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Assessment of Water Quality in India's Groundwater Sources Using the MOORA Method, Modified Drinking Water Quality Index (DWQI)

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Abstract. *In 2011, all groundwater using it as a source of drinking water in metropolitan regions of Iran were subjected to a novel "drinking water quality index (DWQI)" developed as "Modified DWQI" and based on the Canadian DWQI. The input parameters are modified in DWQI by having weighting factors applied. Twenty-three water quality characteristics and pertinent Iranian requirements for drinking water were chosen as model parameters and criterion, respectively, in the creation of the updated DWQI. The hyperparameters, the number of assessments throughout the dataset conveying the criteria, and thus the amount of deviation from the benchmarking in the violator observations are used to generate the adjusted DWQI for each sample location over the course of a year. The health-based index "Modified HWQI" and the acceptance index "Modified AWQI" are the two sub-indices that make up the modified DWQI. With a scale from 0 to 100, the updated DWQI and its subindices divide water quality into 5 categories: bad, marginal, fair, good, and excellent. The case study's findings showed that the adjusted DWQI, HWQI, and AWQI scores for groundwater resources across the country were, respectively, and that the overall water quality status in groundwater recharge was well described. This paper discusses various defuzzification techniques as well as how to compute the distance between the two fuzzy integers. The MOORA method's ratio structure and good reference approach can be applied in confusing settings by employing these techniques. The proposed adjustment makes the MOORA approach applicable to a wide range of real-world issues. An example of machining circuits designing process is taken into consideration to show the applicability and efficacy of the suggested approach. The alternatives are Albany, Bunbury, Perth and Geraldton. the Evaluation parameters are Mean TDS (ppm), Annual Range (ppm), Minimum (ppm) and Maximum (ppm). The final rank of this paper the Albany is got fourth rank, Bunbury is got third rank, Perth is got second rank, Geraldton is got first rank. The final result is done by using the MOORA method.*

1. Introduction

Safeguarding the quality of water sources, which is crucial to supplying safe drinking water, typically calls for the cooperation of numerous stakeholders, including managers of water resources, businesses, water delivery systems, local governments, and the general public. A proper comprehension of groundwater resources among stakeholders with various scientific backgrounds cannot be achieved through the use of individual parameter assessments of water quality. On the other perspective, using the conventional method could lead to biased and subjective conclusions, even from water quality specialists. Several groundwater resources indices have been established to translate measurements of water quality variable measures into an unifying indicator particular number using mathematical methods, solving issues in the characterization and understanding of water quality status. Despite the criticism levelled at this measure, it may be impossible to avoid using it given the necessity for a percentage and could be used as a benchmark and the scarcity of data previous to 1990, the benchmark year at target 7c. There was no global agency for gathering information on water quality in 1990. The data that are currently available, however, point to significant data gaps for low-income suburban regions and small, frequently rural delivery systems worldwide. Additionally, because specific factors were approximated using various sampling and reporting techniques, data comparability between nations was weak. Introducing the MOORA approach, which stands for "multi-objective optimization based on ratio analysis", are Brayers and Zavadskas (2006). Despite being a recently developed technology, MOORA has already been used to numerous administrative, financial, and construction issues. For instance, Brauers and Ginevicius and Brauers and Zavadskas employ the MOORA technique to address decision-making issues in a variety of economics domains. The MOORA approach is used in construction by Graca et al. (2010) to address issues with energy loss when heating buildings, and by Chakraborty (2011) to address various decision-making issues in a physical production context. Kadak (2011) proposed the optimization of the turning operation, Karande and Chakraborty (2012) proposed the selection of the fluid quality management, and Day et al. (2012) recommended both procurement processes and warehouse location selection based on the ratio method approach of the MOORA technique. The method can be applied for order prioritisation using "multi-objective optimization based on TOPSIS and ratio analysis (MOORA)". A recently created MCDM technique called MOORA chooses the best option from a list of alternatives using a statistical method. This approach is incredibly simple to comprehend, offers nearly flawless rankings for material choices, and is simple to use. In this case, Brauers et al. MOORA employed an approach

to select the proper performing maintenance contractors by both the perspective of the client and the perspective of the contractor. By using the MOORA technique, Karande and Chakraborty [5] chose various materials while taking into account their costs and qualities.

2. Water Quality

We hope to increase awareness of the intricate connections between quality of water and aquatic environments by employing a huge database containing water quality measures and a deep understanding of groundwater resources challenges. We looked at data from numerous databases around the nation linked to source and final quality of the water in order to build a database scheme suitable for the data used in this research. To handle vast amounts of water quality data and to assist in the detection of water quality anomalies or phenomena inside water systems, various software has been developed. While some event monitors, like the CANARY programme created by the EPA's National Domestic Security Research Facility, are designed expressly for WSI, others, like the Hach Environment Monitor and Water Monitoring Station, are often supported by commercial event detection software. Conventional water quality parameters including calcium chloride, pH, and organic carbon carbon are estimated using a range of detection methods by the CANARY programme. Mathematical and statistical methods are used to identify the beginning of aberrant water quality events. The utility staff can understand better anticipated false alarm rates by using event detection software like CANARY, which uses recent operational data or retraining information to discover natural change in certain water quality metrics. CANARY can identify unexpected "normal" events like sensors failure or pipe breaking in addition to abnormal conditions or probable contamination events. Up until recently, the state was well known for its tin and mineral mining operations. There is no information on drinking water supply and contributing factors of water pollution in the scholarly literature. Since the area is now a major tourist destination, it is critical to evaluate the state's drinking quality of the water to guarantee that both locals and visitors have access to safe drinking water. The purpose of the current study is to evaluate the taste and purity of drinking water, both tap and bottled. Malaysia's Perak State waters. In-depth physical and chemical analyses of water samples were collected from different residential and industrial regions throughout the state were completed. How trustworthy is the general public's assessment of quality of drinking water and related health hazards, nevertheless, in the policy discourse? Do people's perceptions of water quality really reflect its actual state? There are four possible outcomes when comparing the public's impression of theoretical and real water quality: at worst, two are matched—satisfaction with excellent quality and displeasure with poor quality—and two are discrepant. Therefore, any survey that is restricted to the general public may be skewed and cause the relevant authority to make a bad policy choice. There are very few studies that demonstrate if the public's perception of drinking water quality is impacted in any way. Because of this, it is crucial to research how the public perceives the quality of the tap water provided by the local public utilities in each community.

3. MOORA Method

A multi-objective optimization technique is called MOORA, which is based on ratio analysis. The "multi-criteria or multi-optimization method" for attributes is another name for the MOORA approach. The MOORA technique operates by performing concurrent operations to optimize two or more competing criteria, qualities, or objectives that are subject to particular limitations. The MOORA approach involves constrained simultaneous optimization of two or more opposing qualities (references). The values of these purposes are determined for each possible outcome in a decision-making problem; this gives a basis for choice comparison and subsequently makes it easier to choose the best (satisfying) option. As a result, multi-objective optimization approaches appear to be a useful tool for sorting or choosing one or more options from a list of potential choices based on a variety of frequently competing factors. The MOORA method's extreme simplicity, stability, and robustness have already been noted. It also involves the least amount of processing time and mathematical calculations. A popular multi-criteria or multi-attribute optimization technique that can be used to address a variety of difficult decision-making issues in manufacturing settings is the MOORA approach "(Multi-Objective Optimization Based on Ratio Analysis)". It is also an easy way that could be used to figure out the best values for a process with many responses. Therefore, in this work, the MOORA approach is employed to identify the ideal cladding process parameters. In order to choose the ideal ratio of wire cutting various parameters for an electrical discharge process, the use of the MOORA method and the AHP approach was described. It should be noted that some of the typical subject cases were chosen using the MOORA approach. Additionally, the complete multiplicative MOORA method and the good reference approach were investigated. As a nutshell, all three techniques were incredibly straightforward to use and produced nearly similar results for the subject exams. Multiple competing criteria is used to solve scheduling and decision-making issues using the fuzzy MCDM technique known as MOORA. When theoretical results are wanted, some of these competing criteria are advantageous, while others are useless when following calculations are desired. The MOORA technique ranks alternative from either a set of available options by taking advantage and disadvantage factors into account. Ratio analysis aids MOORA in selecting the best option from all available options, and the boundary conditions measure completes component ranking's task of objectively evaluating CBSS reliability.

4. Result And Discussion

TABLE 1. Water quality of TDS using MOORA

	Mean TDS (ppm)	Annual Range (ppm)	Minimum (ppm)	Maximum (ppm)
Albany	390.00	114.00	332.00	446.00
Bunbury	357.00	460.00	269.00	720.00
Perth	281.00	409.00	112.00	521.00
Geraldton	759.00	983.00	209.00	1192.00
	B	**B**	**NB**	**NB**

Table 1 shows the Water quality for the alternatives are Albany, Bunbury, Perth and Geraldton. the Evaluation parameters are Mean TDS (ppm), Annual Range (ppm), Minimum (ppm) and Maximum (ppm).

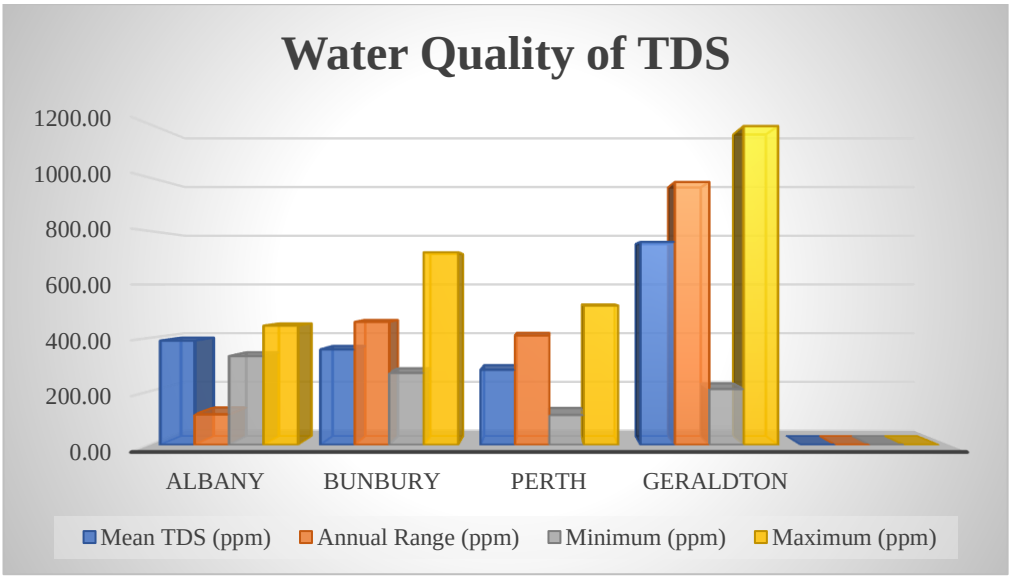

FIGURE 1. Water quality of TDS using MOORA

Shows the figure 1 Water quality of TDS for the alternatives are Albany, Bunbury, Perth and Geraldton. the Evaluation parameters are Mean TDS (ppm), Annual Range (ppm), Minimum (ppm) and Maximum (ppm).

TABLE 2. Divide and Sum

	Mean TDS (ppm)	Annual Range (ppm)	Minimum (ppm)	Maximum (ppm)
Albany	152100.0000	12996.0000	110224.0000	198916.0000
Bunbury	127449.0000	211600.0000	72361.0000	518400.0000
Perth	78961.0000	167281.0000	12544.0000	271441.0000
Geraldton	576081.0000	966289.0000	43681.0000	1420864.0000
	934591.0000	**1358166.0000**	**238810.0000**	**2409621.0000**

Shows the table 2 Water quality of TDS Divide and Sum matrix formula used this table.

TABLE 3. Normalized Data

	Mean TDS (ppm)	Annual Range (ppm)	Minimum (ppm)	Maximum (ppm)
Albany	0.4034	0.0978	0.6794	0.2873
Bunbury	0.3693	0.3947	0.5505	0.4638
Perth	0.2907	0.3510	0.2292	0.3356
Geraldton	0.7851	0.8435	0.4277	0.7679

Table 3 shows the various Normalized Data alternatives are Albany, Bunbury, Perth and Geraldton. Normalized value is obtained by using the formula (1).

TABLE 4. Weight

	Mean TDS (ppm)	**Annual Range (ppm)**	**Minimum (ppm)**	**Maximum (ppm)**
Albany	0.25	0.25	0.25	0.25
Bunbury	0.25	0.25	0.25	0.25
Perth	0.25	0.25	0.25	0.25
Geraldton	0.25	0.25	0.25	0.25

Table 4 shows the Weightages used for the analysis. We take same weights for all the parameters for the analysis. All weight value same 0.25.

TABLE 5. Weighted normalized decision matrix

	Mean TDS (ppm)	**Annual Range (ppm)**	**Minimum (ppm)**	**Maximum (ppm)**
Albany	0.1009	0.0245	0.1698	0.0718
Bunbury	0.0923	0.0987	0.1376	0.1160
Perth	0.0727	0.0877	0.0573	0.0839
Geraldton	0.1963	0.2109	0.1069	0.1920

Table 5 shows the Weighted normalized decision matrix Albany, Bunbury, Perth and Geraldton. the weighted default result is calculated using the matrix formula (2).

TABLE 6. Assessment value and Rank

	Assessment value	Rank
Albany	-0.1164	4
Bunbury	-0.0626	3
Perth	0.0192	2
Geraldton	0.1083	1

Table 6 shows the Assessment value and Rank value used. Assessment value for Albany= -0.1164, Bunbury= -0.0626, Perth= 0.0192, Geraldton= 0.1083. the final rank of this paper the Albany is got fourth rank, Bunbury is got third rank, Perth is got second rank, Geraldton is got first rank. The final result is done by using the MOORA method.

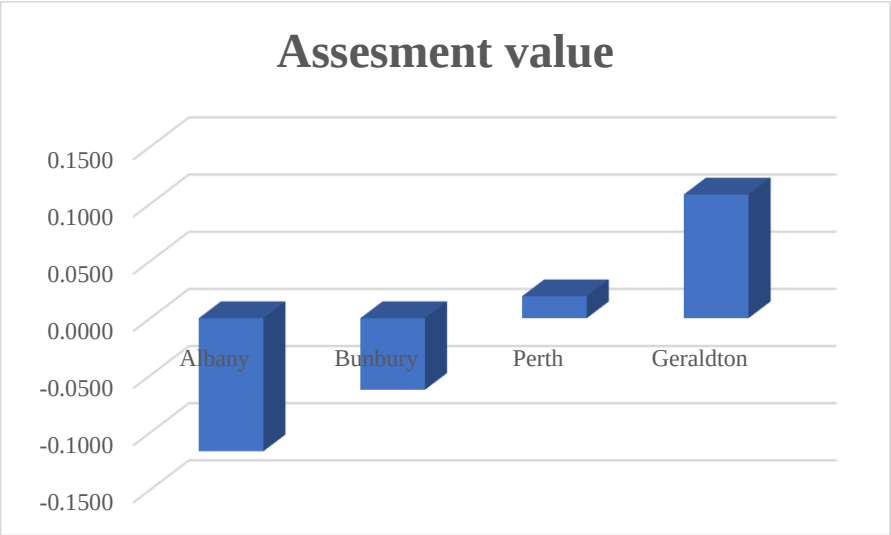

FIGURE 2. Assesment value

Figure 2 Assessment value shows theAssessment value for Albany= -0.1164, Bunbury= -0.0626, Perth= 0.0192, Geraldton= 0.1083.

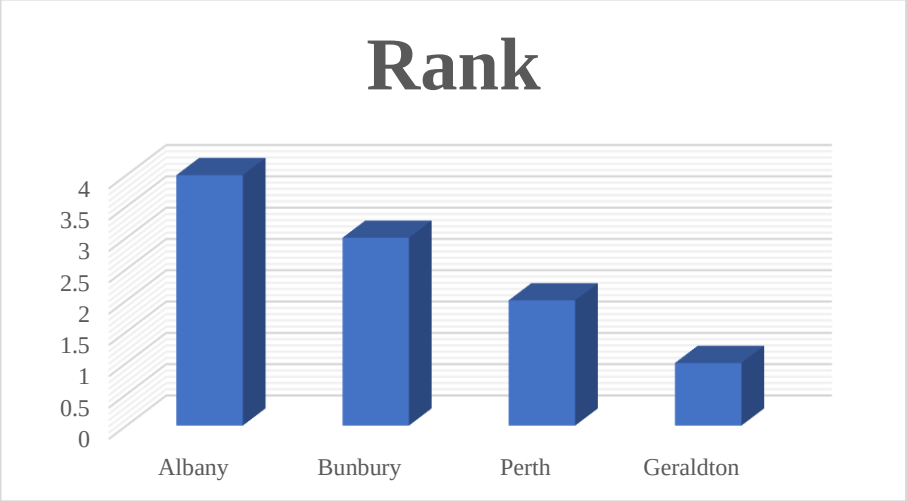

FIGURE 3. Final Result of rank

Figure 3 Shows the final result of this paper the Albany is got fourth rank, Bunbury is got third rank, Perth is got second rank, Geraldton is got first rank. The final result is done by using the MOORA method.

5. Conclusion

The study demonstrates that there is a significant distorted link between public perceptions of quality of drinking water and real water quality. However, as popular sentiment is frequently used as a standard for public services like the provision of drinking water, the study's lessons are crucial from a policy perspective. As a result, local governments, regional agencies, and the province government should create a system for communicating with communities and disseminating state of water quality in an approachable way. For regular people, publishing observations on websites is insufficient. Finally, a deeper understanding of the intricate dynamics behind the widespread disruption of the water supply is required. The Ministry of Environment Board has so far established underground quality requirements for drinking water requirements as well as water quality standard standards for bottled water. Only 30 characteristics are subject to these water quality requirements, and micropollutants like pesticides are not included. In an effort to lessen water pollution and guarantee a supply of safe drinking water, the Thai government should raise the requirements for water quality. In this research, we presented a modification based on transforming the continuous fuzzy responses to precise values before ranking in important to formulate the MOORA approach in fuzzy environments. The use of discretization and several approaches to determine the separation between two fuzzy integers are covered in this essay. As demonstrated by the example under consideration, these strategies enable the use of the MOORA method's rate system and good reference approach in confusing circumstances. Both the supplied defuzzification methods and the methods for calculating the distance around two fuzzy integers have their own advantages and specifications. But none of them are given priority in this essay. We think that future studies can build on the fuzzy modification of the MOORA approach that has been provided, and their researchers can select the most appropriate one based on the issue at hand. the final rank of this paper the Albany is got fourth rank, Bunbury is got third rank, Perth is got second rank, Geraldton is got first rank. The final result is done by using the MOORA method.

REFERENCES

[1]. Kruawal, Kornprabha, Frank Sacher, Andreas Werner, Jutta Müller, and Thomas P. Knepper. "Chemical water quality in Thailand and its impacts on the drinking water production in Thailand." Science of the total environment 340, no. 1-3 (2005): 57-70.

[2]. Rossiter, Helfrid MA, Peter A. Owusu, Esi Awuah, Alan M. MacDonald, and Andrea I. Schäfer. "Chemical drinking water quality in Ghana: Water costs and scope for advanced treatment." Science of the Total Environment 408, no. 11 (2010): 2378-2386.

[3]. Van der Wende, E., William G. Characklis, and D. B. Smith. "Biofilms and bacterial drinking water quality." Water Research 23, no. 10 (1989): 1313-1322.

[4]. Ochoo, Benjamin, James Valcour, and Atanu Sarkar. "Association between perceptions of public drinking water quality and actual drinking water quality: A community-based exploratory study in Newfoundland (Canada)." Environmental research 159 (2017): 435-443.

[5]. Mohebbi, Mohammad Reza, Reza Saeedi, Ahmad Montazeri, Kooshiar Azam Vaghefi, Sharareh Labbafi, Sogol Oktaie, Mehrnoosh Abtahi, and Azita Mohagheghian. "Assessment of water quality in groundwater resources of Iran using a modified drinking water quality index (DWQI)." Ecological indicators 30 (2013): 28-34.

[6]. Van Halem, D., S. A. Bakker, G. L. Amy, and J. C. Van Dijk. "Arsenic in drinking water: a worldwide water quality concern for water supply companies." Drinking Water Engineering and Science 2, no. 1 (2009): 29-34.
[7]. Nickson, R. T., J. M. McArthur, B. Shrestha, T. O. Kyaw-Myint, and David Lowry. "Arsenic and other drinking water quality issues, Muzaffargarh District, Pakistan." Applied geochemistry 20, no. 1 (2005): 55-68.
[8]. Rahmanian, Nejat, Siti Hajar Bt Ali, M. Homayoonfard, N. J. Ali, M. Rehan, Y. Sadef, and A. S. Nizami. "Analysis of physiochemical parameters to evaluate the drinking water quality in the State of Perak, Malaysia." Journal of Chemistry 2015 (2015): 1-10.
[9]. Ailamaki, Anastassia, Christos Faloutos, Paul S. Fischbeck, Mitchell J. Small, and Jeanne VanBriesen. "An environmental sensor network to determine drinking water quality and security." ACM Sigmod Record 32, no. 4 (2003): 47-52.
[10]. Storey, Michael V., Bram Van der Gaag, and Brendan P. Burns. "Advances in on-line drinking water quality monitoring and early warning systems." Water research 45, no. 2 (2011): 741-747.
[11]. Bain, Rob ES, Stephen W. Gundry, Jim A. Wright, Hong Yang, Steve Pedley, and Jamie K. Bartram. "Accounting for water quality in monitoring access to safe drinking-water as part of the Millennium Development Goals: lessons from five countries." Bulletin of the World Health Organization 90 (2012): 228-235.
[12]. Abtahi, Mehrnoosh, Najmeh Golchinpour, Kamyar Yaghmaeian, Mohammad Rafiee, Mahsa Jahangiri-rad, Alidad Keyani, and Reza Saeedi. "A modified drinking water quality index (DWQI) for assessing drinking source water quality in rural communities of Khuzestan Province, Iran." Ecological indicators 53 (2015): 283-291.
[13]. Johnson, Branden B. "Do reports on drinking water quality affect customers' concerns? Experiments in report content." Risk Analysis: An International Journal 23, no. 5 (2003): 985-998.
[14]. Stanujkic, Dragisa. "An extension of the MOORA method for solving fuzzy decision-making problems." Technological and Economic Development of Economy 19, no. sup1 (2013): S228-S255.
[15]. Sutarno, S., M. Mesran, S. Supriyanto, Y. Yuliana, and A. Dewi. "Implementation of Multi-Objective Optimazation on the Base of Ratio Analysis (MOORA) in Improving Support for Decision on Sales Location Determination." In Journal of Physics: Conference Series, vol. 1424, no. 1, p. 012019. IOP Publishing, 2019.
[16]. Lubis, Ahmadi Irmansyah, Poltak Sihombing, and Erna Budhiarti Nababan. "Comparison SAW and MOORA Methods with Attribute Weighting Using Rank Order Centroid in Decision Making." In 2020 3rd International Conference on Mechanical, Electronics, Computer, and Industrial Technology (MECnIT), pp. 127-131. IEEE, 2020.
[17]. Patnaik, Prabina Kumar, Priyadarshi Tapas Ranjan Swain, Srimant Kumar Mishra, Abhilash Purohit, and Sandhyarani Biswas. "Composite material selection for structural applications based on AHP-MOORA approach." Materials Today: Proceedings 33 (2020): 5659-5663.
[18]. Hanifatulqolbi, D., I. E. Ismail, J. Hammad, and M. H. Al-Hooti. "Decision support system for considering the best teacher performance using MOORA method." In Journal of Physics: Conference Series, vol. 1193, no. 1, p. 012018. IOP Publishing, 2019.
[19]. Karande, Prasad, and Shankar Chakraborty. "A Fuzzy-MOORA approach for ERP system selection." Decision Science Letters 1, no. 1 (2012): 11-21.
[20]. Chaudhari, Pavan G., Priyank B. Patel, and Jaksan D. Patel. "Evaluation of MIG welding process parameter using Activated Flux on SS316L by AHP-MOORA method." materials today: proceedings 5, no. 2 (2018): 5208-5220.
[21]. Aydemir, Salih Berkan, and Sevcan Yilmaz Gündüz. "Extension of multi-Moora method with some q-rung orthopair fuzzy Dombi prioritized weighted aggregation operators for multi-attribute decision making." Soft Computing 24, no. 24 (2020): 18545-18563.
[22]. Akkaya, Gökay, Betül Turanoğlu, and Sinan Öztaş. "An integrated fuzzy AHP and fuzzy MOORA approach to the problem of industrial engineering sector choosing." Expert Systems with Applications 42, no. 24 (2015): 9565-9573.
[23]. Shihab, S., N. Khan, Pratyush Myla, Sanjay Upadhyay, Z. Khan, and A. Siddiquee. "Application of MOORA method for multi optimization of GMAW process parameters in stain-less steel cladding." Management Science Letters 8, no. 4 (2018): 241-246.
[24]. Gürbüz, Feyza, and Gizem Erdinç. "Selecting the best hotel using the Fuzzy-Moora method with a new combined weight approach." In 2018 2nd International Symposium on Multidisciplinary Studies and Innovative Technologies (ISMSIT), pp. 1-8. IEEE, 2018.
[25]. Siddiqui, Z., and Kirti Tyagi. "Application of fuzzy-MOORA method: Ranking of components for reliability estimation of component-based software systems." Decision Science Letters 5, no. 1 (2016): 169-188.
[26]. Tansel İç, Yusuf, and Sebla Yıldırım. "MOORA-based Taguchi optimisation for improving product or process quality." International Journal of Production Research 51, no. 11 (2013): 3321-3341.
[27]. Stanujkic, Dragisa. "An extension of the ratio system approach of MOORA method for group decision-making based on interval-valued triangular fuzzy numbers." Technological and Economic Development of Economy 22, no. 1 (2016): 122-141.
[28]. Sahu, Anshuman Kumar, Siba Sankar Mahapatra, Suman Chatterjee, and Joji Thomas. "Optimization of surface roughness by MOORA method in EDM by electrode prepared via selective laser sintering process." Materials Today: Proceedings 5, no. 9 (2018): 19019-19026.