# RISK MANAGEMENT IN THE CONTEXT OF THE PROBLEM OF INTEGRAL WATER MANAGEMENT

Ivica Opačak[1] Šemsudin Dedić[2] Tihomir Vujčić[3]
[1]High School Matija Antun Reljković, Slavonski Brod, Republic of Croatia
e-mail: ivopac2019@gmail.com
[2]Parliamentary assembly of Bosnia and Hercegovina, Sarajevo Bosnia and Herzegovina
e-mail: semsudin.dedic@parlament.ba
[3]International University Brčko District BiH, Brčko, Bosnia and Herzegovina
e-mail: tihomir.vujcic72@gmail.com

***Professional paper***
***https://doi.org/10.58952/nit20241202023***
***UDK/UDC 658:628.1:577.3***

**Summary**

*The paper analyzes the issue of integral management of water as a natural good, through the segment of potential risks in the field of water management. The construction of a theoretical model, which respects the interaction of people and their environment, requires practical solutions in order to integrate different requirements and forms of action in water management. The increasingly widespread consideration of the impact of climate change affects the building of social awareness of the problem of ecological management of natural resources. It also contributed to the understanding that it is not good to ignore resource management issues, and that it is one of the most prominent policy issues at all levels of management. Through the paper, the issues of understanding the economic factors of water resources management, which in practice become social and cultural issues, and the problems of the complexity of their quantification and measurability, as well as the vision of the environment, are considered as issues that cannot be separated from economic activities.*

*Keywords: water resources management, risk, solutions*

*JEL classification: O13, O33, Q01, I10*

# 1 INTRODUCTION

Social and economic development, as well as the impact of climate change, have forced considerations of river flows and water quality, their pollution, problems of irrigation and flood defense, different scenarios of climate change, hydrological patterns of river ecosystems and numerous other issues. Understanding the complexity of water management, and the relationship between hydrological and biological processes, at the scale of watersheds, is a prerequisite for ensuring the desired water quality, biodiversity and sustainable development. The aforementioned directs policies towards the harmonization of the natural resource management system, with the aim of ensuring sustainability, and through the development of managerial techniques to deal with threats to ecosystem health. For this purpose, it is necessary to develop mechanisms that will remove threats to the ecosystem, such as various sources of pollution, floods, droughts, etc., and to expand the possibilities of using the ecosystem and its characteristics, as well as the development and application of appropriate management tools. The desire to ensure sustainable development and the race for wealth, as a result, caused the disruption of the ecosystem, where its balance was permanently disturbed and caused the necessary need for the harmonization of measures and solutions. The effort is to stabilize and improve the quality of natural resources, primarily water, through integrated regulations. There are numerous viewpoints of the same problem, the preservation of the ecosystem from the point of view of water, which should be viewed through the prism of different values determined by generally accepted and religious beliefs, social and territorial determinations, and economic, political, legal and moral value systems. In this context, water is seen as a regenerative substance of the ecosystem, subject to pollution, which is a symbol of wealth and productivity, a source of energy and as a common good and right of all people. The diversity of the context of observing the need for water resource management indicates the requirement to include science in the study and provision of a systematic model of water management, through the appreciation of the interaction of people in relation to their environment.

# 2 THE RISK MANAGEMENT SYSTEM FOR PROTECTION AND MANAGEMENT OF WATER RESOURCES

The risk management system includes a series of activities, from their recognition to their characterization and assessment. Ecological risk assessment is based on the assessment of their probability and danger to human health, safety and functioning of the ecosystem [1]. The importance of water management and its protection is also reflected in the inclusion of the aforementioned matter in the environmental policy, through directives on water, which include groundwater, drinking water, bathing water, environmental quality standards, municipal water treatment, nitrates, and floods [2].

Each individual can provide his personal contribution to water protection in numerous ways. First of all, it is only necessary to change established habits a little, and with the rational use of water,

prevent the creation of large amounts of waste water at the source itself. In order to ensure biological decomposition, it is necessary to use biodegradable detergents, and to use a water softener instead of a fabric softener, in order to use soft water to reduce the consumption of detergent and protect the washing machine, and to ensure that the resulting waste water is more acceptable for waterways. It is necessary to take care of what is dumped into the sewage system, because all of it will ultimately end up either in a wastewater treatment plant or, quite often, in a watercourse. By using natural fertilizers, instead of artificial ones, and by avoiding waste disposal near sources of drinking water and watercourses, we will prevent the penetration of unwanted substances into the water. It is preferable to leave water conservation to natural mechanisms, so that forests near the source are not cut down, and that we control soil erosion on our own property by planting plant cover and stabilizing areas prone to erosion. By using official disposal sites for hazardous waste, such as used motor oil, we will ensure that it does not end up near water resources and pollute significant amounts of water. It is estimated that one liter of used motor oil pollutes over a million liters of water. It is similar with the disposal of used batteries, whether they contain zinc, cadmium, or mercury, which are dangerous pollutants, where the amount of polluted water ranges from 3,000 hL per one battery.

Understanding the importance of water for plant life is necessary to understand that plants are most easily supplied with water, and that plants easily absorb substances from water, whether they are useful or unwanted substances. This is especially pronounced for plants that often cannot easily reach water on land, because they have difficulty extracting it from the soil to a sufficient extent. For terrestrial plants, water is one of the ecological factors, while for aquatic plants it is their living environment. In terrestrial plants, water comes from the roots of the plant to the leaves. This process is established by transpiration, during which a certain amount of water constantly evaporates from the transpiration surfaces. With the movement of water through the plant, it stands upright under water pressure, while a plant that loses a large amount of water due to drought, withers and leans over. The circulation of water in the plant is also called the water regime of the plant, which essentially consists of three processes, receiving water from the soil, transporting water in the tissues of the roots, tree and leaves, and evaporation of water through above-ground organs, transpiration. The relationship between the water taken in and the water evaporated is called the water balance of the plant. Evaporation of water also cools the plant, which is an important prerequisite for plant survival in a tropical climate. Water is extremely important for the life of animals. Water is the original living environment in which life originated, so their mutual connection is understandable, especially for animals whose living environment is water. Water is a component of the organism of animals, where its content in the organism of animals varies from 50 to 93%, and the content of water is the highest in aquatic organisms. Mammals can hardly tolerate water loss, and are at risk of death when their body's water content drops by 15 to 20%, although some animals can survive a water loss of up to 80%. In the process of evolution, some organisms have adapted to the problem of lack of water, surviving by moving into a

latent, anabiotic state, in which they can survive for a long time. The importance of water for the human species is also evident in the fact that the body of an adult has a water content of 40 to 75%, and as such it represents one of the basic conditions for human survival and life on Earth. Depending on the climatic conditions, water consumption for maintaining the life of adults ranges from 3 to 12 liters per day. Therefore, water is by far the richest component of all living organisms and has fundamental importance in maintaining both the structure and function of all tissues, i.e. cells as the basic units of living matter. Not drinking water can significantly worsen the general condition of the organism, and can quickly lead to death. If water is not taken in, death occurs after a few days, as the organism loses 10 to 20% of its entire fluid volume. In case of no food intake, life is maintained for several weeks, despite the loss of all fat tissue and about 50% of tissue proteins. The proportion of water in the human body is different in different tissues, i.e. organs. It can be said that the largest amount of water in the body is found in the skin and muscles, and the least in the skeleton and adipose tissue. An adult male weighing 70 kilograms contains 9 liters of water in the skin, 22 liters in the muscles, 2.45 liters in the skeleton, 4.65 liters in the blood and 0.7 liters in the fat tissue. Although the heart, lungs, kidneys and brain contain a high proportion of water, their proportion in the mass of the organism is smaller.

Persons involved in the process of environmental risk assessment, regardless of the position they occupy, in the implementation of decisions aimed at elimination, retention or reduction to an acceptable level, should have communicative interaction. In the mentioned concept, it is necessary to identify and evaluate the risk, and to select and implement procedures aimed at reducing the risk, both for human health and for the entire ecosystem. The risk management process is based on scientific achievements and takes into account social, economic, ethical, political and legal aspects. In particular, it is necessary to promote the changes necessary for radical changes in the value of water and the way water is used. Water management requires thinking about water as a global common good, which can only be improved through collective action, both in individual countries and through cross-border cooperation, so that the benefits of water management are visible to everyone [3]. For the purpose of risk management, it is necessary to carry out a risk assessment, which is at the same time an integral part of it and a tool for risk management. The goal of risk management is their reduction, where in addition to the risk of environmental pollution, various socio-economic risks appear. As one of the components of risk management, control and monitoring include management improvements and assessments of the current status. Scientific methods of risk assessment make it possible to determine the probability and level of risk, including ecological and human effects, as well as acceptable levels of risk, which are largely socially determined. As risk tolerance decreases with limited access to information and with the feeling of powerlessness and that everything is controlled by external forces, every management decision must also take into account the time aspect of risk, which can last much longer than the current management process. Through the process

of achieving the goals of risk management, it is necessary to make decisions about the acceptability of risks, and when the need is assessed, to implement the measures necessary to suppress them. The risk zones range, depending on the dependence of the exposure and the magnitude of the damage caused, from normal to prohibited. In the acceptable risk zone, it is understood that there is a low probability of its exposure and harmful effects, in the case of water resources, limited persistence of contaminants, reversibility of damage and low potential of social conflict. The increase in the probability of occurrence of risks, as well as the negative effects that their occurrence can cause as a result, imposes the need to observe the potential risk in the sphere of the increasing probability of occurrence, that is, the damage it can cause by its manifestation, and it is necessary to make decisions to take certain measures in order to prevent its occurrence, or to reduce the potential damage it causes. When positioning the risk, taking into account the possible harmful consequences of its occurrence, as well as the probability of occurrence, it is necessary to include the effects on the ecosystem and human health, the probability of occurrence and evaluations depending on the type of effects. So, for example, for the risk of extreme floods, a frequency of once a year is considered very high, while from the aspect of bathers' exposure to the risk of low pollutant concentrations during swimming, once a year is most likely negligible, and is recorded as an extremely low risk event, for which it is not it is necessary to take any preventive actions. For the purpose of risk assessment, it is necessary to create a risk matrix, in which all recognizable risks are mapped. It is a tool used to illustrate different risks, in order to develop a risk management model. The matrix as a risk management model is the basis for the need to make decisions based on the quantification of risks, i.e. the probability of their occurrence, as well as the harmful consequences they can cause. Therefore, the risk indicators for water resources management must be selected as sufficient and appropriate, from the aspect of management objectives, and must be accepted by the interested public and allow the risk to be ranked and the places to be prioritized. Risk management is motivated through the inclusion of fundamental human values, documented in the form of directives or legislation, then the satisfaction of human needs, in terms of social activities related to water and water resources, but also through social expectations and perceptions, to preserve or improve the quality of life [4]. With the purpose of appropriate risk management, it is necessary to define the desired goals of risk management, which include the need to meet regulatory criteria, economic sustainability, ensuring the quality of the environment and the development of nature and the preservation of the environment and the quality of human life. All the stated objectives lead to the avoidance or reduction of risks and unwanted impact on the environment, which is achieved through the implementation of various risk management options. If there are indicators of the existence of a risk or its occurrence is certain, it is necessary to state that they are a necessary tool for connecting risks with management options. Observing the risk indicators and risk management options of water resource pollution, we distinguish two points of view, first the site-specific approach, and second the river basin approach. Failure to meet the criteria does

not affect risk management at the level of the river basin, while exceeding them is an indicator of non-compliance with other management goals. Risk indicators at the local level should include the concentration of contaminants, which can influence the choice of priority hazardous substances through different behavior. The same applies to ecotoxicological effects, where the inclusion of different routes of exposure facilitates the assessment of the risk of contaminant transfer from sediment to water. Also, by choosing indicator living species, especially sensitive to changes in the environment, risks can be indicated and their ranking according to their essential function. The approach to river basin pollution risk management depends on site-specific regulations, such as bathing water, drinking water and habitat protection directives. In the case of a river basin, indicators are taken into account that provide information about a locality but also about the risks that exist downstream, comparing hydrological situations with the observation and monitoring of the level of suspended particles and the movement of the number of fish, regardless of the fact that their abundance can be manifested differently on the whole river system. Risk assessments at the local level and at the level of the river basin must be interactive processes, which lead to prioritization and directing funds to those places, with the greatest expected effects in terms of risk reduction in the river basin. As such, they imply the identification of specific contaminants of the river basin and those contaminants that threaten the goals of river basin management. The identification process involves locating contaminated localities along the watershed, from which sediments are transported downstream and under certain conditions, such as low water levels and floods, lead to exposure of the location to harmful substances. As a result, it is necessary to use different risk management options, such as reducing the existing emissions of contaminants that tend to bind to sediment, reducing the exposure of organisms to contaminants, reducing the effect of accumulated contaminants, changing the purpose of land use in a given location, and evaluating the location within the framework of river basin management. The aforementioned includes the application of measures in case of non-fulfillment of regulatory criteria, analysis of sediment transport and application of suspended particle transport models, exchange of knowledge and technologies with interested organizations located downstream and upstream along the river course, and to facilitate communication with the interested public and involve them in risk management processes. In order to better manage the quality of the environment and the development of nature, it is necessary to analyze the risks of ecosystem preservation, especially from the perspective of ecological ethics and loss of awareness due to poor or non-management. The appearance of risk as an unwanted event can lead to damage to human health, extinction of species, destruction of habitats, disruption of ecological functions and deterioration of water quality. We can observe risk indicators and conflicts with other goals through two levels, local and river basin level. Thus, at the local level, they can be manifested as inputs of contaminants into the environment, various ecotoxicological effects, changes in biodiversity, loss of species, species invasion, increase in lesions and necrosis in fish, changes in hydrodynamics and eutrophication, while at the level of the

river basin, these are changes in migration of fish species, loss of indicator species, changes in biodiversity, different physical and chemical parameters, imbalance of nutrient cycles, etc [5]. For this purpose, different risk management options are being developed, which can be viewed from the same aspect. Local-level management options may include pollution source controls, river basin management guidelines, land use changes, exposure reduction, adsorptive barriers, leaching, capture, in-situ treatments, natural dilution, and habitat compensation. Risk management includes activities such as control of pollution sources, reduction of diffuse pollution, trend monitoring, revision of industrial and agricultural regulations, identification of responsible contaminants, application of the "polluter pays" principle or injured party pays to speed up solutions, cross-border cooperation, and implementation of a management plan across the board basin area. When dealing with risk, with the aim of better risk management, we should be guided by questions such as whether we need to collect more data, whether we should carry out remediation actions, and how to choose the most profitable remediation and achieve the goals of remediation, whereby the answers to the questions will give us suggestions for action, and whether it is necessary to collect more data. The process of risk management, from the point of view of collecting sufficient data, for the purpose of basic risk assessment, implies that all relevant facts, which contribute to a certain problem, have been taken into account and analyzed. Then, in order to make a decision on the implementation of certain actions, remediation, it is necessary to recognize which actions can and should be applied, depending on different parts and localities, at the time of occurrence of the risk, but also in the future. In order to find out if the most cost-effective and effective remediation has been chosen, it is necessary to provide answers to additional sub-questions, which would channel the appropriate solutions. Through this step, it is defined when the engineering and institutional controls during the selection of remediation options are contrary to removal or treatment, and it justifies the remediation chosen as optimal, by assessing the comprehensive impact on the environment. finally, it is important to determine whether the defined goals of the remediation have been met.

## CONCLUSION

The rapid development of technologies has introduced us to a world full of surprises and novelties, which require appropriate scientific theoretical approaches and the application of good practices, in order for the development to take place in the correct way. Demanding approaches to the use of natural resources is the challenge of the future and the basis of the development of civilization, especially in the area of water use and water resources. It was noticed that in this context there is no best way, but approaches are used through the concepts of trial and error, through which numerous problems in the management of water resources are solved through interdisciplinary cooperation. In addition to the inclusion of scientific disciplines, it is crucial to ensure institutional, social and political support, in order to create the necessary tools for implementing valid management decisions and achieving the desired goals. Water resource management must never become an end in itself. It has a

significant role to play in bridging the growing gap between theory and practice, and science and human society are gaining more and more importance as the use of water in various ways around the world intensifies. The use of water resources leads to more and more numerous, complex and unexpected problems, which require a special field of interest and necessity of application. As the management of water resources has become one of the most topical issues, attention is being paid to modern strategic eco-management, which plans the concept of ecologically sustainable socio-economic development, having an impact on all spheres of human activity. The above requires a change of opinion, approach and behavior of all social factors, so as not to cause long-term consequences for nature and people. For this purpose, it is necessary to study the consequences of water resources management and to recognize aspects of the manifestation of human activity on water resources. Complementary, harmonized and integral strategic planning for the sustainable use of water resources ensures the fulfillment of strategic decisions, primarily through the analysis of the state of water resources, in order to identify the risks arising from the use of water in time, and, according to the assessment of the impact of their use on the environment, predict the trends of changes in the state and undertake all necessary activities related to the conservation of water, as an important natural resource.

## LITERATURE

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