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## ADDRESSING WATER CONTAMINATION: THE IMPACT OF THERMAL POWER PLANTS

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**Abstract:** Water, often referred to as the "source of life," is essential for the existence of all organisms, including humans. It not only sustains life but also constitutes a vital component of the human body. Although water resources are renewable, disruptions in ecological balance can lead to depletion and scarcity. With rising global temperatures, the demand for water for drinking and irrigation purposes is expected to increase. Effective management of wastewater involves various levels of government administration, from strategic national planning to local operational activities. It is crucial for economic development as it forms part of communal infrastructure, facilitating progress. However, it also has significant implications for the environment and public health. Energy production is a major contributor to pollution, affecting air, water, and soil quality. This pollution poses significant risks to both the environment and human health. Given the projected increase in global energy demand, urgent measures are required to mitigate the adverse impacts of energy exploitation on the environment and public health.

**Keywords:** water, pollution, energy, life, health

### 1. INTRODUCTION

#### **Navigating the ecological matrix: unveiling factors of environmental pollution**

In the ecological system, ecological factors - factors of the environment - act harmoniously and complexly, as a whole. After all, the environment is a complex of agents (factors) that act on organisms in the place where these organisms live. In the course of his evolution, man was forced to adapt to changes in living conditions in the biosphere, looking for new sources of food and habitats. The biosphere provided and provides favorable conditions for its survival and development. Only man works and produces means (tools) for work and changes nature and adapts it to his needs and desires. In doing so, he creates new products, changing the functions of the existing natural space. Practically all energy sources and facilities have a greater or lesser adverse impact on the environment, due to the fact that there is no ecologically completely clean source of energy (Kimmerer, 2013). The permanent growth of needs and (or) dependence and the non-existence of real alternatives (which cannot be replaced by anything) means that its provision becomes imperative at the cost of great material, ecological, human, spatial, organizational and other sacrifices and renunciations, and its management is the basis of the quality of the environment, existential security and socio-economic development. Otherwise, the effects of its insufficiency or of poor quality are transmitted in a chain (domino system) through all segments of the life of social communities, generating the most difficult political, economic, hygienic, health and other problems. The development and decline of civilizations is directly dependent on the way water resources are used and managed and the system for their control. Throughout all stages of the development of society, water is an indispensable component biological, economic and social progress. That is why the question of the volume and quality of water resources is one of the key problems of society, the solution of which is necessary at the cost of great economic, ecological, human, spatial, organizational and other losses and limitations. Due to the continuous growth of the need for water resources, activities aimed at securing them are becoming an increasingly pronounced form of anthropoppression, which, over time, expands expansively in space (Kolbert, 2014). There are few regulated waste dumps in the countries of the Western Balkans. Irresponsibility on the one hand and confused priorities where this problem is put on the second plan lead to the permanent destruction of drinking water supplies because groundwater can be protected from surface pollutants by building landfills with controlled drainage, which is much more than aesthetics and much closer to reason. The two most important services that aquatic ecosystems provide to humans and which are important for well-being are the provision of drinking water and food. The primary source of renewable drinking water for human use comes from terrestrial aquatic ecosystems including lakes, rivers, wetlands and underground aquifers (Savić & Terzija, 2018).

### 2. UNVEILING THE MECHANISMS: SYSTEMS OF ENVIRONMENTAL POLLUTION

Organizational ecosystems were created by the constructive action of man (for example, the urban system). He visibly shapes them and constantly controls and regulates their movement. These are systems that are primarily based on the inflow, apart from solar energy, and additional energy media, primarily fossil energy carriers (wood, oil and natural gas) and electricity of various origins (fuel, hydroelectric power, nuclear power). Organizational ecological systems include any combination of natural and technological systems. Quasi-natural ecological systems are industrial systems.

Natural and quasi-natural systems are complete ecosystems that have sufficient populations of autotrophic organisms (organisms that are capable of creating organic matter from inorganic) that produce the majority of matter and energy needed for the functioning of the system. However, organizational systems are incomplete systems, which must make up for their deficit in primary organic matter and energy from other ecological systems (Ricklefs & Miller, 2000). Complete ecological systems dominated by autotrophic organisms still cover by far the largest areas of the biosphere. However, the existing reserves and possible yields in complete ecological systems are not unlimited. This suggests taking the necessary measures to protect the ecosystem from degradation. Natural resources are common good and common wealth. Their use, economic application and economic valorization should be planned and purposefully controlled. Regardless of the type, structure and individual quantities, they are the basis for the upcoming economic and economic development. Certainly, there is a part that must remain outside the economic and economic flows and that should be preserved for current and future generations. This is especially true for non-renewable natural resources (Kolbert, 2014). Bearing in mind the complexity and multidisciplinary nature of the issue, natural resources are all around us, and due to growing needs, we use them up very quickly. Many wear out faster than they can be replaced with new ones. We must pay attention to the fact that some of them will be completely exhausted if we do not reduce consumption, which is a serious problem, because the living world depends on these resources. The current economic, social and political environment requires management to introduce a humane dimension into the management of natural resources, especially when it comes to water. For long-term success in business, the application of new business concepts, which are based on an economic, ethical and innovative structure, is of crucial importance. Therefore, maintaining a constant focus on business ethics helps the corporation/enterprise/institution to meet its responsibilities. The central issue of business ethics is the concept of socially responsible business, which represents one of the most significant challenges of modern management (Savić & Terzija, 2018). For a long time, water was the most accessible resource to man, which he squandered and consumed uneconomically and irrationally, not hoping that one day it would become a deficient natural resource. Since it is the most precious natural resource, without which the survival of the human race is not possible, it is necessary to protect and preserve this resource. The urban development of human civilization, in addition to its positive side, which is reflected in technological progress and development, also has its negative consequences, which are reflected in the unsustainable use, consumption and distribution of natural resources and environmental pollution (Annual report on the state of the environment, 2020).

### **3. UNRAVELING INDUSTRIAL IMPACT: FACTORS OF ENVIRONMENTAL POLLUTION**

The relationship of man to the environment (living and non-living nature) is exceptional and specific. Man has a dual role within every ecological system on Earth, which is its specificity. First, man is an integral part of nature, that is, a member of the corresponding ecological system of a life area. Second, it has become an active factor - a control mechanism in the functioning of every ecological system. Man threatens the environment in many ways, the most significant of which are: global climate change (greenhouse effect); global sea level rise; damage to the ozone layer; atmospheric pollution; water pollution; soil pollution; destruction of natural ecological systems; destruction of certain plant and animal species (Kimmerer, 2020). Depending on the type of coal and the place from where it is mined, coal contains many other compounds in different amounts. When burning coal, the following are emitted: solid particles consisting mainly of carbon, silicon, aluminum, and iron oxides, fly ash, and different gases are produced: carbon dioxide, sulfur oxides, nitrogen oxides, carbon monoxide, hydrocarbons, etc. The extent and intensity depend on the quality of the lignite and on the technological process applied in the thermal power plant (Reports and Gjendjes Mjedisore në KEK, 2022). The progress and development of human society, on the one hand, brought progress to man because it enabled him to live a simpler and better life. On the other hand, it led to a series of negative phenomena that have a daily negative impact on the limited drinking water resources. The increase in human population, the constant development of industry have led to a series of by-products of human labor, which is reflected in the change in water quality (Kolbert, 2019).

### **4. INDUSTRIAL WASTE AND ITS ENVIRONMENTAL IMPLICATIONS**

Waste materials (waste) are materials that are created in the performance of production, service, or other activities, items excluded from use, as well as waste materials that are created during consumption and can be used directly or with appropriate finishing and processing as raw materials or as semi-finished products. These are solid, liquid, or gaseous substances that were created as a product of human activity in production and other activities, circulation, and use of material goods, and which have no use value. Waste is a substance or object that the owner disposes of, intends to dispose of, or is required to dispose of in accordance with the law. Waste is deposited in the basic media of the environment - air, water, and soil. Most of them are deposited on land or end up in waterways. A part of those materials, such as gaseous products of combustion (carbon dioxide, carbon monoxide, sulfur dioxide, etc.), are

included in the circular material flows of the biosphere. The rest of the material waste is included in the one-way flow of material and ends up in the environment (Savić & Terzija, 2018). Atmospheric water is in the form of precipitation: dew, snow, hail, and as such it reaches the earth. The biggest role in water pollution is played by humans with their activities, which fall under artificial pollution. Although water covers  $\frac{3}{4}$  of the earth's surface, the water problem is becoming bigger and more general-international. In the process of technological energy production, including heating plants, thermal power plants, and oil refineries, as well as during transportation accidents or through wastewater and direct spills, a multitude of pollutants find their way into water sources, posing significant environmental risks. Industrial organizations and settlements often dispose of their waste materials along riverbanks, leading to the creation of new and untested compounds in these landfills, further exacerbating pollution in rivers and coastal waters. It is not uncommon for garbage to be discharged directly into the river. Beneath the waste material, a thick dark filtrate of mostly poisonous composition is created from the discarded waste, and as a liquid, it penetrates into the depths, contaminating underground sources of drinking water which are connected to the river by legally connected vessels, thus causing double pollution (Kolbert, 2019).

In certain regions of the world, due to specific historical events and the accumulation of problems for which states cannot find adequate solutions regarding the distribution and control of drinking water resources, there is a high risk of conflict escalation. However, a topic that is largely silent and little known is that wars in the future will be fought over water, leaving oil as a secondary problem (Reports and environment not KEK, 2021).

## **5. ENVIRONMENTAL IMPACTS OF THERMAL POWER PLANTS: POLLUTION AND REMEDIATION EFFORTS**

Soil pollution from thermal power plants is closely linked to ash emissions and their deposition in the environment. After burning coal, up to 25% of ash remains, which translates to 0.12 to 0.25 tons of ash remaining per ton of coal burned. Ash primarily consists of inorganic compounds such as silicon, calcium, and magnesium minerals. The high concentrations of gas and aerosol emissions from thermal power plants pollute arable land in their immediate vicinity. These pollutants are absorbed by plants from the soil, entering the food chains of various consumers and thereby posing a greater negative impact on the health of the population and the quality of agricultural products in the affected area (Smith, 2017). Polluting substances not only contaminate the soil but also penetrate deeper into the layers, contaminating underground water, potential sources of drinking water. Therefore, polluted water can be consumed by humans. Concerning water pollution from thermal power plants, two main issues arise: water pollution due to the transport of ash from the plant to the landfill and thermal pollution of the recipient, such as the watercourse into which insufficiently cooled water used to cool the turbines is discharged. Pollution of surface and underground water and soil from coal and ash dumps is significant, with waste water from thermal power plants containing pollutants such as chlorine, chromates, oils, phosphates, suspended particles, bases, boron, copper, iron, non-degradable organic matter, zinc, etc. (Jones, 2019). An overview of the legislation in the Republic of Kosovo related to environmental protection, based on the comparison of measured pollutant values and other parameters with permitted values, serves as the basis for compiling the Report on the State of the Environment in KEK. These laws regulate and guarantee citizens' rights to electricity supply and to live in an environment with clean air, water, and soil, protecting human health, flora, and fauna, as well as natural and cultural values. From this perspective, environmental issues are sensitive and complex, representing one of society's greatest challenges now and in the future. General data indicate a continuous increase in electricity production needs in Kosovo, resulting in a wide range of environmental impacts at local, regional, and global levels. The goal is to reduce the emission of pollutants without hindering the country's economic development, bringing KEK's pollution in line with permitted environmental norms (Ministry of Environment and Spatial Planning of the Republic of Kosovo, 2020). KEK strives to base all its operations on the principles of sustainable development, which entails responsible management, positive business practices, compliance, and the trust of all interested parties, fostering dynamic development that is environmentally friendly and does not harm the environment. KEK acknowledges the environmental impacts of its electricity production activities and recognizes the need to preserve, protect, and improve the environment (Annual Environmental Report of KEK, 2021).

## **6. CONCLUSION**

In conclusion, the issue of water pollution from thermal power plants is multifaceted and requires urgent attention. Throughout this analysis, it becomes evident that water, often hailed as the "source of life," is indispensable for all organisms, humans included. However, disruptions in ecological balance, compounded by the impacts of rising global temperatures, pose significant challenges to water availability and quality. Effective management of wastewater is essential for economic development and public health, yet the pollution generated by energy production remains a major concern. The adverse effects of pollution from thermal power plants extend beyond

water to soil contamination, posing risks to agricultural productivity and human health. Regulatory frameworks play a crucial role in safeguarding environmental and public health interests, but enforcement and compliance are essential for meaningful progress. Furthermore, the transition to sustainable energy sources is imperative to mitigate the environmental impacts of energy exploitation. In conclusion, addressing water pollution from thermal power plants requires a holistic approach, encompassing regulatory measures, technological innovations, and public awareness initiatives. By prioritizing environmental stewardship and sustainability, we can work towards ensuring a healthier future for both ecosystems and human communities.

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