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Potential contaminants and risk assessment in the Meriç-Ergene Basin under the EU Water Framework Directive

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Abstract The European Union's Water Framework Directive (WFD) 2000/60/EC provides a strategic solution to deal with chemical pollution in rivers. The directive encompasses monitoring and detection of priority pollutants and specific contaminants found in surface waters. An increase in the number of compounds to be monitored may pose a challenge. Hence, it is crucial to prioritize pollutants that require immediate action in the short, medium, and long term based on capacity reports submitted by relevant industries in high-pollution basins. As a consequence of this, prioritizing studies in basins has gained significance in terms of the process of planning the monitoring of chemicals that call for immediate action and lowering the expenses associated with monitoring. According to prioritized strategies, a number of studies for the Meriç-Ergene basin were conducted. Based on the findings of the study, it is recommended to monitor a total of 81 contaminants in the Meriç-Ergene basin in Türkiye.
Keywords: pollutants, river basin, water framework directive

1. Introduction

The Water Framework Directive (WFD) is a European Union directive that aims to achieve good ecological status for all surface waters and groundwater bodies. The WFD is a comprehensive and ambitious piece of legislation that takes into account a wide range of factors, including water quality and quantity. The WFD recommends all member countries draw up river basin management plans which describe the main pressures on water resources and the actions being taken to reduce them. The WFD also requires member states to monitor the condition of water bodies and report on their progress towards achieving good ecological status. Thus, The WFD has received commendation for its ambitious objectives and all-encompassing strategy towards the governance of water resources. The WFD has also been recognized as a valuable tool for developing countries and candidate countries. In these countries, water resources are often under pressure from population growth, economic development, and climate change. The WFD can help countries to manage their water resources more sustainably by providing a framework for planning and decision-making. The WFD may assist the identification of primary pressures on water resources and establishing of related mitigation strategies. The WFD has the potential to facilitate the monitoring of water bodies' condition and provide updates on their progress towards achieving ideal status for all transitional and coastal waters, rivers, and lakes (European Commission, 2000; Eker and Çokay, 2022; Kallis and Butler, 2001).

In contrast, during the implementation of the WFD could bring several challenges for developing countries such as financial constraints, lack of infrastructure, technical expertise, legal framework. Developing countries often lack the financial and technical resources to implement the WFD. Meeting the requirements of the WFD is no mean feat—especially for developing countries that lack sufficient funds for investing in essential infrastructure monitoring systems, and enforcement protocols. Managing water quality under the WFD necessitates considerable expertise and technical know-how. This poses difficulties for developing countries that may not have adequate human resources to implement this directive effectively. Additionally, the lack of pollution control technologies can pose challenges for developing countries. These are major challenges for developing countries, which often lack resources to implement the WFD.

Therefore, developing countries need to carefully consider their specific needs and circumstances before implementing the WFD (Moroglu and Yazdan, 2008). Despite these challenges, the WFD has the potential to make a significant contribution to sustainable water management in countries. By providing a comprehensive framework for planning and decision-making, the WFD can help these countries to protect their water resources for future generations.

Despite the challenges, Türkiye as a candidate country has achieved noteworthy advancements in the execution of the Water Framework Directive. Türkiye is making significant progress in updating its regulations within the framework of the current EU directives after becoming a candidate country to the European Union (EU). The new Water Regulations are a positive step for Türkiye, and it is expected to have a significant impact on the country's water management (Burak et al, 2022). The implementation of new water quality regulations in

Türkiye is expected to mitigate pollution and enhance the overall health of the country's water resources. The legislation additionally establishes a novel water management framework that will assume the duties of strategizing, executing, and overseeing water reserves within Türkiye. These efforts are helping to improve the quality and quantity of water resources in Türkiye, and they are making the country more resilient to the effects of climate change.

The priority pollutant list, purposed by WFD, is a list of pollutants that are considered to be the most harmful to human health and the environment and is used to guide water quality management in member states. In addition, WFD proposed to monitor additional pollutants determined by the country's requirements. The 250 pollutants on the final list, included in the "Regulation on Surface Water Quality Management" published by the Republic of Türkiye Ministry of Environment, Urbanization and and Climate Change, are considered to be the most hazardous pollutants in Türkiye's river basins (Karahan et al., 2016). By conducting an additional assessment within the river basin, it is possible to identify the pollutants that are most likely to be a problem and to prioritize them for monitoring and remediation for certain river basin (Çokay et al, 2016; Eker and Çokay, 2022a). This can help protect the river basin with lower monitoring and analysis costs. The Meriç-Ergene Basin was selected as the study area for this study.

2. Study Area

Türkiye is divided into 25 hydrological watersheds, which are facing a number of challenges, including pollution, climate change, and population growth. Pollution from agricultural runoff, industrial wastewater, and sewage is a major problem in many of the watersheds in Türkiye. The Meriç-Ergene Basin is situated in the Thrace Sub-Region, which extends from the Istanbul Provincial border in the east to the Bulgarian and Greek borders in the west, in the transition zone from the Marmara Region to Europe. The basin is under pressure to a significant amount of agricultural production with a wide variety of crops being grown, including wheat, corn, cotton, and vegetables, industrial activity including textile manufacturing, food processing, and metalworking and urban population (Ministry of Environment and Forestry, 2010). The most active sectors were evaluated as 15.11 (Leather Clothing and Leather Accessories), 20.13 (Chemicals, Agricultural Pesticide and Fertilizers), 13.30 (Ready-Made Garment Materials and Machines), 13.99 (Yarn and Fiber Products), 22.21 (Plastics), 22.22 (Plastics), 22.29 (Plastics) and 24.10 (Iron, Steel, Aluminum and Smelting) in the basin. As a result, the pollutants that may occur in the basin were determined according to the sectors in line with the data obtained from the projects carried out by Ministry of Forestry and Water Affairs. Additional, prioritization assessment studies were carried out to establish the ranking of substances that pose a risk for the substances detected in the basin (Eker and Çokay, 2022b; Karahan et al., 2016). Table 1 presents the outcome of the sector pollutant matching analysis conducted for the potential contaminants in the basin.

Table 1. Suggested Chemicals for Monitoring in River Basin

Chemicals	
Styrene	4,5-dichloro-2-octyl-2H-isothiazol-3-on; DCOIT
2,2'-dichloro-4,4'-methylenedianiline	2,2'-dimethyl-4,4'-methylenebis(cyclohexylamine)
Monobromodifenil eter; 4-bromodifenil eter	Endrin
2,2-dibromo-2-cyanoacetamide	4,4'-DDD
Propylbenzene	2-[2-[2-[2-(4-nonylphenoxy) ethoxy]ethoxy]ethoxy]ethanol
1,4-Dichlorobenzene	2,4,6-tri-tert-butylphenol
4-Chloroaniline	Aluminium
m-xylene	Iron
Chlorobenzene	Silicon
1,1'-isopropylidenebis(p-phenyleneoxy)dipropan-2-ol	Silver
Dioctyl phthalate	Tin
Benzyl benzoate	Titanium
2,4-Dichlorophenol	Antimony
Fenitrotiyon (ISO)	Arsenic
Tributyl phosphate	Barium
Perchloroethylene	Chromium
Polychlorinated biphenyls (PCBs)	Cobalt
Benzododecinium chloride	Copper
Diizobütil adipat	Vanadium
Benzothiazole-2-thiol	Zinc
Crom+6	Bromide
Benzo(e)pyrene	Trichloroethylene
4,4'-Dibromodifenil eter	1,1,2,2-Tetrachloroethane
Benzo(a)fluoren	Tetrabromobisphenol A
2(3)-Tert-butyl-4-methoxyphenol	Dibutyltin oxide
Tris(nonylphenyl) phosphite; TNPP	Dibutylphthalate (DBP)
Aldrin	BBP; Benzylbutylphthalate
Propetamphos	1-Methylnaphthalene
Diazinon	Biphenyl
Triclosan	o-xylene
DDT	1,2-Dichlorobenzene
Permethrin	1,2,4-trimethylbenzene
1,3-Dichlorobenzene	Isopropylbenzene; cumene
Carbon tetrachloride	Ammonia
Free Cyanide	Ammonium Nitrogen
4-Chloro-3-methylphenol;	Chemical Oxygen Demand (COD)
Ethylenediamine Tetra Acetic Acid (EDTA)	Oil-grease
Dieldrin	Polyaromatic Hydrocarbons
Propanenitrile	Suspended solid matter

Bis(2-ethylhexyl) terephthalate; Dioctyl terephthalate (DOTP)	Total petroleum hydrocarbons
Total Phenol	

The risk codes indicate that the chemical can be harmful to aquatic organisms, such as fish and other wildlife. The substances in list have the potential to inflict enduring harm upon the aquatic ecosystem and exhibit persistence within the environment over extended periods. They posse the capacity to bioaccumulate within the food chain. Aquatic life can suffer brain impairment, reproductive issues, and death. Eating infected fish can also harm humans. Almost all of the chemicals in the list are defined in the R20, R21, R36/37/38, R48/20, R50/53 groups, which are all considered to be hazardous. The release of hazardous chemicals listed above into a river basin is a serious problem that can have a number of negative impacts on human health, the environment, and the economy. It is important to take steps to prevent these chemicals from entering the river basin. Therefore, it is recommended to carry out monitoring studies of these pollutants in the basin.

Developing countries need to find ways to reduce the cost of monitoring and controlling pollutants. This can be done by using prioritizing pollutants determined in the basin. For example, monitoring an inactive chemical in water is deemed unnecessary. On the other hand, it is important to include pollutants used in high amounts in the industries in the basin to be monitored in the monitoring studies. Besides, it is possible to prioritize pollutants that need to be monitored in the basin based on require immediate action in the short term, using the final list. Thus, the monitoring cost can be reduced. There are a number of factors that can be considered when prioritizing pollutants that need to be monitored in a basin and require immediate action in the short term. These factors can be summarized as the toxicity of the pollutant, the persistence of the pollutant, the mobility of the pollutant, the sources of the pollutant, and the cost of monitoring.

Additionally, the hazard statements R52 and R53 are indicative of the chemical's potential harm to the aquatic environment. Substances that are assigned the R52-53 risk code are typically persistent and bioaccumulative, meaning that they can remain in the environment for long periods of time and can build up in the tissues of organisms. This can lead to a variety of health problems for aquatic organisms, including reproductive problems, neurological damage, and death. By being aware of this risk, people can take steps to reduce their exposure to these substances and to protect the environment.

it was identified several substances that require priority attention by the evaluation conducted using the prescribed methodology. These substances include Dibutylphthalate, 1,4-Dichlorobenzene, o-xylene. Biphenyl, Triclosan, Isopropylbenzene. These chemicals are all known to be harmful to human health and the environment, and can have a significant impact on the quality of water in for the studied river basin. By taking immediate action to reduce the levels of these pollutants in river basin, it is possible to protect human health and the environment.

3. Conclusions

The cost of monitoring and controlling pollutants is an important consideration for developing countries. Developing countries often have limited resources and may not be able to afford the same level of pollution control as developed countries. This can lead to a number of problems, including increased health problems, damage to the environment, and economic losses.

Conducting basin-specific pollutant monitoring at the national level is likely to result in savings in significant analysis-related expenditures and time. By taking prioritization steps, it is possible to reduce the levels of pollutants in river basins, quickly and improve the quality of water for human use.

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