Guest Editorial Preface

Special Issue on Impact of Climatic Change in Optimization of Water and Energy Systems

Tarun Kanti Bandyopadhyay, University of Calcutta, Kolkata, India
Ganesh Kale, S V National Institute of Technology, Surat, India
Mrinmoy Majumder, National Institute of Technology Agartala, Jirania, India

The burgeoning population along with recent technological advancements has induced excessive use of energy. As a result, the release of Green House Gas(GHG) which is a result of incomplete combustion of fossil fuels, have amplified. This inflated concentration of GHGs in the atmosphere is mainly attributed to the rise in global temperature which in turn imbibed changes in the regular pattern of the climate, observed in different locations of the World.

The utilization of natural resources without any regulation has depleted the natural sinks of carbon in the World and as a result, due to this human activity, concentration of carbon in the atmosphere is more than normal. The temperature of ocean has also increased turning the ocean water acidic due to the imbalance in equilibrium of carbon compounds. At the time of deforestation, trees emit their stores of carbon dioxide, adding to atmospheric GHG which enforce to a course for "runaway global warming "(WWF, 2018; NASA, 2018; NOAA, 2018).

The amount of natural resources is finite. Uncontrolled and unconstrained utilization of the resources in the last 150 years has created an imbalance which signifies the need of optimal utilization of natural resources. Due to the change in the regular climatic trend, there is an urgent necessity for controlled use of the natural resources like water. Water can produce renewable energy like hydro and wave power. Hydrological imbalances within the regions was aggravated by the climate change. As the availability of water resources is stressed the production of energy was also affected. The unregulated industrialization and uncontrolled urbanization in different regions of the globe also attributed to the degradation of quality of water available in the catchment which further reduce the quantity of usable water.

Consequently, the need of optimal utilization of both water and energy resource in a mutual manner which satisfies the demand from the technologically enhanced population and also minimize the wastage of the resources has become significant. If optimal utilization of the resources is needed then incorporating the impact of climate change in the decision making will yield realistic and practical solution to this problem.

Accordingly, the present issue was conceptualized and "practical" solution was invited for publication such that wider audience can follow the idea and may replicate or modify the same for a better solution. For this present special issue of the International Journal of Energy Optimization and Engineering(IJEOE), the papers are selected from various types of optimal utilization of water and energy resources considering climate change impacts.

The first paper was about the minimization of utilization of energy in vertical farms by the application of advanced bio inspired optimization algorithms. This solution will help the cultivators to conserve both energy and water. Vertical farms are an example of stacked agriculture where vertical floors were used for cultivation of plants which can sustain in water scarcity. To reduce the load on the floors, application of water has to be minimum. The benefit of vertical farming is from

a single location multiple crops can be cultivated. The total harvest from the farm is also multiplied by the number of floors used for cultivation. One of the drawback of such systems is much amount of energy is used for providing cooling air to the cultivated plants. The pumping operation to distribute water to the plant and also for releasing excess water from the system also augment to the total use of energy within the vertical setups. This study tried to minimize the energy used under the constraints of profit, production and need of the plant for sustenance. As such optimization needs greater domain of feasibility the algorithms like Bacterial Foraging Optimization(BFO) techniques were used to find the solution. The benefit of the BFO algorithm is it can initiate from any point and has a condition-based searching for the optimal loci which enforce an algorithm to iterate continuously and distribute such that each possible solution can be verified before yielding the final optimal solution. The quality of result for this type of optimization was found to be more compared to conventional optimization techniques (Subudhi and Pradhan, 2018; Hernández-Ocaña et al., 2018)

As discussed previously, quality of water has also degraded in the recent years. (Hounslow, 2018). The second paper of this special issue has tried to highlight the impact of location selection for optimal performance of surface water treatment plant. The selection of location for installation of treatment plants are significant as various factors are location dependent which directly impacts the usability of the treatment plant. For example, number of consumers are extremely important for economic viability of a SWTP and that also in proximity to the plant, will reduce conveyance loss and can also supply to maximum number of beneficiaries. But if a treatment plant is installed in a location which have very few consumers in the proximity and to satisfy the need of maximum consumers the treated water has to be conveyed to the distant population, amount of loss will be high and the profit will be required to be compromised. Here climate is also an important factor as for a SWTP surface water is the only source of intake. If climatic parameters like precipitation indicates a dry region then installing a SWTP in the proximity of that location can treat minimum amount of water and cannot supply to maximum number of consumers due to the lack of quantity. The condition of the water will also be degraded due to the absence of fresh water supply. As a result, if change in climate is not considered in selection of location then the output from the plant will not be of standard. That is the reason the present study tried to use meta-heuristics and objective decision-making technologies to locate the region for installation of SWTP ensuing both economic and environmental sustainability of the plant.

Hydropower is deemed to be the most reliable but most inexpensive alternative which have the potential to replace the conventional energy sources. Due to the rapid increment in urban population, in recent years, stress on power plant to supply energy to the needed population has increased. Change in climate has augmented the uncertainty. But to find a solution for nullifying the effect of climate change and urbanization on hydropower plant production capacity, a method has to be devised where a single parameter modification can reduce the effect and optimize the plant utilization factor. The third paper in this special issue, highlights this approach and try to identify the most significant parameter in this regard for providing a single solution to the problem of climate change and urbanization impact. In this aspect the decision-making methodology like Multi Criteria Decision Making(MCDM) (Majumder,2015) techniques were used to solve this problem. A new method was proposed where the Analytical Hierarchy Process(AHP) (Saaty, 1980) was used for selection of parameter and an optimization algorithm (Group Method of Data Handling' (Ivakhnenko and Ivakhnenko, 1995). The review of problems solvable by algorithms of the group method of data handling (GMDH). Pattern Recognition And Image Analysis C/C Of Raspoznavaniye Obrazov I Analiz Izobrazhenii, 5, 527-535.) was cascaded to the result to take the decision for yielding optimal solution only. Generally, MCDM methods does not considers the optimality in output while making a selection of option. In this present study, authors have tried to identify the option for producing optimal solution. The result encouraged the authors for further application of the technique.

In the fourth study, the authors have applied a new and modified version of MCDM which is known as Boot Strap MCDM (Ghoddousi et al., 2018). The advantage of this method is it segments the

available data and decides as per segment about the solution which can result in optimal productivity. Here also the case study area is a hydro power plant. But instead of selection of parameters which can optimize the utilization factor of the plant, in this study the indicators were ranked as per their significance on optimizing the plant performance. Such studies are useful for providing solution for proper management of the power plants, where the quality of the results will be more accurate compared to that from the conventional MCDM techniques, as in those techniques the learning data is not segmented.

The last paper which was selected for the special issues was also related to SWTP. But here the temporal monitoring of intake water quality was conducted by the neurogenetic model where a stoichiometric framework was developed for prediction of quality parameter for different location based on the data of earlier location just before the intake point of collection. This study utilized the cognitive ability of neural networks for development of an adaptive model for prediction of variation in the concentration of the selected quality parameter in the flowing water from which the water is conveyed to the treatment plant for purification. The automated frame work also helps to monitor the change real time such that the treatment mechanism can be adjusted according to the variation in the concentration of the parameter. Thus, the energy utilized to run the treatment processes in the SWTP can be conserved and optimally utilized.

The five papers selected for the issue depicted how different soft computation' technologies can be utilized for optimal utilization and risk assessment due to climate change on the quantity and quality of the natural resources like water and energy. This works can help the other researcher to develop innovative ideas for utilizing the natural resources in a more economical manner considering the environmental and social well-being of the stake holders.

Tarun Kanti Bandyopadhyay
Ganesh Kale
Mrinmoy Majumder
Guest Editors
IJEOE

REFERENCES

Ghoddousi, P., Nasirzadeh, F., & Hashemi, H. (2018). Evaluating highway construction projects' sustainability using a multicriteria group decision-making model based on bootstrap simulation. *Journal of Construction Engineering and Management*, *144*(9), 04018092. doi:10.1061/(ASCE)CO.1943-7862.0001514

Hernández-Ocaña, B., Chávez-Bosquez, O., Hernández-Torruco, J., Canul-Reich, J., & Pozos-Parra, P. (2018). Bacterial Foraging Optimization Algorithm for Menu Planning. *IEEE Access*, *6*, 8619–8629. doi:10.1109/ACCESS.2018.2794198

Hounslow, A. (2018). *Water quality data: analysis and interpretation*. CRC press.

Ivakhnenko, A. G., & Ivakhnenko, G. A. (1995). The review of problems solvable by algorithms of the group method of data handling (GMDH). *Pattern Recognition And Image Analysis C/C Of Raspoznavaniye Obrazov I Analiz Izobrazhenii, 5*, 527-535.

Majumder, M. (2015). Multi criteria decision making. In *Impact of urbanization on water shortage in face of climatic aberrations* (pp. 35–47). Singapore: Springer.

National Aeronautics and Space Administration (NASA). (2018). How climate is changing, Retrieved from https://climate.nasa.gov/effects/

National Oceanic and Atmospheric Administration (NOAA). (2018). Climate change impacts, Retrieved from http://www.noaa.gov/ resource-collections/climate-change-impacts

Saaty, T. L. (1980). *The Analytical Hierarchy Process, Planning, Priority. Resource Allocation*. USA: RWS Publications.

Subudhi, B., & Pradhan, R. (2018). Bacterial Foraging Optimization Approach to Parameter Extraction of a Photovoltaic Module. *IEEE Transactions on Sustainable Energy*, *9*(1), 381–389. doi:10.1109/TSTE.2017.2736060

World Wildlife Foundation (WWF). (2018). The Effects Of Climate Change. Retrieved from https://www.wwf.org.uk/effectsofclimatechange