water bills.

Industry, on the other hand, will compensate the increased water expenses in the price of the final products which means that just about everything will become more expensive. But there is more. The worst case scenario even foresees armed conflicts for water resources.

The problem with increased pressure on drinking

water resources can be prevented with water conservation methods and prevention of further water pollution. That little drinking water left must be kept clean which, however, again requires cooperation of everyone. Most people erroneously think that industry is the only source of water pollution failing to realize that the actions of an individual have a tremendous effect on water pollution. For example, each time we buy a conventionally grown apple we are contributing to water pollution because that apple was produced with the use of tones of artificial fertilizers and pesticides. These toxic chemicals do not only remain on the apples and apple tree. The rain washes them off into the soil though which they reach groundwater which is the only source of drinking water worldwide. If we want to continue to drink tap water, we will also have to give up toxic chemicals or at least use them more responsible like we did over the last century.

If we would like to limit the amount of pollution we produce and thus help keep the oceans, rivers and lakes clean, there are a number of things we can do.

- Keep our car well maintained and immediately service it if we notice any oil leaking from the car;
- Replace our air fresheners with eco-friendly candles, incense and/or potpourri;
- Purchase environmentally friendly cleaning products that do not harm the land if they happen to be flushed or emptied into a drain;

- Reduce the amount of power we use and purchase energy saving light bulbs and appliances. This helps reduce the amount of emissions being released by utility companies and our own home products;
- Conserve our water usage and do not leave water running when we are not using it;
- Reduce, recycle and reuse materials that we have purchased. Plastics and papers may be sent to the recycling bin while some of our glass materials may be able to be reused or re-purposed;
- Make sure non recyclable waste is contained properly so that it does not spill into the land, street drain sewage drain;
- Purchase local food that has been grown from healthy agricultural farms that do not use polluting fertilizers and pesticides;
- Purchase eco-friendly lawn fertilizers and pesticides for our own lawn in order to prevent our lawn from becoming toxic;
- Recycle old clothing by giving it away to shelters and non for profit re-sellers;
- Use a reusable grocery bag rather than the plastic bags offered at grocery stores when shopping for food to minimize our plastic waste;
- Eliminate unnecessary mail and have our bills sent to us by email. This helps protect the trees and reduce the amount of paper we have to dispose of later;
- Properly dispose of toxic chemicals rather than dropping them down the drain. We can do an online search for local toxic chemical disposal areas near us.

As we can see there are a lot of things we can do to help reduce the amount of pollution we produce.

Even if we only implement a few of these strategies we could end up reducing a ton of waste and unnecessary garbage that is created in daily life. Never throw rubbish away anyhow. Always look for the correct waste bin. If there is none around, please take it home and put it in a trash can. This includes places like the beach, riverside and water bodies.

Do not keep the tap running when not in use. Also, we can reduce the amount of water we use in washing and bathing. If we all do this, we can significantly prevent water shortages and reduce the amount of dirty water that needs treatment.

Do not throw chemicals, oils, paints and medicines down the sink drain, or the toilet. In many cities, our local environment office can help with the disposal of medicines and chemicals. Check with our local authorities if there is a chemical disposal plan for local residents.

Buy more environmentally safe cleaning liquids for use at home and other public places. They are less dangerous to the environment.

IV.4. SOLUTIONS TO THE PROBLEMS CAUSED BY WATER AND AGRICULTURE

LOSSES OF WATER CAUSED BY INNEFFICENT WATERING SYSTEMS

Nowadays, there are a variety of improvements that have been implemented to avoid the problems these systems can make:

- **Pressure - compensating water droppers:** They more or less provide a regular flow between some pressure margins. They are more useful than regular water droppers because with them, the droppers at the end of the tube

will not provide less water than the ones at the beginning because of the pressure loss caused by friction. They are also useful when the tube is set upwards. The lower water droppers will suffer more pressure and if they're not prepared for those levels of pressure, they can suffer from water losses.

- **Water droppers and self-cleaning filters:** This watering system is very sensitive to solid particles and it's common to install really effective filters with a periodic self-cleaning system. The own water droppers can also have a system to release little particles that the dropper may get stuck with.
- **Regular water droppers:** Their flow can be manipulated with a mechanic controller.

Watering with water droppers is an effective method and capable of sustaining plants with water in both linear cultivations and single plants. This watering system presents a variety of advantages from agronomic, technical and economic points of view, caused by their efficient watering management and work-force such as:

- The possibility of completely automatizing watering which will stop all kind of money spending on work-force. The control of the doses is easier and more complete.
- You can use saltier water than in regular watering because of the high humidity of the zone.
- An easier adaptation in rocky terrains or terrains with high pendings.
- It reduces the chances of hostile plants on non-watered zones.
- It allows the controlled feeding of nutrients with the watering without risks of leaching with possibilities of modifying them at any moment.
- It allows the use of residual waters because the water droppers can remove water drops with pathogens in air.

POLLUTION CAUSED BY THE USE OF CHEMICALS

Agrarian production has deep effects on the environment. It is the main source of contamination of water by nitrates, phosphates and pesticides.

The use of fertilizers and other chemical supplies was first used a few decades ago, and the "chemical" agrarian products soon replaced the natural ones. But nowadays there's a need of producing healthier products.

In order to solve the problem of water contamination caused by chemicals, we should replace these chemicals used on agriculture for organic fertilizers.

Organic matter is a must to keep soil fertility on a good state. That's why organic fertilizers are needed on ecologic agrarian production.

This practice, as many others such as the soil conservation works, proper rooting, diversity of crops in time and space, and therefore, a continuous production, means the possibility of seeding all year and all years after.

There are many types of organic fertilizers which we can use on ecologic farmlands in order to achieve this objective. Some examples are:

- **Compost:** Fertilizer composed by organic wastes (domestic waste, grass, animal feces...), soil and lime.
- **Bioferments:** They are a product made from the fermentation of organic matter. This process is originated by intense microbiology activity, where used organic matters are transformed into minerals, vitamins, aminoacids and organic acids.

- **Bocashi:** Product elaborated with rice bran or wheat and with EM-I by ME technology. It is a product with great anti-rust power, which helps plants with their growing.

- **Green fertilizers:** Type of cover growing used to incorporate nutrients and organic matter to the soil. These sowings are not used for consuming, but exclusively to incorporate them to the soil as fertilizer, that's why they are called "green" fertilizers.

WATER POLLUTION BY CATTLE RAISING

Year after year, we are witnessing the image of the traditional rancher who owns 70 or 80 pigs, which their feces were used to fertilize the owner's lands, in this case, feces and cattle waste were not a problem but a benefit. Nowadays, there are huge pig farms with hundreds or thousands of pigs raised with intense systems.

There are many consequences and problems that this change on pig raising is causing, from economic problems to social, health and environment issues. The excessive manure production is causing that the nitrates, the main source of salt contained in purines, are filtering into aquifers and surface water.

HOW TO SOLVE THE PROBLEM ABOUT POLLUTION CAUSED BY ANIMAL PURINES

In the first case, it is a must to reorganize pig raising and change it in a way in which family farming must be the focus rather than industrial and intensive raising.

On the other hand, it is fundamental to restore the link between ranching and agriculture, in such a way that the conservation and fertility of the soil, as well as the good condition of the underground and superficial waters, it is a basic and priority condition on which all politics and cattle management is supported.

Therefore, before any measure of final treatment of the slurry, it is necessary and urgent the adequacy of the volume of the cabin of every region to the availability of suitable area to receive the slurry without this one, for supersaturation, ends up by contaminating soils, water and air.

From here we can discover how to proceed with the slurry so that his manipulation is as harmful as possible, even beneficial, to the environment.

Nowadays, depending on the size of the exploitation, some or other systems of treatment can be advisable.

For small farms, it can serve the system of rafts waterproofed in that we evaporate the water then to apply adequately on the area of the doughy manure. But it is suitable to warn that in this process we have the problem with which during the evaporation great quantity of ammonia parts.

For farms with more volume or quantities of slurry, they can use systems of conventional purification, in which it separates solid and liquid. The liquid can go for irrigation and the solid one to behave with vegetable remains to achieve a good relation C/N.

The option that more has spread lately for big developments and that has possessed a strong institutional support is the dehydration of the slurries in floors of cogeneration

Explanation of this system:

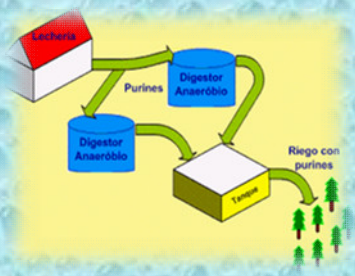
A pig produces between 4 and 7 litters of slurry a day. The slurry is formed in 95 % by water. Its high content of nitrogen and water makes its use complicated as fertilizer without having treated it before, among other things, for the difficulty of the transport up to the place of application.

To carry out the process, plants (floors) of cogeneration are constructed of up to 15 MW for dehydration of purines. In these plants (floors) natural gas is burned to dry the slurry and with the heat of the combustion, electricity takes place.

Another solution is "the anaerobic digestion ". From the calorific point of view, the anaerobic digestion of the purines turns out to be much more suitable.

Explanation of this system:

On a natural basis, on the slurry having decomposed in air absence gas produces methane. This option produces energy, instead of consuming, being able to be used for the own consumption of the farms, whereas the degassed purine can be used as fertilizer.



This system implies extracting an added value to the purine.

For example in Canada there are porcine developments that to temperatures of 21ºC under zero are auto supplied warm by this system.

These are in short the solutions that nowadays can be given to the problem.

OVEREXPLOITATION OF THE AQUIFERS FOR IRRIGATION AND DESERTIFICATION

Measures to take:

There are many measures capable of application, between (among) which there are the legal ones and those of technical character. Inside the last ones it would seem to be evident that the most immediate measure might be the reduction of the extractions, and even come to his cancellation, which is almost never possible without provoking socioeconomic very serious consequences.

Technical measures

Some measures are:

- Accomplishment of recharges (overloads) artificial, as long as available resource exists. In very concrete cases the recovery of the levels can concern the stability of the areas, especially if the "overexploitation" has been due to the need of drain mining developments.
- Redistribution of the captures inside the aquifers one and / or reduction of the volumes pumped by every capture; this can be especially advisable in case of aquifers woods nearest to the bark.
- Reduction of the extractions for improvement in the distribution networks (nets) that annul the losses.
- Desalination of the water of sea in the aquifers woods nearest to the bark, or of salt not usable waters.
- Reutilization of earlier polished waste water.
- Modification of the technologies (skills) of irrigation towards procedures.

Legal measures:

Legal measures hardly satisfy every affected group, because the interests brought to play are very different. In conclusion, there are lots of laws that protect the excessive use of the exploitation of the aquifers and that try to avoid an overexploitation, even though then the laws are interpretable and it is hard to control it because there has to be previous complains which sometimes are solved by a penalty without restoring the damage.

WETLANDS AND OTHER SPACES DETERIORIATION IN ORDER TO PUT LANDS UNDER CULTIVATION

a) Reducing lands demand

By 2050, 319 millions of hectares can be saved if the whole world follows a combination of steps designed to keep land's expansion under the "secure operative space". These steps include the following:

- Improving land's order and its use's planning in order to reduce at minimum built-up areas expansion in fertile ground;
- Investing on degraded land's rehabilitation;
- Improving the practices of agricultural production to increase the intensification on an ecological and socially accepted way;
- Watching the needs of the use of global lands from countries for the total consume of agricultural goods in order to compare them with global average and sustainable offer;
- Reducing the waste of food and favouring diets with major content of vegetables;
- Reducing the subsidies to crops for fuel, which includes assessments reduction and elimination for biofuel in consumer countries.

b) Towards a more sustainable use of the land

Some of these recommendations contribute to limiting the gross expansion of lands under cultivation between an additional 8% and 37% for 2050, allowing that the world adjusts to their secure operative space:

- Watching the use of lands in every country;
- Planning the land's use to prevent the loss of natural areas of big value before the invasion of lands under cultivation;
- Preparing economic instruments that unleash the sustainable offer and demand to encourage the productivity of the long-term ground.

HOW DO THE MASSES OF VEGETATION FAVOUR THE INCREASE OF PRECIPITATIONS?

TRANSPIRATION (THE HYDROLOGIC SYSTEM)

Transpiration is water mode of transport and evaporation from the bottom to the atmosphere through plants, mainly through leaves. While the stomas are opened and the water evaporates in leaves, the roots incorporate water from the ground and the ascending transport of the water in the plant is continuous.

10 % of water vapor of the atmosphere owes to this phenomenon, while the remaining 90 % is a consequence of the evaporation of the watery surfaces, oceans, lakes, rivers mainly.

Plants transpiration raises the moisture of the surrounding air and increases the precipitation, that is why the wooden areas have a major index of rainfall than the areas that have been deprived of its natural forest due to the massive chopping.

The volume of perspired water by the plants is variable and it depends on several factors. For example, the traditional cultivation, like the corn, can perspire every day between 5 and 10 liters per square meter of busy area; and wetlands species like the bulrush have a daily transpiration, in summer, very high, between 15 and 20 liters per square meter and arboreal species like the oak, 150.000 liters can perspire per year.

The combined effect of plants transpiration and the evaporation of the ground receive the name of evapotranspiration.

The energy that allows water movement (transport) along the body of a plant depends on the process of water evaporation in the leaves surface, and therefore, the source of this process is solar

energy. On the other hand, this movement is possible thanks to the special characteristics of water like cohesion and the adherence.

The process of transpiration is the strategy that plants have to survive in a terrestrial environment where desiccation is a permanent challenge.

Water is an increasingly scantily resource that must be managed carefully.

IV.5. WAYS TO HANDLE THE CONSEQUENCES OF TOURISM ON THE AQUATIC ENVIRONMENT

INTRODUCTION

It is a commonly accepted principle that, as far as important issues are concerned, nothing changes for the better without the fruitful combination of personal and collaborative effort. That change cannot result just from one person, thus all of us have to change our way of thinking and our perception of what is taking place.

In fact, family and personal education are of vital importance since they determine the behavior of people through the models to which they give prominence. Of course, the contribution of the state as well as of other bodies that are active in the protection of the environment, such as the World Tourism Organization and the United Nations, in that effort is necessary. Certainly, the actions that can be performed by the European Union are definitely remarkable.

PERSONAL LEVEL

A factor which determines the protection of the hydrosphere and the unhampered and of high quality tourism activity is the personal effort, without which change is not likely to occur. To begin with, all of us have been tourists; consequently, we have noticed that some do not respect the area to which they belong. First of all, we have to realize that the environment is our home; so by destroying it we destroy the place where we live! It is important that every citizen realize the significance of volunteerism in the effort to protect the environmental

resources of an area as well as to reinforce the personal and the collaborative responsibility for the environment.

Having thus realized the importance of the situation, people need to follow a series of good practices. For instance, when somebody finds themselves in a place for holidays or any other purpose, they must pick up the rubbish they have possibly left before they go; it will take them just a few minutes not to spoil the beauty they have just admired! Moreover, at the hotel or wherever they may be, in general, they shouldn't needlessly waste big quantities of water, just because they do not pay for it; they should just bring to mind that other people walk for 15-20 km on a daily basis in order to find water that is not even drinkable!

ORGANIZATIONS

The member states of the European Union, apart from the obligations concerning social, political and financial life, also bear another obligation, which is to implement a number of measures concerning the environment and its protection. Specifically, those European directives mention that not only does every state have to regulate and control the area occupied by tourism facilities , so that the ecosystem is not destroyed, but also there has to be an harmony between the ecosystem and the facilities.

Likewise, the Environment Program of the United Nations highlights the need to change the way that worldwide tourism functions in order to reach a green economy. The Environment Program of the United Nations is the basic instrument for the observation and the promotion of issues concerning the protection of the environment; it was created as a consequence of *the Stockholm Conference on the Human Environment in 1972* and it is based in Nairobi, Kenya. It coordinates the environmental efforts of governmental and non-governmental organizations, national and local bodies. It was based on the concept that the environment should be considered as a system of interacting factors, which has to do with all the sectors of development, and that for the management of that system it is necessary to use a complete approach. The cooperation of the states is considered to be necessary in order to

adopt successful practices as well as to implement the necessary policies at a worldwide level.

At the same time, according to the World Tourism Organization, both the instruments of the state and the various industries should follow a series of contracts that will reinforce the touristic development of the countries. The instruments of the state should plan a mild touristic development, the aim of which will be the creation of a sustainable system of tourism that will contribute to the financial development of the state. The cooperation between the states is also thought to be important, so that there is awareness and information concerning new programs and environment-friendly techniques. Actually, the frequent evaluation of the various activities that are related with the ecosystem is also necessary in order to make comparisons as well as to find out the extent to which the goals set by the Organization have been achieved.

TOURISM ESTABLISHMENTS

Tourism industries as well should have organized their operation with the purpose to become environment-friendlier. An important action is definitely to try to reduce the production of litteras much as possible, e.g. the use of recyclable products is a very good start. The next thing to do is to properly manage solid and liquid waste so that the phreatic zone is not polluted; as far as energy saving is concerned, one of the biggest problems that humanity faces nowadays, it is necessary to turn to renewable energy sources, where water is a good solution.

However, the achievement of the goals mentioned above becomes difficult if tourism businesses do not realize the importance of the protection of the environment. In order to manage so, a change in their entrepreneurial way of thinking and their idea of development is required. Tourism businesses should play a responsible and active role in the necessary process. Specifically, in order to

adopt good environmental practices and implement programs, they will have to follow the guidelines below:

- Be able to reject the development of activities that can damage the environment and especially the marine ecosystem.
- In case they cannot avoid the use of some products, such as the use of heating systems for example, then they have to limit it as much as possible.
- Replace supplies and procedures with others that are environment-friendlier, such as eco detergents.
- Reuse products instead of throwing them away, given the possibility.
- Implement recycling programs as well litter management and process.
- Change the traditional structure of the management and operation of their business aiming to reduce the cost and develop an environment-friendly development policy.
- Qualify the people who work for their business so that they can realize and implement environmental practices.
- Reward people who work for them and achieve the goals set.
- Aim to change the purchasing awareness of their customers so that they can obtain sensitivity to the environment when buying and using touristic products.

GREECE

It is widely known that the financial activity of Greece is mostly based on tourism, so the measures that have to be taken should be formed in such a way that the environment is not threatened but the tourism sector is not badly affected. At a national level, apart from the implementation of the above, the basic goals are:

- Setting strict rules;
- Controlling the way of construction in touristic areas;
- the motivation for the use of mild energy sources;

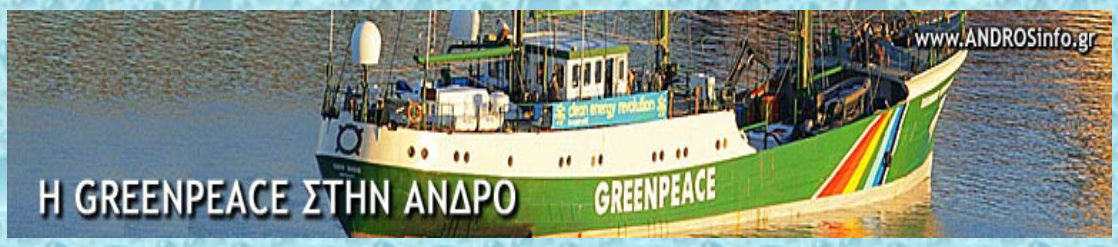
- the strict implementation and observance of environmental standards;
- the creation of protective zones around environmentally sensitive areas;
- the awareness of tourists, local population as well as of people involved in the sector of tourism as far as environment issues are concerned.

In order to actualize those goals, a part of tourism investments must be appropriated for the modernization of tourism establishments and facilities which pollute the atmosphere as well as the marine ecosystem, since many are the facilities that dispose their waste into the sea through pipes.

In Greece, the coastal areas that have been mostly developed as far as tourism is concerned are the Cyclades; however, they always used to have small amounts of water reserves as well as few rainfalls. The traditional societies of those islands would store water in cisterns or tanks, but when tourism increased those methods could not adequately satisfy the needs of the island; in order for the latter to be done they started drilling boreholes. However, the frequent and deep boreholes soon expended the aquifers and in many cases they caused the inflow of sea water, since the level of aquifers lowered and the water became unsuitable for a series of uses and mostly for domestic consumption.

Forceful solutions

Greenpeace's action



The campaign of Greenpeace aims to protect the oceans of the planet by creating a worldwide network of marine reserves, which will cover 40% of the marine areas. The populations of fish increase through propagation by coming out of the limits of the protected area and thus offering fishermen great quantities to fish, without the danger of destroying the propagation areas. This process results to sustainable fishing and development of local societies. Greenpeace's suggestion includes typical marine habitats of the Mediterranean Sea as well as important areas for the propagation and the reproduction of many species that have to be protected, as the seal Monachus-Monachus of the photo above is, a unique species in the Mediterranean Sea, in order to ensure the proper function of the ecosystem. Specifically, Greenpeace suggests a network of 32 marine reserves in the high seas of the Mediterranean, six of which are in the Ionian and the Aegean Sea.

Apart from the Mediterranean campaign, in Greece, Greenpeace has taken action aiming to create marine reserves in our territorial waters and specifically in the Corinthian Gulf and the Northern Cyclades.

Ecotourism - Green Hotels

The purpose of ecotourism and green tourism in general, is to offer the chance for sustainable development on a long-term basis, in order to prevent natural environment and our cultural heritage from being destroyed, and at the

same time to contribute to the prosperity of the local populations and the promotion of local products.

Hotels adopting green practices is necessary and not optional, since they pollute the local water supply system and cause soil erosion and degradation; besides this is something their owners also admit.

"Green hotels" are the alternative to the redevelopment of the natural environment.

ECOTOURISM

Ecotourism is one of the alternative tourism kinds. Greece, with its fascinating landscapes and unique ecosystems - such as Ramsar protected sites, rural areas, majestic mountains and unpolluted rivers- offers exceptional opportunities for the development of ecotourism experiences.

This rapidly increasing market promises important return and it is supported by the offer of attractive motives. Rare biotopes as well as plant and animal species are the things that this kind of tourist is mostly interested in; if they coexist, in combination with an area that the interested person can see, this

becomes a strong visiting motive.

In general, ecotourism is based on the natural environment, it is cost-effective, and it promotes the environmental education and the management of

the natural environment in a sustainable way. Ecotourism contributes to the complete environmental management of an area by interfering and creating the tendencies and the characteristics of local bodies, businessmen and visitors.

However, ecotourism is not such a widespread concept because our ecological awareness has not been developed enough. Schools have to follow this direction, the development of love towards the environment and the dissemination of respective ideas through environmental actions and activities.

If ecotourism is planned in a very careful way and there is strong interventionism with proper knowledge by the local management bodies, it can contribute to the prominence and the protection of the aquatic and the natural, in general, environment; such a remarkable initiative is the ecotourism festival in Aetos, Florina, an area of special natural beauty and ecological interest that is included in NATURA 2000 network.

GREEN HOTELS (ECOHOTELS)

Green hotels or Eco hotels are those which combine the environmental awareness with the ecological philosophy and reward their guests with the "gifts of nature". The protection and preservation of the natural environments are their principal concern. Having their sensitivity, which at the same time contributes greatly in saving natural resources, those hotels choose alternative management ways in harmony with nature.

For instance, we can mention the following "green" practices:

- during the construction of a green hotel all dangerous materials are removed, while the resulting detritus is recycled;;
- energy efficient LED lighting;
- bioclimatic planning and space planning based on energy saving;
- on-site transport by eco (hybrid or electric) vehicles;
- use of renewable energy sources, such as solar energy or wind power.

In many such hotels ventilation takes place with the use of Graywater heat recovery system, that is reusing water for the kitchen, the bathroom and the laundry. When it comes to cleaning, non-toxic cleaners and washing machine detergents are used and 100% organic cotton is used in sheets, towels and mattresses. Moreover, there are recycling bins in the hotel lobby, systems that switch electricity off when removing the key (or card) from the slot in the rooms, etc.

The first eco-labeled hotel in Greece was in Rhodes (2003), while the first one in the Iberian Peninsula was in Madeira Island.

Conclusion

Tourism activity has to coexist with ecological awareness in order to save the source of life, which is water, in order to continue enjoying relaxing moments by the sea, the rivers or the lakes, as well as to benefit from the tourism industry. Consequently, all persons as well as all bodies should contribute, in their way, to the protection of the aquatic environment and the ecosystem in general, as it is threatened by many factors one of which is tourism activity. All of us together can do it better, that's for sure!

IV.6. "THINK GLOBALLY, ACT LOCALLY"

Water is very important for our life. But also the atmosphere is necessary for us. And THE SKY IS ANGRY. Water is essential for life, and as it is constantly cycling from one state to another, it is not surprising that it is the most abundant of all the greenhouse gases. However, water vapor not only acts as a greenhouse gas, it also increases as the atmosphere gets warmer and provides climate feedbacks.

Although the climate change is a global issue, we can not expect a large-scale, a global solution to emerge anytime soon. Binding international law takes a long time to create, and it is difficult to implement. There are some steps in our global history.

1992 - The UN Conference on the Environment and Development was held in Rio de Janeiro. It resulted in the Framework Convention on Climate Change.

1995 - Parties to the UNFCCC met in Berlin (the 1st Conference of Parties (COP) to the UNFCCC) to outline specific targets on emissions.

1997 - The Kyoto Protocol was adopted in Kyoto, Japan, on 11 December. The countries agreed to broad outlines of emissions targets. Kyoto also offered a range of market mechanisms that could help rich countries to offset emissions by investing in low carbon projects in poorer parts of the world.


The Japan Times

Conference adopts Kyoto Protocol

Greenhouse gas emissions to be cut by average of 5.2%

KYOTO COP3

Kyoto convention's success open to debate

Cost of Kyoto Protocol

Picture.2: Delegates celebrate the adoption of the Protocol in 1997

There are some other global activities nowadays, for example the 2015 United Nations Climate Change Conference, COP 21 or CMP 11 was held in Paris, France from 30 November to 12 December 2015. The goal of COP21 is to reach a

new international agreement on climate that is universal (agreed by and applicable to all countries), keeping global warming below 2°C etc. What brings about more greenhouse gases? In this new era (the age of industrialization), the Earth is full of industry. Millions of vehicles, planes and engines are produced every year. A lot of artificial things have been produced and have ended up in waste dumps. Humans produce much more waste than ever before.

Global warming is a dramatically urgent and serious problem. We don't need to wait for governments to find a solution for this problem: each individual can bring an important help. Each of us can do some little things to help our planet. „Think globally, act locally. "Here is a list of simple things that our schools or everyone can do in order to fight against and reduce the Global warming phenomenon. There is the list of our acts.

1. Recycling waste, paper, plastic, etc.

At school we can use 100% recycled paper for notes, we can use recycled paper in our lessons. Paper recycling prevents methane emissions from landfills. Paper recycling leaves more trees vegetating so they can absorb more CO2. One ton of a Tree Preservation-Recycling paper saves 17 trees from being cut down. Production of recycled paper uses 80% less water than paper production using raw materials, reducing methane and nitrous oxide, and therefore greenhouse gas emissions.

We can also sort out the plastic bottles which are used by many pupils every day. The carbon footprint of plastic (LDPE or PET, poyethylene) is about 6 kg carbon dioxide per kg of plastic. In fact, for each PET plastic bottle three tons of carbon dioxide is created. This is 0.1 percent of greenhouse gas emissions each year or 2.5 million tons of carbon dioxide. At school we can use glasses and

recycling plastic bottles. It is better to drink tap water—filtered, if you like—instead of bottled water.

We can carry our drinking water in a reusable bottle. We can use paper or textile bags instead of the plastic ones. When 1 ton of plastic bags is reused or recycled, the energy equivalent of 11 barrels of oil is saved.

We can also recycle glass. The energy saved from recycling one glass bottle can run a 100-watt light bulb for four hours. It also causes 20% less air pollution and 50% less water pollution than in case that a new bottle is made from raw materials. It takes 40% less energy to recycle glass than it will do if we make it from raw materials. There are other materials which we can recycle too, for example recycling one aluminum can saves enough energy to run a TV for three hours.

This year during The World Water Day 2016 we cleaned the river Svratka nearby our school and we recycled more than 860 kilograms of waste. We found it around the river. So cleaning and recycling is the way, too.

2. Save energy

Replacing a regular incandescent light bulb with a compact fluorescent light bulb (cfl) CFLs uses 60% less energy than using a regular bulb. This simple switch will save about 300 pounds of carbon dioxide a year.

So be sure at school or at home that you switch off the lights. It seems to be a common sense but even at school we have caught some classes leaving a room without turning off the lights. You can always switch off your electric equipments. Turn off lights, appliances and other items operated by electricity! Pay closer attention to your family's habits too! OFF is the way.

Picture: Sun energy panel at our school. You can recharge your mobile.

You can save the energy by taking shorter showers too. Showers include 2/3 of all water heating costs. Shorten your daily shower (or even skip a day if you can). Instead of turning up the heating in the winter, it is possible to wear sweaters and heavier clothes inside so that you can turn it down for 2 degrees. At

home you can cook, wash and wash up and safe our atmosphere. Cover your pots while cooking. Doing so can save a lot of the energy needed for preparing the dish. Pressure cookers and steamers are even better: they can save around 70%! A dishwasher and a washing machine should be full when you use it. If you need to use it when it is half full, then use the half-load or economy setting.

3. Be smart, change your shopping habits

When shopping, we can also save some energy and waste if we use a reusable bag instead of accepting a disposable one in each shop. Well, we do not need a special package for each good. Buying products with the least amount of packaging means reducing trash by purchasing products with minimal packaging. It saves 1000 pounds of carbon dioxide from entering our atmosphere. One bottle of 1.5l requires less energy and produces less waste than three bottles of 0.5l.

As well, buy recycled paper products: it takes less 70 to 90% less energy to make recycled paper and it prevents the loss of forests worldwide. You can always refuse the shopping plastic bag too. Buy fresh foods instead of frozen. Frozen food uses 10 times more energy to produce. Buy local products. They reduce the amount of energy required to grow and transport the food to you by one fifth. Seek farmer's markets in your area, and go for them. Buy less meat because methane is the second most significant greenhouse gas and cows are one of the greatest methane emitters. Their grassy diet and multiple stomachs enable them to produce methane, which they exhale with every breath.

4. Walk, run, cycle, use your body to move

Do you like sport? Dou you like walking? Do you like cycling? Does your family like sport? Avoiding just 15 kilometers of driving every week would eliminate about 500 pounds of carbon dioxide emissions a year. Reduce driving by walking, biking, carpooling or taking mass transit with your family wherever possible. You can share the ride with your classmates. And sport is fun, be fit. Air travel produces large amounts of emissions so reducing your flights to one or two trips a year can lower your emissions significantly too.

Picture: School cycling race in 2015.

5. Go green, plant a tree

Forests have three effects on our climate: they cool the air through the process of evapotranspiration; they reduce air pollutants (including CO2, a well-known greenhouse gas) through photosynthesis; and their dark, dense leaves absorb sunlight that warms the planet. Forests and oceans each remove around one fourth of the carbon we humans have added to the atmosphere. So plant the tree and you help the planet.

6. Educate yourself and inform others

Learn more about climate changes and the Earth's ecological systems. This is not an insignificant means of reducing your own impact: It is difficult to adopt an eco-friendly lifestyle without some understanding of ecological problems. Encourage your school, your teachers, family and friends. We are members of A

Worldwide Science and Education Program Globe. The Global Learning and Observations to Benefit the Environment (GLOBE) Program is an international science and education program that provides students and the public worldwide with the opportunity to participate in data collection and the scientific process, and contribute meaningfully to our understanding of the Earth system and global environment.

Picture: We educate ourselves and inform others about the ecological way of living.

So… Save Water! Save our Earth!

CHAPTER V

THE WATER PROBLEMS IN THE WORLD TODAY

VODA JAKO SOUČASNÝ GLOBÁLNÍ PROBLÉM

Základní škola a mateřská škola Brno
Křídlovická 30b, Brno

„Neformální učení je záměrné, ale dobrovolné učení, které probíhá v řadě rozmanitých prostředí a situací, v nichž vyučování, odborná příprava a učení nemusí být nutně jedinou či hlavní oblastí činnosti. Tato prostředí či situace mohou být dočasné nebo se mohou střídat a příslušné činnosti či kurzy mohou vést profesionální facilitátoři učení, ale také dobrovolníci. Aktivity a kurzy jsou naplánované, ale zřídkakdy strukturované jako tradiční vyučovací hodiny nebo předměty.“ (Lynne Chrisholm, Bridges for Recognition 2005)

Cílem našeho projektu Erasmus+: Water and Its Magical Water bylo podpořit a propojit formální a neformální vzdělávání. Toto vzdělávání spolu s informálním učením se vzájemně inspiruje a doplňuje tak, aby dohromady tvořilo rozvíjející se proces celoživotního učení, který motivuje každého jednotlivce (žáka, učitele) k osobnímu i profesnímu rozvoji.

Tento projekt měl také za cíl podnítit zájem studentů o přírodní vědy a přírodní prostředí. Nedostatek pitné vody je globálním problémem lidstva. Špatná dostupnost vody a její nízká kvalita zásadním způsobem ovlivňuje životy mnoha miliónů lidí. Žáci se seznámili s významem vody pro lidskou společnost v historii i současnosti, prozkoumali problematiku vodních zdrojů po celém světě, vyhledali palčivé ekologické problémy spojené s vodou a pokusili se navrhnout řešení těchto problémů.

Žáci se účastnili několika geografických exkurzí. Výuka v terénu má komplexní charakter a umožňuje využití řady výukových metod, které v hodině nelze realizovat. Během dvouletého projektu jsme navštívili Technické muzeum v Brně s expozicí vodních motorů, přečerpávací vodní elektrárnu Dalešice, stavebně-technickou památku – přečerpávací elektrárnu Dlouhé Stráně v Hrubém Jeseníku, soukromý pivovar Dalešice a nejstarší brněnský pivovar Starobrno, Brněnskou přehradu a její hráz, brněnské fontány, kašny a studánky, chov mořských i sladkovodních ryb v Pisárkách, chráněnou krajinnou oblast Moravský kras a další. Pozornost jsme věnovali i úklidu řeky Svratky s pomocí společnosti Povodí Moravy a. s. Zpracování informací z terénních cvičení a exkurzí využijeme i v příštím školním roce ve výuce zeměpisného semináře v 8. ročníku a v dalších předmětech.

Publikaci projektu jsme vytvářeli v anglickém jazyce, práce se účastnili žáci i vyučující. Anglický jazyk přispívá k chápání a objevování skutečností přesahujících oblast zkušeností zprostředkovaných mateřským jazykem. Poskytuje živý jazykový základ a předpoklady pro komunikaci žáků v rámci integrované Evropy a světa. Přispívá ke zvýšení mobility v osobním životě, ve studiu i v budoucím pracovním uplatnění. Pomáhá žákům poznávat odlišnosti ve způsobu života lidí jiných zemí a jejich odlišné kulturní tradice. Vede žáka k porozumění a toleranci a vytváří podmínky pro spolupráci školy, žáka a pedagoga na mezinárodních projektech.

Tvorbu publikace doprovázely i další aktivity spojené s tématem knihy v různých předmětech (včetně poznatků vycházejících z jiných mimoškolních zdrojů informací). Projekt Water and Its Magical Power vykazuje silné interdisciplinární vazby, zajišťuje propojení přírodovědných předmětů (zeměpisu, přírodovědy, chemie, fyziky, GLOBE) s výukou společenskovědních, technických a dalších disciplín.

V následující tabulce je zpracován orientační přehled výstupů našeho ŠVP Heuréka, které souvisí s projektem Erasmus+: Water and Its Magical Power.

Předmět	Výstup	Učivo
Zeměpis	Žák porovnává a rozlišuje prvky složky a prvky přírodní sféry. Žák pozná a uvede příklady přírodní a kulturní krajiny. Žák se snaží uplatnit zásady ochrany přírody a životního prostředí. Žák uplatňuje v praxi zásady bezpečného pohybu a pobytu ve volné přírodě v krajině, uplatňuje v modelových situacích zásady bezpečného chování a jednání při mimořádných událostech. Žák vyjmenuje, organizuje a přiměřeně hodnotí základní geografická informační média a zdroje dat. Žák hodnotí a porovnává přírodní poměry ČR. Žák rozlišuje na konkrétních příkladech specifické znaky a funkce, uvádí konkrétní příklady přírodních a kulturních krajin, uvádí na příkladech závažné důsledky a rizika přírodních a společenských vlivů na životní prostředí.	Hydrosféra Přírodní krajina, kulturní krajina Zásady bezpečného pohybu a pobytu ve volné přírodě Ochrana člověka při ohrožení zdraví a života Geografická exkurze, cvičení a pozorování v terénu místní krajiny Základní informační geografická media a zdroje dat Vodstvo ČR Trvale udržitelný život a rozvoj, principy a zásady ochrany přírody a životního prostředí, chráněná území přírody. Globální ekologické a environmentální problémy lidstva.
Fyzika	Žák rozezná a popíše látky pevné, kapalné, plynné. Charakterizuje pevné, kapalné, plynné těleso podle společných vlastností. Žák pochopí nutnost ochrany atmosféry před znečištěním, umí zařadit pozorované jevy do globálních souvislostí. Žák ví, co je radiační havárie jaderných energetických zařízení, zná charakteristiku a účinky ionizujícího záření na člověka, jak fungují české jaderné elektrárny, chování při radiační havárii. Žák pochopí, že při fyzikálních dějích a při technických procesech dochází k přeměnám či přenosu jednotlivých druhů energie. Žák popíše přeměnu pohybové a polohové energie, (například v PVE Dlouhé Stráně).	Tělesa a látky Vlastnosti látek pevných, kapalných, plynných Globální změny atmosféry Znečištění atmosféry Jaderná energie Změny skupenství Vzájemná přeměna polohové a pohybové energie Výpočet výkonu, účinnost
Chemie	Žák pochopí význam čisté vody pro život, rozliší různé typy vody, způsoby jejího znečištění a její ochranu, vypočítá složení roztoků. Žák chápe principy destilace.	Voda – typy vod, složení, čistota, ochrana Destilace vodní parou

Přírodopis	Žák prohloubí učivo se zaměřením na globální problémy (voda, vzduch); uvědomí si jednotu přírody a koloběh látek, postupný vývoj organismů a jejich závislost na prostředí; získává kladný vztah k přírodě. Uvede význam vlivu podnebí a počasí na rozvoj a udržení života na Zemi různých ekosystémů a charakterizuje mimořádné události způsobené výkyvy počasí a dalšími přírodními jevy, jejich doprovodné jevy a možné dopady i ochranu před nimi. Poznává základy ekologie – OŽP – ochranu atmosféry, hydrosféry, pedosféry a živých organismů, seznámí se se základy etologie a působení vlivů na zdraví člověka. Vysvětlí skleníkový jev, vyjmenuje nejvýznamnější skleníkové plyny, zná vztah mezi koncentrací CO_2 a globální teplotou. Uvědomí si vliv člověka na životní prostředí a závislost člověka na přírodních změnách.	Planeta Země, atmosféra, hydrosféra, ozonosféra, biosféra Vztahy mezi organismy Ekosystémy a společenstva Člověk a příroda Ochrana přírody Mimořádné události způsobené přírodními vlivy – příčiny vzniku mimořádných událostí, přírodní světové katastrofy, nejčastější mimořádné přírodní události v ČR (povodně, větrné bouře, sněhové kalamity, laviny, náledí) a ochrana před nimi Pojem ekologie, charakteristika cenózy, tipy biomů v ČR, na Zemi Vlivy člověka na atmosféru, hydrosféru, pedosféru, život na Zemi Ochrana základních podmínek života – vzduchu, vody, půdy, potravin, živých organismů Negativní vlivy současnosti na zdraví člověka (alergeny, stres, hluk) Globální problémy – působení vody, větru, ledu – klimatické změny, přírodní katastrofy a ochrana před nimi
Dějepis	Žák se pokusí uvést příklad potřebnosti dějepisných poznatků. Žák popíše výhody dějepisných znalostí, ale i příklad toho, jak se lidstvo často z dějin poučit nedokáže. Pomocí časové přímky: zjistí základní časové údaje, zasadí období prvních států do kontextu, světového vývoje, porovná vývoj těchto oblastí s vývojem u nás. Vysvětlí rychlejší vývoj těchto oblastí na základě popisu přírodních podmínek a jejich souvislost se vznikem prvních velkých zemědělských civilizací.	Vznik světa a zrození člověka První státy – oblasti Mezopotámie, Egypta Indie, Číny Kréta a Mykény Kolonizace Malé Asie Sparta a Atény Život a kultura starověkého Řecka Sedm divů světa Starověký Řím: Sjednocení území a římská expanze

	Ukáže oblasti prvních států na mapě a uvede základní zeměpisné údaje, tj. světadíl, názvy velkých řek, dnešní státy v těchto lokalitách. Na mapě prokáže základní orientaci (Balkánský poloostrov – Řecko – Peloponés, Mykény, Atény, Kréta, Egejské moře, Malá Asie apod.). Na konkrétních příkladech dokáže, že průmyslová revoluce znamenala komplexní změnu společnosti. Zhodnotí klady i zápory těchto změn. Zjistí průmyslová centra v Čechách, uvede hlavní osobnosti a jejich vynálezy.	Vrchol římské moci Pád Říma Průmyslová revoluce Industriální doba Kapitalistická společnost před I. sv. válkou Český průmysl, kultura, umění
Anglický jazyk	Žák chápe jazyk jako prostředek historického a kulturního vývoje národa. Žák využívá jazyk coby nástroj celoživotního vzdělávání. Žák získává a předává informace, vyjadřuje své potřeby, prožitky, názory. Žák zvládá běžná pravidla mezilidské komunikace. Žák pracuje s jazykovými a literárními prameny a texty různého zaměření. Žák získává jistotu při vystupování na veřejnosti a spěje ke kultivovanému projevu. Žák získává pozitivní vztah k mnohojazyčnosti a respektování kulturní rozmanitosti. Žák se seznámí s tradicemi a svátky různých zemí světa. Žák vyjadřuje vlastní názor, dokáže porovnávat, srovnává každodenní život v různých zemích.	Pozdravy, osobní informace Rodina, počasí Denní režim, povinnosti, škola Osobní zájmy, volnočasové aktivity Dovolená, prázdniny Zvířata, příroda Jídlo, pití, restaurace Tradice a svátky Zábava, kultura, film Nabídka, návrh, pozvání Státy světa Internetoví přátelé, ICT Přírodní katastrofy Slavné osobnosti, události a jejich příběhy Školní pravidla Bydlení Historie Sport Nákupy, móda, materiály Město, mapa, památky Životní prostředí a jeho problémy Reálie, cestování, památky Počítače, média
IKT	Žák umí přehrát a konvertovat základní video formáty, umí natočit krátký film, uložit jej do počítače, sestříhat a uložit ve vhodném formátu.	Práce s digitálním videem Pokročilá tvorba prezentací Úpravy obrazu v grafickém editoru

	Žák vytváří složitější, nelineární prezentace. Žák ovládá pokročilé operace s digitálním obrazem. Žák pracuje s dostupnými grafickými programy. Žák umí pracovat s digitálním fotoaparátem.	Zásady fotografování Práce s digitálním fotoaparátem
Výtvarná výchova	Žák v samostatné tvůrčí práci aplikuje své kresebné dovednosti, schopnost pozorování skutečnosti a fantazii; při kresbě pozoruje světelnou modelaci, hledá vhodné kompoziční řešení a výtvarné zpracování; je schopen perspektivního zobrazování, používá alternativní způsoby výtvarné práce; při reálné i abstraktní malbě používá barevnou představivost, estetickou a expresivní funkci barev, barevnou symboliku, zkratku, stylizaci, alternativní způsoby malby. Žák umí vnímat a výtvarně vyjádřit tvarové a barevné znaky přírodnin a jejich morfologickou stavbu a strukturu, svůj estetický vztah k přírodě a životnímu prostředí uplatňuje v jejich ochraně; rozvíjí svou představivost a tvořivost na základě vlastní zkušenosti.	Kresba Malba Kombinované techniky Vztah k přírodě
Hudební výchova	Žák se zdokonaluje v jednohlasém i ve vícehlasém zpěvu. Žák zdokonaluje svůj pěvecký a mluvní projev. Žák rozvíjí svůj hudební sluch a hudební představivost. Žák vnímá vztah hudby a slova, spojení projevu divadelního, hudebního, výtvarného a tanečního. Orientuje se v proudu znějící hudby, vnímá užité výrazové prostředky a charakteristické sémantické prvky, chápe jejich význam v hudbě a na základě toho přistupuje k hudebnímu dílu jako k logicky utvářenému celku. Žák rozšiřuje své rytmické dovednosti pomocí hudebních nástrojů Orffova instrumentáře. Žák rozšiřuje své rytmické znalosti a dovednosti, poznává dvoudobý, třídobý a čtyřdobý takt, hudebně-pohybový projev rozvíjí jednoduchými tanci.	Pěvecký a mluvní projev Intonace a vokální improvizace Hudební rytmus Orientace v notovém záznamu vokální skladby Rozvoj hudebního sluchu a hudební představivosti Reflexe vokálního projevu Hudební styly a žánry Interpretace znějící hudby Hra na hudební nástroje Tvorba doprovodů pro hudebně dramatické projevy Pohybový doprovod znějící hudby Orientace v prostoru Pohybové vyjádření hudby v návaznosti na sémantiku hudebního díla Pohybové reakce na změny v proudu

		znějící hudby
GLOBE	Žáci si uvědomí, že voda je všude kolem nás. Žáci budou bádat, jak stará je voda, kterou pijeme, jaké problémy jsou s vodou. Zapíší si velkou myšlenku o vodě. Zná možné způsoby omezování emisí CO_2 a jejich potenciál. Změří svou uhlíkovou stopu a navrhne, jak ji snížit. Vysvětlí funkci organizace IPCC a zná základní mezinárodní dohody pro ochranu klimatu.	Badatelská aktivita: simulace vzniku vodních srážek Vodní výzva Skleníkový jev Skleníkové plyny Globální teplota Zdroje emisí CO_2 Uhlíková stopa Mezinárodní organizace a dohody zabývající se ochranou klimatu

V budoucích letech bychom rádi naše nabyté zkušenosti využili ve volitelném předmětu "The Water Problems in the World Today". Tento předmět bude dále rozšiřovat poznání žáků, umožní jim získat komplexní pohled na danou problematiku a současně bude u nich formovat postoje a hodnotový systém. Obohacují tak jejich osobnost a pozitivně tím ovlivňují atmosféru a sociální vztahy ve škole. Průřezová témata rozvíjejí osobnostní, sociální a morální vlastnosti a potřeby žáků, zdůrazňují multikulturní, demokratický, globální a proevropský aspekt výchovy a vzdělávání. Poskytují žákům základní úroveň mediální gramotnosti a vedou je k pochopení důležitosti odpovědného environmentálního jednání. Tedy i náš volitelný předmět i projekt je během dvou let naplňuje.

Volitelný předmět "The Water Problems in the World Today" doplňuje výuku přírodních věd, IKT a AJ v osmém nebo devátém ročníku s týdenní hodinovou časovou dotací. Předmět doplňuje části vzdělávací oblasti Člověk a příroda. Upřednostňovanou formou realizace je vyučovací hodina, vřazovány jsou dlouhodobější projekty. Výuka probíhá převážně ve specializované učebně informatiky, část výuky probíhá i mimo interiéry školy. Časově-tematický plán zahrnuje roční kurz. Osnovy předmětu lze využít i v dalších volitelných předmětech: Seminář ze zeměpisu, GLOBE. Předmět vykazuje významný integrační potenciál, vzájemně propojuje znalosti a dovednosti nabývané v jiných předmětech a integruje je v dimenzi prostoru povrchu Země. Proto významným

způsobem přispívá k dosažení řady kompetencí žáka vymezených v průřezových tématech RVP.

Předmět rozvíjí vědomosti a dovednosti potřebné v praktickém životě, tvořivost a schopnost řešit problémy. Žáci by měli studovat tak, aby:

- si osvojili a rozšířili základní geografické poznatky o vodě a její důležitosti pro lidskou společnost,
- se naučili klást geografické otázky: kde je to umístěno, proč je to tam, jak to vzniklo, jaký to má vliv na prostředí, co je na této poloze význačné, jaký má tato poloha vztah k umístění ostatních geografických objektů, atd.,
- využívali informační a komunikační technologie při práci s geografickými a dalšími daty,
- si osvojili schopnost získávat geografické informace v českém i anglickém jazyce,
- si rozšířili a upevnili základní terminologii týkající se tématu předmětu v anglickém jazyce,
- uměli používat mapy, tabulky, grafy, texty, fotografie a další dokumenty při pozorování a interpretaci vztahů, tendencí a souvislostí,
- dokázali zpracovávat a hodnotit informace o vodě, pojmenovali hlavní problémy s vodou v našem regionu, uvědomili si význam vody pro společnost v minulosti i současnosti,
- dovedli hledat odpovědi na ekologické otázky, uměli hledat řešení ekologických a globálních problémů, směřovali k trvale udržitelnému rozvoji,
- dokázali rozvíjet kritické myšlení: posuzovat a porovnávat územní změny, sociální a hospodářské jevy a procesy v prostoru místní krajiny, místní oblasti a vlastní země ve srovnání s obdobnými či odlišnými jevy a procesy v evropském a celosvětovém měřítku,
- se naučili chápat kulturní odlišnosti lidských ras, národů a kultur, vážit si jejich přínosu pro rozvoj lidské společnost.

Všechna témata a výstupy uvedené v osnovách předmětu nemusí být realizovány. Doporučené tematické celky ani jejich uvedený obsah nejsou závazné.

Výběr je zcela v kompetenci školy a závisí pouze na jejím rozhodnutí. Obsah témat je možno vhodně doplňovat či omezovat s přihlédnutím k zájmu žáků i místním podmínkám a rozvíjet je podle časových dispozic (zařazení předmětu pouze v jednom nebo více ročnících), dostupných materiálů, regionálních problémů, aktuálních témat atd. Šíři, hloubku a způsob prezentace obsahu rovněž určuje vyučující.

Osnovy předmětu "The Water Problems in the World Today"

Měsíc	Výstupy	Učivo	Doporučené aktivity
Září	Žák si osvojí terminologii spojenou s tématem voda.	Voda a anglický jazyk	CLIL Water and English Práce s obrázkovým slovníkem
Říjen	Žák se seznámí s rolí vody v historii. Žák pracuje s jazykovými a literárními prameny a texty různého zaměření.	Role vody v historii	Návštěva technického musea Práce s odborným textem, publikace
Listopad	Žák se seznámí s rolí vody v naší historii, pracuje s různými geografickými zdroji dat.	Role vody v historii našich zemí	Pracovní list Voda a města Práce s odborným textem, publikace
Prosinec	Žák umí vnímat a výtvarně vyjádřit tvarové a barevné znaky přírodnin a jejich morfologickou stavbu a strukturu, svůj estetický vztah k přírodě a životnímu prostředí uplatňuje v je-jich ochraně; rozvíjí svou představivost a tvořivost na základě vlastní zkušenosti.	Voda a umění	Tvorba výrobků s motivem vody na charitativní jarmark
Leden	Žák rozlišuje na konkrétních příkladech závažné důsledky a rizika přírodních a společenských vlivů na životní prostředí.	Problémy s vodou v Evropě	Práce s odborným textem Pracovní list
Únor	Žák rozlišuje na konkrétních příkladech závažné důsledky a rizika přírodních a společenských vlivů na životní prostředí.	Řešení problémů s vodou Trvale udržitelný rozvoj	Aktivity organizace Tereza a projektu GLOBE Pracovní list

Březen	Žák rozlišuje na konkrétních příkladech závažné důsledky a rizika přírodních a společenských vlivů na životní prostředí, dokáže zpracovávat a hodnotit geografické informace.	Řešení problémů s vodou Trvale udržitelný rozvoj	Práce s odborným textem Pracovní list
Duben	Žák se naučí klást geografické otázky: kde je to umístěno, proč je to tam, jak to vzniklo, jaký to má vliv na prostředí, co je na této poloze význačné, jaký má tato poloha vztah k umístění ostatních geografických objektů atd.	Příprava geografické exkurze a terénního cvičení	Práce s mapou, atlasem Tvorba prezentace Tvorba mapových podkladů
Květen	Žák uplatňuje v praxi zásady bezpečného pohybu a pobytu ve volné přírodě v krajině, uplatňuje v modelových situacích zásady bezpečného chování a jednání při mimořádných událostech.	Geografická exkurze a cvičení	Geografická exkurze, terénní cvičení
Červen	Žák uplatňuje v praxi zásady bezpečného pohybu a pobytu ve volné přírodě, v krajině, uplatňuje v modelových situacích zásady bezpečného chování a jednání při mimořádných událostech.	Geografická exkurze a terénní cvičení	Geografická exkurze a terénní cvičení

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