Scholar Publishing Group
Water Pollution Prevention and Control Project
https://doi.org/10.38007/WPPCP.2022.030301
ISSN 2790-2730 Vol. 3, Issue 3: 1-9

# *Efficient Nonlinear Optimization Algorithm Based on Water Pollution Prevention System*

**Edi Kurniawan***

*Bangladesh University of Engineering and Technology, Bangladesh*

**corresponding author*

***Keywords:*** Efficient Nonlinear Optimization Algorithm, Water Pollution Prevention and Control, Water Quality Model, Water Environment

***Abstract:*** Due to the emergence of water pollution (WP) problems in many places, these problems have not been completely solved and WP incidents still occur from time to time. Therefore, carrying out WP prevention and control work and solving WP problems have become important topics of discussion and research for relevant scholars. In this paper, an efficient non-linear optimisation algorithm is used to establish a water quality model, which can be used to assess the regional water quality conditions. This paper uses an efficient nonlinear optimization algorithm (ENOA) to establish a water quality model, which can be used to assess the regional water quality conditions. Through the analysis of the industrial and domestic production of sewage discharge in T city, the problems and suggestions of WP control in T city are put forward, hoping to improve the water environment and people's living standard in T city through scientific and reasonable development of WP prevention and control scheme in T city.

## 1. Introduction

The relevant environmental policies issued by our government point out that only by strengthening the construction of ecological civilization and restraining the behavior of destroying the environment can we achieve the sustainable development of human civilization. The prevention and control of WP is crucial to China's socio-economic development and human health at this stage. Failure to prevent and control WP is a serious threat to human health and has a serious impact on the coordinated and stable development of social economy [1-2].

The research on WP prevention and control has achieved good results. For example, some researchers believe that, from the perspective of the classification of problems, the prevention and control of sewage pollution is a public management problem that all mankind must face. The leaders of governments in various countries must take the lead. The leaders should also do a good job in assessing the implementation of government systems for WP control, improve the responsibility division system for WP discharge, pay attention to the construction of the sewage management system, and strengthen the management of sewage treatment, Establish a sound legal system for water environment [3]. Some scholars believe that when the government calls on the whole people to control WP waste, the government usually faces management deficiencies in sewage treatment efficiency evaluation, sewage treatment plant status evaluation and each kind of supervision and regulation failure. Therefore, it is necessary to start from the system level to understand the constraints and internal motivation of the government's supervision of enterprises and people's behavior, Moreover, the sewage treatment performance evaluation system and environmental responsibility system must have a scientific framework to achieve equal distribution of capacity, financial resources and environmental protection responsibilities, so as to improve the effectiveness of WP prevention [4-5]. However, in the current process of WP prevention and control, insufficient funds limit the strength and scope of WP prevention and control. In many places, there are widespread defects, such as scarce funds for pollution control, narrow sewage treatment channels, insufficient innovation in sewage management models, and large gap in environmental protection taxes. Therefore, it is imperative to expand diversified WP control methods. A sound sewage management system is not the only source to prevent WP, but various efficient sewage treatment methods can be found to find a more perfect WP treatment model.

This paper firstly introduces the ENOA model and its application in water quality model parameter estimation, then analyzes the total COD emissions, total NH3-N emissions, total wastewater emissions and wastewater collection network construction in City T during 2017-2021, and finally analyzes the WP prevention and control problems and suggestions in City T.

## 2. Basic Overview

### 2.1. ENOA

In recent years, the ENOA has been widely used due to its compatibility and practicality, and is suitable for solving non-linear optimisation problems. The algorithm does not constrain the search range, so it is more convenient and simple to handle in optimisation problems, however, due to the shortcomings of the algorithm, optimisation results are sometimes not obtained [6]. In this paper, the algorithm is used to solve a WP multi-objective optimisation problem. For WP control system planning.

$$Z = k_1 Q^{k_2} + k_3 Q^{k_2} \eta^{k_s} \tag{1}$$

Z is the cost of wastewater treatment, Q is the scale of wastewater treatment, η is the efficiency of wastewater treatment, k1, k2, k3, ks are the cost function parameters.

The water quality model uses Streeter Phelps water quality model with the following expressions:

$$L = \left[ \exp(-g \frac{x}{u}) \right] \cdot L_0 \tag{2}$$

$$C(x) = C_0 \exp(-k \frac{x}{u}) \tag{3}$$

$L_0$ is the initial distance amount of WP, $C_0$ is the initial concentration of WP, x is the distance from the source, u is the average water velocity, and g and k are parameters..

## 2.2. Research on the Application of ENOA in the Valuation of Water Quality Model Parameters

The process of establishing and applying a mathematical model of water quality is shown in Figure 1, and can be broadly divided into: data collection, mathematical expression of the established model, correction, parameter estimation, and model application. In practice, the parameters are often applied to debug the water quality model, and then for specific waters, only to determine and assess whether the selected water quality model can accurately test the water quality situation, and then the water quality model calibration and testing [7-8].

The process of determining water quality in rivers is complex, and the identification of polluting wastes in water bodies in rivers is much more difficult when water quality is not collected at all sections of the river and when material resources are limited, so that only non-comprehensive judgements can be made on water quality indicators. On the other hand, considering the interference of wastes in wastewater to water quality monitoring, river water quality will also be affected by the natural environment, making the identification of wastewater more complex than other engineering systems [9]. Therefore, to establish a water quality model with good results, it is necessary to pre-determine the model's identification parameters for water quality indicators through water quality parameter valuation to achieve efficient water quality detection.

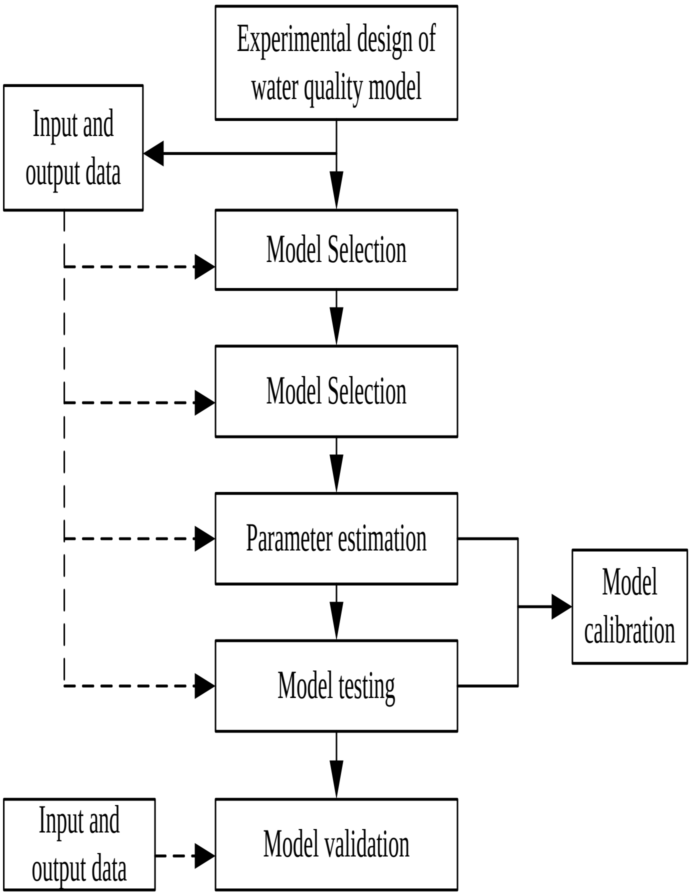


*Figure 1. The process of establishing water quality model*

## 3. Analysis of Total Pollutant Discharge Control Problems

### 3.1. Analysis of WP Emissions

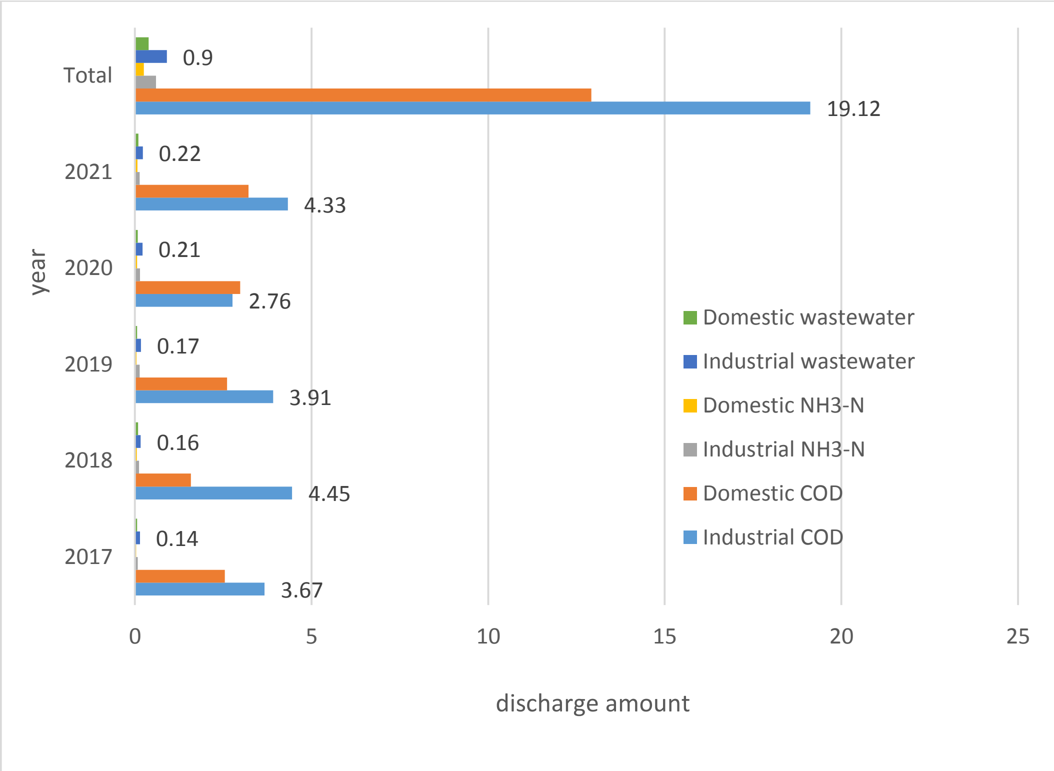


*Figure 2. Industrial WP discharge*

The industrial and domestic production activities in T have exacerbated the resource-based water shortage situation in T. During the period of 2017-2021, the total COD emission is 320,400t, including industrial COD emission of 191,200t and domestic COD emission of 129,200t; the total NH3-N emission is 0.84 milliont, including industrial NH3-N emission of 0.59 milliont and domestic NH3-N emission of 0.25 milliont; the total wastewater emission is 1.29 milliont, including industrial wastewater discharge 0.90 million t, domestic wastewater discharge million 0.39 t. See Figure 2 for details.

### 3.2. Construction of Sewage Collection Network

At present, there are 3 sewage treatment plants in operation within the city of T, namely A, B and C, with a daily sewage treatment capacity of 34,000 tons, 15,000 tons and 32,000 tons respectively, for a total of 81,000 tons, with actual water intake of 28,000 tons, 0.7 million tons and 29,000 tons. And T city daily water supply of about 420,000 tons, the daily generation of sewage about 330,000 tons, even if all three sewage treatment plants are working at full capacity, the actual sewage treatment rate across the region is still significantly inadequate, a large number of untreated sewage with the natural water bodies directly discharge emissions. Although some large companies also have sewage treatment facilities, the treatment capacity can only meet their production needs and there is no excess treatment capacity. At this stage it is still necessary to rely on government investment in sewage treatment plants and the importance of sewage treatment should be taken into account. The construction of new sewage treatment plants is therefore a priority.

*Table 1. Sewage treatment plant operation (million tons)*

| | Regional division | Daily treatment volume | Actual water intake | Operation Status |
|---|---|---|---|---|
| A | Agriculture-related areas | 3.4 | 2.8 | Unsaturated |
| B | Agriculture-related areas | 1.5 | 0.7 | Unsaturated |
| C | Built-up area | 3.2 | 2.9 | Upgrading |

As can be seen from Table 1, none of the three existing sewage treatment plants in City T are operating satisfactorily. sewage treatment plants A and B are mainly responsible for treating sewage from agricultural areas, but the number of sewage treatment plants constructed is not enough to treat the pollution. Because the sewage, drainage and sewerage network is mainly compounded in the construction area, the agriculture-related areas basically do not establish and improve the centralised and standardised pipe collection system, a large amount of sewage cannot be sent to the sewage treatment plant for treatment, and can only be discharged directly and scattered [10]. c sewage treatment plant is mainly responsible for the sewage treatment of the construction area, there are several large residential areas nearby, and the corresponding facilities of the pumping station and closed sewage treatment station relatively well developed. In recent years T city and a number of new real estate projects, and has moved into use, a large number of domestic sewage collection and treatment of centralized for water conservancy projects, resulting in water conservancy project load operation, sewage water treatment efficiency is reduced, the urgent need to improve the standard transformation, improve the sewage treatment capacity [11].

Sewage treatment plants are the core facilities for wastewater treatment, with infrastructure such as pumping stations, pressure pipelines and sewerage networks as secondary wastewater treatment facilities. For City T, the construction of pumping stations, pressure pipelines and sewerage networks is key compared to the construction of additional sewage treatment stations. Only when the wastewater is pressurised, intercepted and transported to the sewage treatment plant, can the wastewater be collected and treated as much as possible, forming a closed-loop management of sewage treatment [12-13].Supporting infrastructure such as water, electricity, heat, gas and roads have been weak in City T. Rapid urbanisation and large-scale economic development have created urban geographic disparities that not only constrain the current carrying capacity of the territory, but will also affect the future sustainable development [14]. At present, although investments in the prevention and control of urban WP are increasing year by year, they must be supported by city governments as they require extensive construction and city financial resources cannot afford the full cost of building supporting facilities.

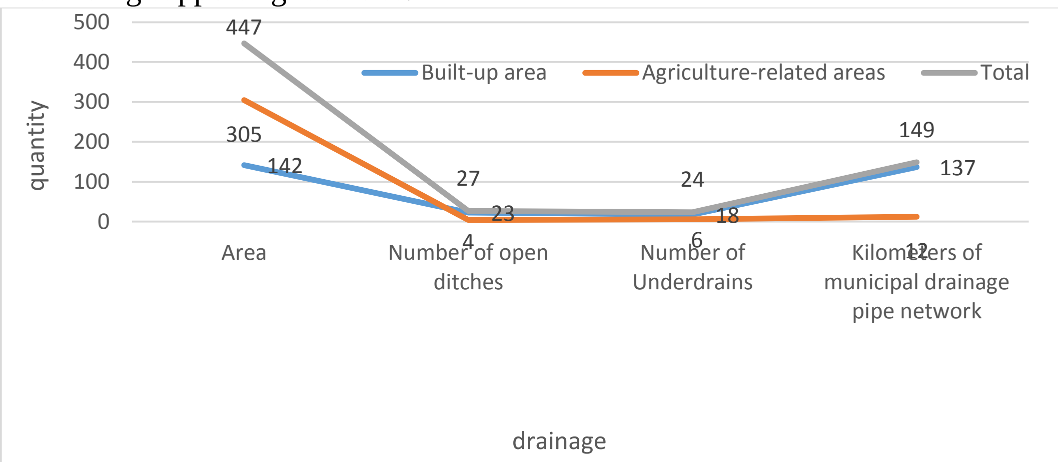


*Figure 3. Construction of drainage network*

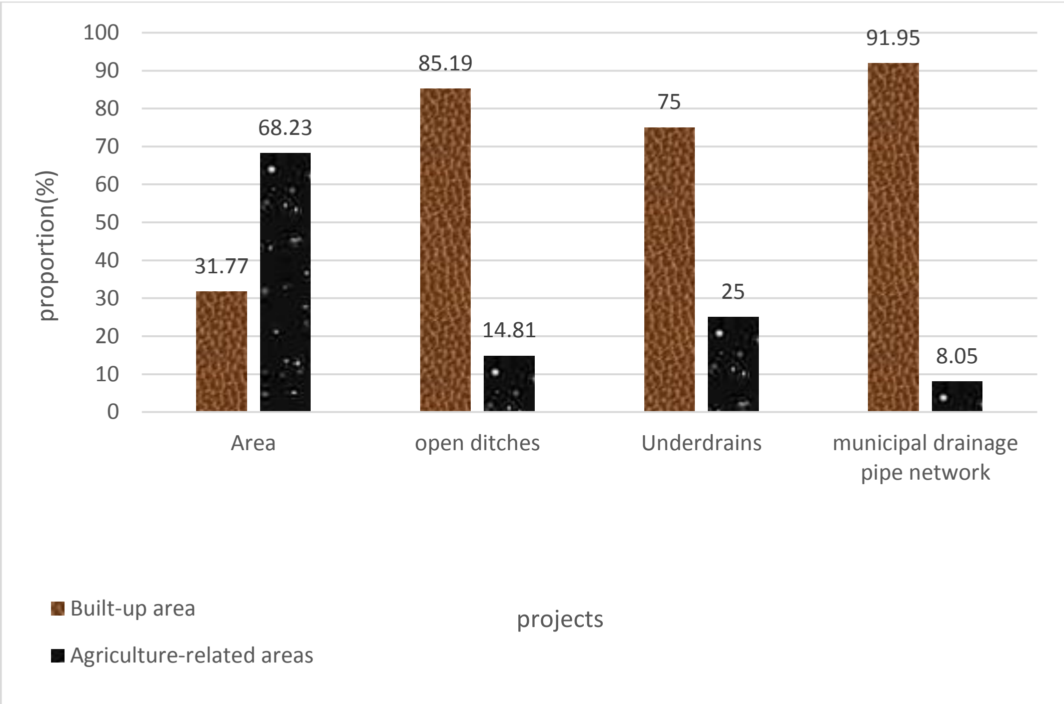


*Figure 4. The proportion of drainage network construction*

As can be seen from Figures 3 and 4, the drainage open ditches, culverts and drainage networks mainly cover built-up areas, and the farming-related areas are basically without a sound centralised and standardised pipe collection system, while the area of the farming-related areas in City T is more than double the area of the built-up areas. The existing drainage network also suffers from ageing pipes, small pipe diameters, confusing connections, inadequate pumping station layouts, uneven drainage and sewage mixing systems, and low operational efficiency. In particular, with the strengthening of development efforts and industrial transfer in the region, agriculture-related areas, i.e. new neighbourhoods and factories, have also been built, but because of the drainage system, rainwater and sewage are still not diverted from agriculture-related areas, and new sewage treatment plants and industrial plants do not divert rainwater effectively when precipitation is high [15-16]. The financial resources of the city of T are sometimes unable to meet the funding needs of the city's two levels of matching.

## 4. T City WP Prevention and Control Problems and Suggestions

### 4.1. Prevention and Control Problems

(1) Lack of systematic design of the sewage system

The prevention and control of WP, fundamentally speaking, is an economic act. However, in order to take the important results of pollution control, we also need to systematically design and organize WP prevention and control in the process of sewage treatment model construction, the only way to effectively control the total amount of sewage, the number of pollutants entering the watershed will be greatly reduced, there will be a turning point in the prevention and control of WP in T, and the deterioration of WP in T will be better controlled. However, from the current situation, there is currently a lack of systematic system design in terms of sewage system design [17-18].

(2) Insufficient public participation

As the environment is closely related to human survival and has a direct impact on sustainable human development, public awareness of environmental protection must be raised. Public participation is an important part of solving environmental problems, including WP, and according to the current situation of pollution prevention in City T, the lack of public participation has not been taken into account, despite a certain degree of public participation. Compared to ordinary citizens in developed countries who are aware of the importance of the environment, the general public in China is currently relatively unaware and generally less aware of WP, which also affects the general public's participation in the prevention of pollution in City T.

## 4.2. Pollution Source Prevention and Control System Optimization

(1) Industrial sources of pollution

All drainage enterprises at enterprise level are to be rectified in accordance with the highest level of pollution prevention mechanism. Install emergency pipes at key locations in the wastewater treatment plant area and regulate the location of emergency pipes. Install effluent monitoring points to ensure that pollution is intercepted in a timely manner through effluent monitoring; regularly maintain WP risk prevention and control facilities to ensure that all risk warning facilities are able to give early warning and respond accordingly in the event of a WP incident, helping wastewater management personnel to make timely decision options; prepare appropriate emergency supplies, improve emergency equipment, improve emergency alarm systems and emergency monitoring systems to ensure that accident warning operations, such as emergency interception and effluent monitoring, can progress smoothly. Wastewater treatment plants need to arrange regular preparatory drills in the event of a major WP incident to enable staff to deal effectively with contaminated waste in the face of an unexpected pollution event, after which the results of the drills are reported to the Ministry of Environmental Protection.

(2) Government level

The construction of wastewater treatment plants is an effective measure to control sewage water in the basin, allowing for centralised treatment of regional sewage and reducing pressure on the water environment in the basin. local standards for the quality of the outlet of wastewater treatment plants should be established or strengthened in the City T basin, taking into account regional water quality and pollutant characteristics and other practical conditions. The watershed should increase investment in sewage treatment, accelerate the construction and expansion of urban sewage treatment facilities, especially urban sewage treatment facilities, and build urban sewage networks to achieve centralised sewage collection and treatment.

## 5. Conclusion

The development of a regional WP prevention and control system and good pollution prevention can prevent and control sudden WP accidents more efficiently. In this paper, we address the WP prevention and control problems in city T. The co-ordinated planning and study of the amount of water resources available in city T, the quality of the water environment and its geographical distribution, and the unified planning of key pollution source control, sewage treatment facility construction and regional integrated pollution prevention and control projects in the basin are conducive to improving the water environment of the entire basin and achieving the goal of joint coordination between the water environment and the economy.

## Funding

This article is not supported by any foundation.

## Data Availability

Data sharing is not applicable to this article as no new data were created or analysed in this study.

## Conflict of Interest

The author states that this article has no conflict of interest.

## References

*[1]Tristan Thielmann. Environmental conditioning: Mobile geomedia and their lines of becoming in the air, on land, and on water. New Media Soc. (2022) 24(11): 2438-2467. https://doi.org/10.1177/14614448221122190*

*[2]Totan Garai, Harish Garg. Possibilistic multiattribute decision making for water resource management problem under single-valued bipolar neutrosophic environment. Int. J. Intell. Syst. (2022) 37(8): 5031-5058. https://doi.org/10.1002/int.22750*

*[3]Angelika Zube, Dominik Kleiser, Alexander Albrecht, Philipp Woock, Thomas Emter, Boitumelo Ruf, lgor Tchouchenkov, Aleksej Buller, Boris Wagner, Ganzorig Baatar, Janko Petereit. Autonomously mapping shallow water environments under and above the water surface. Autom. (2022) 70(5): 482-495. https://doi.org/10.1515/auto-2021-0145*

*[4]Joseph Weiss, Rob Stephens, Nadine Miller. Control System cyber Incidents are Real - and Current Prevention and Mitigation Strategies Are Not Working. Computer. (2022) 55(1): 128-137. https://doi.org/10.1109/MC.2021.3124359*

*[5]Mahdi Azizi, Siamak Talatahari. Improved arithmetic optimization algorithm for design optimization of fuzzy controllers in steel building structures with nonlinear behavior considering near fault ground motion effects. Artif. Intell. Rev. (2022) 55(5): 4041-4075. https://doi.org/10.1007/s10462-021-10101-4*

*[6]Said Ali Hassan, Prachi Agrawal, Talari Ganesh, Ali Wagdy Mohamed. A Novel Multi-Objective Nonlinear Discrete Binary Gaining-Sharing Knowledge-Based Optimization Algorithm: Optimum Scheduling of Flights for Residual Stranded citizens Due to COVID-19. Int. J. Appl. Metaheuristic Comput. (2022) 13(1): 1-25. https://doi.org/10.4018/IJAMC.290541*

*[7]Ing Ming Chew, Wei Kitt Wong, Jobrun Nandong. Optimization Analysis of Nonlinear Process Using Genetic Algorithm. J. Inf. Sci. Eng. (2022) 38(5): 909-921.*

*[8]Makoto Yamashita, Einosuke lida, Yaguang Yang. An infeasible interior-point arc-search algorithm for nonlinear constrained optimization. Numer. Algorithms. (2022) 89(1): 249-275. https://doi.org/10.1007/s11075-021-01113-w*

*[9]Ajay Kumar, Kumar Abhishek , Muhammad Rukunuddin Ghalib, Achyut Shankar, Xiaochun Cheng. Intrusion detection and prevention system for an loT environment. Digit. Commun. Networks. (2022) 8(4): 540-551. https://doi.org/10.1016/j.dcan.2022.05.027*

*[10]Amal Agarwal, Lingzhou Xue. Model-Based Clustering of Nonparametric Weighted Networks with Application to WP Analysis. Technometrics. (2020) 62(2): 161-172. https://doi.org/10.1080/00401706.2019.1623076*

*[11]Suresh Muthulingam, Suvrat S. Dhanorkar, Charles J. Corbett. Does Water Scarcity Affect Environmental Performance? Evidence from Manufacturing Facilities in Texas. Manag. Sci. (2022) 68(4): 2785-2805. https://doi.org/10.1287/mnsc.2021.4013*

*[12]V. A. Miklush, I. A. Sikarev, Tatiana M. Tatarnikova. Organization of Environmental Monitoring of the Port Water Area by Processing an Anti-Interference Signal from a Vessel*

*Traffic Control System. Autom. Control. Comput. Sci. (2021) 55(8): 999-1004. https://doi.org/10.3103/S0146411621080204*

[13]*Mostafa Kabolizade, Kazem Rangzan, Sajad Zareie, Mohsen Rashidian, Hossein Delfan. Evaluating quality of surface water resources by ANN and ANFIS networks using Sentinel-2 satellite data. Earth Sci. Informatics. (2022) 15(1): 523-540. https://doi.org/10.1007/s12145-021-00741-z*

[14]*Stefano Armenia, Davide Bellomo, Carlo Maria Medaglia, Fabio Nonino, Alessandro Pompei. Water resource management through systemic approach: The case of Lake Bracciano. J. Simulation. (2021) 15(1-2): 65-81. https://doi.org/10.1016/j.repl.2021.02.049*

[15]*Giovani Farias, Bruna Leitzke, Miriam Born, Marilton S. de Aguiar, Diana Francisca Adamatti. Water Resources Analysis: An Approach based on Agent-Based Modeling. RITA. (2020) 27(2): 81-95. https://doi.org/10.22456/2175-2745.94319*

[16]*Mala Kalra, Sarbjeet Singh. An intelligent water drops-based approach for workflow scheduling with balanced resource utilisation in cloud computing. Int. J. Grid Util. Comput. (2019) 10(5): 528-544. https://doi.org/10.1504/IJGUC.2019.101995*

[17]*Alessandro Hill, Eduardo Lalla-Ruiz, Stefan VoB, Marcos Goycoolea. A multi-mode resource-constrained project scheduling reformulation for the waterway ship scheduling problem. J. Sched. (2019) 22(2): 1 73-182. https://doi.org/10.1007/s10951-018-0578-9*

[18]*Olawale Ogunrinde, Ekundayo Shittu, Kanwalroop Kathy Dhanda. Distilling the Interplay between Corporate Environmental Management, Financial, and Emissions Performance: Evidence from U.S. Firms. IEEE Trans. Engineering Management. (2022) 69(6): 3407-3435. https://doi.org/10.1109/TEM.2020.3040158*