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Research Article

Food's Waste Water Biosolid Assessment against Toxic Element Absorbability of Food's Cropping Soil Plant by Dominance Theory

Yanan Li,[1,2,3] **Dan Wu**,[1,2,3] **and Anoop Kumar Sahu**[4]

[1]Shaanxi Provincial Land Engineering Construction Group Co., Ltd., Xi'an, Shaanxi 710075, China
[2]Institute of Land Engineering and Technology, Shaanxi Provincial Land Engineering Construction Group Co., Ltd., Xi'an, Shaanxi 710075, China
[3]Technology Innovation Center for Land Engineering and Human Settlements Shaanxi Land Engineering Construction Group Co., Ltd. and Xi'an Jiaotong University, Xi'an, Shaanxi 710075, China
[4]Faculty, Mechanical Engg., Guru Ghasidas Vishwavidyalaya, Bilaspur, C.G., India

Correspondence should be addressed to Yanan Li; liyananbest@sina.com

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The blending of the Food's Waste Water Biosolid (FWWB) fertilizer with Food's Cropping Soil (FsCS) results the absorption of the toxic macromicroorganisms from FsCS (is known as absorbability index). It is observed that such as blending not only increase the fertility and productivity of FsCS by neutralizing or absorbing the macromicroorganisms but also catering the necessary nutrition to plants. The authors sensed that a few research works are conducted recently in the dimension of evaluating the best FWWB among available FWWBs under *O*-(objective) FWWB's parameter models. On potential analysis of published research works, the authors claimed that there is yet no research document, which can evaluate the best FWWB among available FWWBs or assess the best absorbability index of *O*-(objective) as well as *S*-(subjective) FWWB's model corresponding to evaluated FWWBs or alternative points. It is accepted as a first research challenge. On extensive review, the authors determined that published FWWB's parameter models are simulated by only single or nondynamic multivariable optimization techniques, which is accepted as a second research challenge. To address both research challenges, preliminary, the authors developed and proposed FWWB's parameter model, consisted of physical, chemical, and biological parameters corresponding to *O* and *S* in nature via auditing a real case of FWWB alternative points such as Narendr Rice Mill-P^1, Liese Mahamaya Rice Mill-P^2, Vijay Rice Mill-P^3, Mahim Rice Mill-P^4, and Dhansingh Rice Mill-P^5 and their characteristics vs. parameters. Next, the authors framed the FWWB parameter model by acquiring *O* and *S* information against *O*-physical, chemical, and *S*-biological parameters corresponding to FWWB alternative points. To evaluate the results, the authors applied the robust multiparameter optimization "RMPO" (crisp VIKOR "VIseKriterijumska Optimizacija I Kompromisno Resenje" and FMF "Full Multiplicative Form technique with dominance theory") approach on defuzzified *S*-data and *O*-data to evaluate the best FWWB point among available based on absorbability index assessment. The results are described in summary part.

1. Introduction

Biogeochemical is a field where we study about the contribution of macromicroorganisms for the growth of soil plant and environmental ecosystem. Biogeochemical directs the researchers to study about the natural phenomenons, i.e., the behavior of metalloproteins, artificial metallic compounds, and macromicroorganisms/agents. WHO, US Environmental Protection Agency (EPA), International Standards Organization (ISO), Water Environment Federation (WEF), and National Biosolids Partnership (NBP) stated that biogeochemical study deals with the formation of macromicroorganisms, assisting for assessing the soil-plant chemistry/interaction for controlling pollutants and pollution in the ecosystem. It is declared by WHO, EPA Office of Wastewater Management, Biosolids Quality Standard (BQS), and Pathogen Equivalency Committee (PEC) that healthy soil helps the farmers for the rapid food's cropping, provides the best quality of foods, does not emit the toxic pollutants to ecosystem, and therefore contributes towards controlling the pollution. Healthy soils not only produce the best quality of harvesting the foods but also make the happiest life to plants. As per the Food and Agriculture Organization of the United Nations (FAOUN), healthy soil provides the hygiene environment to farmers. It is probed via literature of recent research articles and observed from various statements of US-EPA, ISO, NBP, and EPA Office of BMS, BQS, and PEC that rich growth rate of archaea, bacteria, protozoa, algae, fungi, and oomycetes results in the rich fertility of FsCS. Therefore, it is found that the FsCS fertility can be improved by mixing the best biosolids (BS) and has potential absorbability against phytophthora, fusarium, verticillium, Pythium, and Rhizoctonia microorganisms from FsCS.

Biosolids (BSs) are organic substance, which are recovered by sewage treatment processes and employed as fertilizers. Biosolids (BSs) are considered as a strong biogeochemical agent, which has the capability to absorb/neutralize/deactivate the Phytophthora, Fusarium, Verticillium, Pythium, and Rhizoctonia microorganisms existing in FsCS as per FAOUN, NBP, and EPA Office of WM and BQS. As per PEC, the farmers can utilize the animal's manures as BSs to hoist the high fertility of FsCS. It also improves the fertility of waste soil fertilizers. BSs are spread over the soil of agriculture fields to cater the fertility to FsCSs and absorb/neutralize/deactivate the toxic microorganisms such as Phytophthora, Fusarium, Verticillium, Pythium, and Rhizoctonia from FsCS as per FAOUN and NBP. BSs fertilize the FsCS with nitrogen (N), lime (L), and phosphorus (P), which absorb/neutralize/deactivate the toxic FsCSs. BSs also make the strong chemistry/interaction between FsCS and foods producing plants as FsCSs provide many nutrition such as sulfur (S), zinc (Zn), manganese (Mn), iron (Fe), copper (Cu), molybdenum (Mo), and boron (B) to plants. The farming community beliefs to use the animal manures or restaurant waste water, rice mill wastewater, waste water, and waste materials come from chemical treatment industries as fertilizer. The recent researches and scientists confirmed that these BSs encompass the strong nutrition for FsCS than animal manures. All BSs, which are brought into use as fertilizer by farming communities, are usually treated to increase fertility and productivity of FsCS by absorbing/-neutralizing/deactivating the toxic macromicroorganisms of FsCS.

The authors investigated that evaluation and selection of the best BS among available BSs to be mixed with FsCS in purpose absorb the toxic macromicroorganisms or pollutants from FsCS that is recently respected as a challenging work as per Costa et al., [1]; Koksal [2]; Barrett and Feng [3]; Wirawan and Yan [4]. It is seen that the evaluated best BS helps to improve the productivity and fertility of FsCS Fozouni Ardekani et al., [5]; Ag Majid et al., [6]; Zhang et al., [7]. Said evaluation process is advised by researchers as the best and cheapest way to obtain rich quality of foods with high production rate too as per Novita and Rowena [8]; Thome et al., [9]; Aqueveque and Rodrigo [10].

It is prescribed by the US Clean Water Act of 1972 and by real empirical survey as well as glancing the recent research documents that the waste food water can be used as BS or fertilizers. Waste food water comprises the liquid with solid waste that is discharged by domestic residences, commercial properties, agriculture facilities, industrial and rice mill organizations, etc. Waste food water is a mixer of dirty/byproduct or waste generated by rice mills and is abbreviated as Food's Waste Water Bio Solids (FWWBs), which contains a large range of contaminants at different concentrations. The discussed FWWBs exhibit the three characteristics such as physical (turbidity, color, odor, total solids, temperature), chemical (chemical oxygen demand, total organic carbon, nitrogen, phosphorus, chlorides, sulfates, alkalinity, ph, heavy metals, trace elements, priority pollutants), and biological (biochemical oxygen demand, oxygen required for nitrification, microbial population). The said prosperities make the discussed FWWBs to absorb/deactivate the toxic microorganisms form FsCS and make it pollutants free and also help to reduce the pollution around the agriculture land, enable farmers to produce good quality of foods with rich production rate.

Presently, multiparameter optimization (MPsO) field has been vastly growing to tackle the problems for evaluating the best FWWB among available FWWBs or stuffs or options or alternatives. MPO field deals for assessing the performance of FWWB options in the existence of individual *O*-(objective)/observed or *S*-(subjective)-fuzzy-expert data). The parameters, which are dealing with measured or mapped or observed data, are called as *O*-(objective) parameters, while the parameters cannot be mapped are called as *S* -(subjective) parameters. *S* parameters can be framed mathematically by fuzzy or expert data. MPOs have become a one of the significant and superlative growing fields today in the context of assessing and evaluating the best FWWB option among available FWWBs or BSs as per EPA office of WM and BQS. MPO field is immortal since many decades and dwelling in the heart of the FWWB alternative's evaluators. It is proved by mathematicians that MPO techniques are vital for solving the evaluation problem of FWWB options under different *O-S* (objective-subjective) data corresponding to *O-S* parameters. It is investigated that the evaluation of FWWB option plays a significant function in all farming societies. The authors conducted the real case study for framing the FWWB parameter model (to be used for assessing the absorbing index of FWWBs option against toxic micro organisms of FsCS) under *O-S* parameters. Moreover, a few literature surveys are conducted to reconfirm the case study model and frame the dynamic MPO technique and can tackle mixed *O-S* data corresponding to *O-S* parameters.

2. Literature Review

Rashid et al. [11] presented an overview of the applications of paper mill-based BSs to enhance the physical, chemical, and biological characteristics of soil of agricultural land

White et al. [12]. The authors stated that growing industries produced the different types of wastes or by products to be used as or BSs for agricultural land Arulrajah et al. [13]. The authors proposed the managerial as well as technical suggestions to the road making companies to minimize the green risks during the filling of BSs over the road embankment Oleszkiewicz and Mavinic [14]. The authors said that proper treatment of wastewater BSs diminishes the bioavailability of heavy metals and also lead to efficient waste management Gerba and Pepper [15]. The authors described the characteristics of modern treatment processes of land waste water. The methods to be used for transforming land waste water in to BSs are discussed. Furthermore, the quantity of organic matters is required for biological treatment of land waste water BSs that is examined.

Various tests are conducted to assess the quantity of organic matters such as biochemical oxygen demand (BOD), chemical oxygen demand (COD), and total organic carbon (TOC) involved in land waste water BSs. The physicochemical parameters, namely, pH, temperature, turbidity, BOD, COD, DO, TOC, conductivity, TDS, TSS, total alkalinity, sulphate, nitrate, phosphate, and heavy metal concentrations (iron, copper, lead, nickel, and zinc) are described by APHA (1992) and Guide Manual (Manivasakam N, 2011), ([16–18], Wanga et al., [19], [20], Djafarou, et al., [21], Florencia et al., [22], Djafarou, et al., [21] Kumar et al., [23]. The authors made effort for the treatment of biosolids or sewage sludge for making it more suitable and feasible BS to be used for a real life application. Sharma et al. [24] conducted an extensive investigation on utilization of agricultural BSs and its potential upshots over soil and plant growth. The research work tried to update the knowledge about the characteristics of agricultural BSs.

Liu et al., [25] The authors proposed a novel Mg-Al mixed oxide adsorbent technique to synthesize biosolid by using the dip calcination such as Fluff of Chinar Tree (FCT) over an Mg (II) and Al (III) chloride solution. Gonzalez et al., [26] the biosorption of Co (II) was studied for three fungal biomasses. The results showed that concentration of the biosorbent increases the removal of the metals. It is concluded that Co (II) is present naturally in contaminated waste water. WHO [27], AWWA [28], Sharma et al., [29], Bahry et al., [30], BIS (Bureau of Indian Standards) 10500 [31], Biswas, et al., [32] explained that Co (II) contaminated waste water is significant for fertility of biosolid, Odularu and Ajibade [33]. The authors addressed the challenges, which are experienced during the fusion of dithiocarbamate and mechanisms. The precursors of dithiocarbamate used for synthesize adducts, nanoparticles, and nanocomposites are discussed and investigated, Ma et al., [34]. The authors determined the concentration of heavy metals available in the foods waste water samples along with its effects on environment that is investigated. The physicochemical parameters as well as levels of heavy metals of food waste water are investigated in a case study by using the standard analytical process. Kannan et al. [35] applied a fuzzy-TOPSIS (technique for order preference similar to ideal solution) approach upon GSCM framework (included practices) for obtaining the ranking orders the twelve supplier options. The obtained result computed by fuzzy-TOPSIS is compared with the ranks obtained by the geometric mean and the graded mean methods for final selection of material supplier option.

Kannan et al. [36] developed a multicriteria decision-making hierarchical model (consisted of the traditional as well as environmental criteria) and implemented with an intellectual approach to evaluate the best green supplier for a Singapore-based plastic manufacturing company. Sahu et al. [37] presented an efficient material supplier performance assessment index with generalized trapezoidal fuzzy numbers set. A fuzzy overall evaluation index is estimated towards assessing the GSC performance of supplier options. Valeris [38] displayed that environmental indices are key factors in the evaluation, selection, and maintenance of any supplier in the context of SCM. A case study of an autoindustry is carried out to justify this assertion. [39] developed an environmental concern material supplier model, which is solved by application of artificial neural network (ANN) with two more multiattribute judgment analyses (MAJA) techniques such as data envelopment analysis (DEA) and analytic network process (ANP). Mazzella 2007 said that industry is a chief customer of natural resources and a major contributor to the overall pollution. As per organization for economic cooperation and development, one-third of energy and about 10% of the total water consumption at global platform are due to only industries. The industry is the major contributor to the total pollution and pollutants, i.e., organic substances, sulfur dioxide, particulates, and nutrients [40]. Waste water is used as fertilizer and can be treated for minimizing the industrial pollution.

3. Research Gaps and Objectives

After literature surve,y the authors found that a few research documents are in the line of assessing the best absorbability index of FWWBs under either *O*-(objective) or *S*-(subjective) FWWB parameter model. Therefore, authors had not found any research document and can assess the best absorbability index of FWWBs under dual or mixed *O* -(objective)-*S*-(subjective) FWWB parameters. Moreover, the authors found that there is still no research article, which can deal with RMPO approach, and can tackle the both: *O* -(objective)-observed and *S*-(subjective)-fuzzy-expert data simultaneously for solving FWWB's parameter model. To address the said research gaps, the authors received motivation to (1) frame and propose a new FWWB's parameter model by addressing the physical, chemical, and biological parameters of FWWB's model and (2) to resolve the constituted model by designing the robust MPO approach (defuzzification based crisp VIKOR and FMF technique with dominance theory) for assessing the best absorbability index of FWWBs options.

4. Methods for Assessing the Best Absorbability Index of FWWBs vs. Toxic Macro- and Microorganisms of FsCS

4.1. Fuzzy Set towards Mathematical Framing of S-Parameters. The fuzzy set theory was implemented by Zadeh

[41] to deal with the problems aligned with vagueness and imprecise data. triangular fuzzy numbers (TFNs) were presented by [42] and are explored in the presented research forum for assigning the appropriateness ratings and priority weights against *S*-parameters of FWWB's parameter and priority weights against *O*-objective FWWB's parameters. Since a few years, the fuzzy logic was effectively applied in the context of many practical applications. Fuzzy sets help the decision-makers in undertaking imprecise data Zadeh [43] and Zadeh [41]. It is observed as verdict support models, which are brought into use to solve the issues, expecting the fuzzy modeling. Fuzzy sets obviously reach towards an adequate solution after passing through many operations. A fuzzy set is respected as a mathematical based language by the current researchers to approximate situations, dealing with contradictory parameters. The presented work explores the operations of TFNs [44].

Definition 1. Zadeh [41] Fuzzy number. If a fuzzy set A on the universe R of real numbers satisfies the following conditions, we call it a fuzzy number.

(1) A is a convex fuzzy set

(2) There is only one x_0 that satisfies $f_A(x_0) = 1$, and

(3) $f_A(x)$ is continuous in an interval

The numbers in fuzzy set is defined by [43, 45].

Definition TFNs are as follows:

Let $\tilde{B} = (a, b, c)$, $a < b < c$, be a fuzzy set on $R = (-\infty, \infty)$. It is known as TFN, if its membership function is

$$\mu_{\tilde{B}}(x) = \begin{cases} \dfrac{x-a}{b-a}, & \text{if } a \le x \le b, \\ \dfrac{c-x}{c-b}, & \text{if } b \le x \le c. \\ 0, & \text{otherwise} \end{cases} \tag{1}$$

Clearly, we can treat the TFN $\tilde{B} = (a, b, c)$ as the trapezoid fuzzy numbers (a, b, b, c):

$$\begin{aligned} \tilde{a} \oplus \tilde{b} &= (a_1, a_2, a_3) \oplus (b_1, b_2, b_3) = (a_1 + b_1, a_2 + b_2, a_3 + b_3), \\ \tilde{a} - \tilde{b} &= (a_1, a_2, a_3 \sim) - (b_1, b_2, b_3) = (a_1 - b_4, a_2 - b_3, a_3 - b_2), \\ \tilde{a} \otimes \tilde{b} &= (a_1, a_2, a_3) \otimes (b_1, b_2, b_3) = \tilde{a} \otimes \tilde{b} = (a_1 \times b_1, a_2 \times b_2, a_3 \times b_3), \end{aligned} \tag{2}$$

$$\tilde{a}/\tilde{b}(a_1, a_2, a_3)/(b_1, b_2, b_3) = ((a_1/b_3), (a_2/b_2), (a_3/b_1)).$$

4.2. Dominance Technique towards Calculating Absorbability Index of FWWBs under O-S-Parameters. It is investigated that every decision in relation to assess and evaluate the best FWWB helps for reducing the pollutants and absorbing the toxic macro and microorganisms from FsCSs, decreasing emission of toxic pollution, improving the fertility, and also assisting farmers to obtain the best quality of foods with rapid production as discussed. Therefore, decision must be reliable and robust in nature. For taking care of this matter, (Sahu et al., 2019) proposed the dominance technique, which motivated the authors to apply in the current research work. The authors proposed the defuzzification-based MPO (crisp-VIKOR-FMF) technique. The dominance technique is used by the authors to advise the reliable results as discussed by performing the comparative analysis.

Let $E = \{k_1, k_2, \cdots, k_q\}$ be the set of decision-makers in the group decision-making process. Let $P = \{P_1, P_2, \cdots, P_m\}$ be the set of options and $c_j = \{c_1, c_2, \cdots, c_n\}$ be the set of parameter attributes. Then, the TFNs aggregated fuzzy rating of options with respect to each parameter can be defined as

$$\tilde{\tilde{x}}_i = (a_i, b_i, c_i), \tag{3}$$

where

$$a_{ij} = \frac{1}{k}\sum_{k=1}^{q} a_i, \tag{4}$$

$$b_{ij} = \frac{1}{k}\sum_{k=1}^{q} b_i, \tag{5}$$

$$c_{ij} = \frac{1}{k}\sum_{k=1}^{q} c_i. \tag{6}$$

Then, the aggregated fuzzy weight of each parameters can be defined as

$$w_j = (w_{j1}, w_{j2}, w_{j3}), \tag{7}$$

where

$$w_{j1} = \frac{1}{k}\sum_{k=1}^{q} w_{j1}, \tag{8}$$

$$w_{j2} = \frac{1}{k}\sum_{k=1}^{q} w_{j2}, \tag{9}$$

$$w_{j3} = \frac{1}{k}\sum_{k=1}^{q} w_{j3}. \tag{10}$$

4.3. Defuzzification. The defuzzification is the method, which is utilized to transform the TFNs fuzzy elements into the crisp or single value for determining and comparing the FWWB options. [37, 42] explained the many approaches as the max parameters, mean of maximum, and the center of area.

The center of gravity technique to transform the TFNs $(a, b\,; c)$ into the measured or crisp or single value is defined by [42, 44]:

$$\frac{a + 4b + c}{6} \tag{11}$$

4.4. Crisp-VIKOR Technique. VIKOR is expressed as a hybrid technique and defined by VIseKriterijumska Optimizacija I Kompromisno Resenje Technique Mohanty and

Table 1: Developed and proposed FWWB's parameter model.

Model	Nature of information	FWWB parameters	Characteristics (concentration mg/l)	Symbols
FWWB's parameter model	*O*-data	Physical	Total solids	TS
			Dissolved solids	TDS
			Suspended solids	SS
		Chemical	Phosphorus	P
			Alkalinity (as $CACO_3$)	ALK
			COD	COD
			BOD	BOD
	S-data	Biological	Nutrition development	ND
			Cropping growth rate	CGR
			Toxic gases emission	TGE
			Cropping effectiveness	CE

Table 2: FWWB *O-S*-parameters and corresponding data.

FWWB points	FWWB *O-S*-parameters and data corresponding to their characteristics: *O*-data							*S*-data			
	TS	TDS	SS	P	ALK	COD	BOD	ND	CGR	TGE	CE
P^1	1200	850	320	20	200	1820	750	$F -^{\text{assessment}}$	$F -^{\text{assessment}}$	$F -^{\text{assessment}}$	$F -^{\text{assessment}}$
P^2	1100	840	350	18	189	1730	770	$F -^{\text{assessment}}$	$F -^{\text{assessment}}$	$F -^{\text{assessment}}$	$F -^{\text{assessment}}$
P^3	1000	830	340	15	191	1630	710	$F -^{\text{assessment}}$	$F -^{\text{assessment}}$	$F -^{\text{assessment}}$	$F -^{\text{assessment}}$
P^4	1150	820	300	18	175	1530	730	$F -^{\text{assessment}}$	$F -^{\text{assessment}}$	$F -^{\text{assessment}}$	$F -^{\text{assessment}}$
P^5	1200	750	310	16	170	1710	720	$F -^{\text{assessment}}$	$F -^{\text{assessment}}$	$F -^{\text{assessment}}$	$F -^{\text{assessment}}$

Mahapatra [46], Sayadi et al., [47]. This technique is used to rank the FWWB options/points and ascertain the compromise solution that is the nearby to the ideal value. This technique was presented by Sahu et al. [42], which is brought into the use in the presented research work for arriving to the appropriate or best FWWB option/points. This technique takes into account of the decision-makers' preferences. This technique was recent introduced as a one of MPO decision-making techniques for complex decision-making, which decides the compromise rank solution under priority weight concern. This technique forms the decision-making problem pursued by normalization of data. This technique formed the weighted matrix by evaluating the positive ideal and negative ideal solution of the evaluated FWWB options/points. This technique explores the equations for decision evaluation perspectives.

The operational rules of the trapezoidal fuzzy numbers $\tilde{a}$ and $\tilde{b}$ are shown as follows:

$$r_{ij}= \frac{x_{ij}}{\sqrt{\sum_{j=1}^{n} x^2{}_{ij}}}, i = 1, 2, 3,. \cdots \cdots m, , j = 1, 2, 3,. \cdots \cdots n. \tag{12}$$

For beneficial attributes,

$$\tilde{\tilde{\mathcal{V}}}^{+} = \left[\tilde{\tilde{v}}^{+}_{j}\right]_{1\times n}, \tilde{\tilde{\mathcal{V}}}^{-} = \left[\tilde{\tilde{v}}^{-}_{j}\right]_{1\times n}. \tag{13}$$

Table 3: The scale for assigning weights for *O*-parameters and rating and weights for *S*-parameter's characteristics of FWWB's parameter model.

Linguistic	Rating variables	Weight variables	Rating/weights
Very poor	VP	ML	(0, 0, 3)
Poor	P	M	(0, 3, 5)
Fair	F	MH	(2, 5, 8)
Good	G	H	(5, 7, 10)
Very good	VG	VH	(7, 10)

For nonbeneficial attributes,

$$\tilde{\tilde{\mathcal{V}}}^{+} = \left[\tilde{\tilde{v}}^{-}_{j}\right]_{1\times n}, \tilde{\tilde{\mathcal{V}}}^{-} = \left[\tilde{\tilde{v}}^{+}_{j}\right]_{1\times n}, \tag{14}$$

$$\mathcal{S}_i = \sum_{j=1}^{n} \frac{d\left(\tilde{\tilde{v}}^{+}_{j}, \tilde{\tilde{v}}_{ij}\right)}{d\left(\tilde{\tilde{v}}^{+}_{j}, \tilde{\tilde{v}}^{-}_{j}\right)}, \tag{15}$$

$$\mathcal{R}_i = \max_{j} \left[\frac{d\left(\tilde{\tilde{v}}^{+}_{j}, \tilde{\tilde{v}}_{ij}\right)}{d\left(\tilde{\tilde{v}}^{+}_{j}, \tilde{\tilde{v}}^{-}_{j}\right)}\right], \tag{16}$$

$$\mathcal{Q}_i = \nu \frac{(\mathcal{S}_i - \mathcal{S}^*)}{(\mathcal{S}^- - \mathcal{S}^*)} + (1-\nu) \frac{(\mathcal{R}_i - \mathcal{R}^*)}{(\mathcal{R}^- - \mathcal{R}^*)}, \tag{17}$$

Table 4: Fuzzy ratings and aggregated fuzzy ratings vs. FWWB *S*-parameters.

FWWB points	*S*-parameters	$k-1$	$k-2$	$k-3$	$k-4$	$k-5$	$k-6$	$k-7$	Aggregated fuzzy ratings
P^1	ND	$F-^{G}$	$F-^{VP}$	$F-^{VP}$	$F-^{VP}$	$F-^{VP}$	$F-^{VP}$	$F-^{G}$	(2.00, 2.70, 5.70)
	CGR	$F-^{VG}$	$F-^{F}$	$F-^{F}$	$F-^{F}$	$F-^{F}$	$F-^{F}$	$F-^{VG}$	(2.70, 5.70, 7.10)
	TGE	$F-^{VP}$	$F-^{G}$	$F-^{G}$	$F-^{G}$	$F-^{G}$	$F-^{VG}$	$F-^{VP}$	(1.20, 3.00, 6.10)
	CE	$F-^{VP}$	$F-^{VG}$	$F-^{VG}$	$F-^{VG}$	$F-^{VG}$	$F-^{VP}$	$F-^{F}$	(1.90, 4.20, 6.10)
P^2	ND	$F-^{F}$	$F-^{VP}$	$F-^{VP}$	$F-^{VP}$	$F-^{VP}$	$F-^{VP}$	$F-^{VG}$	(3.20, 5.20, 7.40)
	CGR	$F-^{VG}$	$F-^{F}$	$F-^{F}$	$F-^{F}$	$F-^{F}$	$F-^{F}$	$F-^{VP}$	(1.90, 3.90, 5.90)
	TGE	$F-^{VP}$	$F-^{VG}$	$F-^{VG}$	$F-^{VG}$	$F-^{VG}$	$F-^{G}$	$F-^{VG}$	(1.40, 3.90, 6.30)
	CE	$F-^{VP}$	$F-^{VG}$	$F-^{VG}$	$F-^{VG}$	$F-^{VG}$	$F-^{VG}$	$F-^{G}$	(2.50, 4.90, 6.70)
P^3	ND	$F-^{F}$	$F-^{VP}$	$F-^{G}$	$F-^{G}$	$F-^{G}$	$F-^{G}$	$F-^{VG}$	(3.90, 6.60, 9.00)
	CGR	$F-^{G}$	$F-^{F}$	$F-^{VG}$	$F-^{VG}$	$F-^{VG}$	$F-^{VG}$	$F-^{VP}$	(3.10, 4.80, 7.90)
	TGE	$F-^{VG}$	$F-^{VG}$	$F-^{VP}$	$F-^{VP}$	$F-^{VP}$	$F-^{VP}$	$F-^{F}$	(3.50, 5.60, 6.90)
	CE	$F-^{VP}$	$F-^{VP}$	$F-^{F}$	$F-^{F}$	$F-^{F}$	$F-^{F}$	$F-^{VG}$	(0.40, 3.40, 5.60)
P^4	ND	$F-^{F}$	$F-^{VG}$	$F-^{VG}$	$F-^{VG}$	$F-^{VG}$	$F-^{VG}$	$F-^{VP}$	(2.00, 5.00, 8.00)
	CGR	$F-^{G}$	$F-^{VP}$	$F-^{VP}$	$F-^{VP}$	$F-^{VP}$	$F-^{VP}$	$F-^{VP}$	(5.00, 7.00, 10.0)
	TGE	$F-^{VG}$	$F-^{F}$	$F-^{VG}$	$F-^{VG}$	$F-^{VG}$	$F-^{VG}$	$F-^{F}$	(6.00, 10.0, 10.0)
	CE	$F-^{VP}$	$F-^{VG}$	$F-^{VG}$	$F-^{VG}$	$F-^{VG}$	$F-^{VG}$	$F-^{VG}$	(2.00, 0.00, 3.00)
P^5	ND	$F-^{VP}$	$F-^{VG}$	$F-^{VG}$	$F-^{VG}$	$F-^{VG}$	$F-^{VG}$	$F-^{VG}$	(2.00, 3.00, 5.00)
	CGR	$F-^{F}$	$F-^{VP}$	$F-^{VP}$	$F-^{VP}$	$F-^{VP}$	$F-^{VP}$	$F-^{VP}$	(3.00, 5.00, 8.00)
	TGE	$F-^{G}$	$F-^{F}$	$F-^{F}$	$F-^{F}$	$F-^{F}$	$F-^{F}$	$F-^{F}$	(4.00, 7.00, 10.0)
	CE	$F-^{VG}$	$F-^{VG}$	$F-^{VG}$	$F-^{VG}$	$F-^{VG}$	$F-^{VG}$	$F-^{VG}$	(2.00, 2.80, 5.80)

Table 5: Fuzzy priority weight and aggregated fuzzy weights vs. FWWB *O-S*-parameters.

FWWB *O-S*-parameters	$k-1$	$k-2$	$k-3$	$k-4$	$k-5$	$k-6$	$k-7$	Aggregated fuzzy weights
TS	$F-^{ML}$	$F-^{ML}$	$F-^{ML}$	$F-^{ML}$	$F-^{ML}$	$F-^{ML}$	$F-^{ML}$	(2.70, 5.00, 7.20)
TDS	$F-^{H}$	$F-^{H}$	$F-^{H}$	$F-^{H}$	$F-^{H}$	$F-^{H}$	$F-^{H}$	(3.00, 5.10, 7.70)
SS	$F-^{VH}$	$F-^{VH}$	$F-^{VH}$	$F-^{VH}$	$F-^{VH}$	$F-^{VH}$	$F-^{VH}$	(3.70, 6.00, 7.60)
P	$F-^{M}$	$F-^{M}$	$F-^{M}$	$F-^{M}$	$F-^{M}$	$F-^{M}$	$F-^{M}$	(2.40, 4.70, 7.30)
ALK	$F-^{ML}$	$F-^{ML}$	$F-^{ML}$	$F-^{ML}$	$F-^{ML}$	$F-^{ML}$	$F-^{ML}$	(1.30, 3.40, 5.70)
COD	$F-^{H}$	$F-^{H}$	$F-^{H}$	$F-^{H}$	$F-^{H}$	$F-^{H}$	$F-^{H}$	(2.80, 5.20, 7.70
BOD	$F-^{M}$	$F-^{ML}$	$F-^{ML}$	$F-^{ML}$	$F-^{ML}$	$F-^{ML}$	$F-^{ML}$	(1.00, 1.80, 4.20)
ND	$F-^{ML}$	$F-^{H}$	$F-^{H}$	$F-^{H}$	$F-^{H}$	$F-^{H}$	$F-^{H}$	(1.00, 1.50, 4.00)
CGR	$F-^{VH}$	$F-^{VH}$	$F-^{VH}$	$F-^{VH}$	$F-^{VH}$	$F-^{VH}$	$F-^{VH}$	(2.20, 6.80, 9.20)
TGE	$F-^{ML}$	$F-^{M}$	$F-^{M}$	$F-^{M}$	$F-^{M}$	$F-^{M}$	$F-^{M}$	(2.00, 1.80, 4.20)
CE	$F-^{ML}$	$F-^{ML}$	$F-^{ML}$	$F-^{ML}$	$F-^{ML}$	$F-^{ML}$	$F-^{ML}$	(2.00, 1.50, 4.00)

where ν is defined as priority weight of the all considered parameters or the maximum group utility. Rank the options by sorting the values of $\mathcal{Q}_i$ in set as ascending orders.

4.5. Crisp-FMF Technique. It is full multiplicative form that was proposed by [44]. It combined the maximization as well as minimization of utility functions, where overall utility of i_{th} option is expressed as dimensionless number, and w_j is considered as priority weight:

$$U_i' = \frac{A_i}{B_i}. \quad (18)$$

Table 6: Computed defuzzified crisp values for FWWB *O-S*-parameters vs. FWWB points.

FWWB *O-S*-parameters	Defuzzified priority weights/weight's crisp values	Defuzzified appropriateness ratings/rating's crisp values				
		P^1	P^2	P^3	P^4	P^5
TS	5.0	0.00	0.00	0.00	0.00	0.00
TDS	5.2	0.00	0.00	0.00	0.00	0.00
SS	5.9	0.00	0.00	0.00	0.00	0.00
P	4.8	0.00	0.00	0.00	0.00	0.00
ALK	3.5	0.00	0.00	0.00	0.00	0.00
COD	5.2	0.00	0.00	0.00	0.00	0.00
BOD	1.9	0.00	0.00	0.00	0.00	0.00
ND	1.7	2.2	3.9	4.5	0.5	3.2
CGR	6.8	4.5	2.9	3.3	2.8	5.5
TGE	1.9	3.2	5.0	4.0	4.0	3.2
CE	1.7	5.1	5.6	7.2	7.2	3.1

Table 7: Computed normalized values of FWWB's *O-S*-parameters corresponding to FWWB points.

FWWB's *O-S*-parameters	P^1	P^2	P^3	P^4	P^5
TS	0.4800	0.5280	0.5220	0.3390	0.3220
TDS	0.4730	0.5140	0.5170	0.2960	0.3970
SS	0.4160	0.5030	0.4770	0.2770	0.5200
P	0.4800	0.4750	0.4700	0.3820	0.4210
ALK	0.3330	0.6250	0.3570	0.5480	0.2650
COD	0.3000	0.5810	0.0940	0.7500	0.0190
BOD	0.4170	0.3990	0.3790	0.6070	0.3930
ND	0.4800	0.4750	0.4700	0.3820	0.4800
CGR	0.3330	0.6250	0.3570	0.5480	0.3330
TGE	0.3000	0.5810	0.0940	0.7500	0.3000
CE	0.4170	0.3990	0.3790	0.6070	0.4170

Table 8: Computed values of S_i linking FWWB's *O-S*-parameters corresponding to FWWB points.

FWWB's *O-S*-parameters	P^1	P^2	P^3	P^4	P^5
TS	0.132	0.140	0.031	0.915	1.000
TDS	0.197	0.015	0.140	1.000	0.544
SS	0.730	0.930	0.823	0.110	1.001
P	0.220	0.051	0.101	1.000	0.601
ALK	0.190	0.150	0.256	0.785	0.200
COD	0.384	0.769	0.102	1.000	0.200
BOD	0.168	0.088	0.200	1.001	0.061
ND	0.015	0.220	1.000	0.015	0.480
CGR	0.930	0.823	0.230	0.930	0.333
TGE	0.051	0.101	1.000	0.051	0.300
CE	0.417	0.399	0.379	0.607	0.417

Here, $A_i = \prod_{j=1}^{g} x_{ij}\,; i = 1, 2, \cdots, m$ denotes the multification of positive parameters of the i_{th} option to be maximized with $g = 1, 2, \cdots, n$ being the number of parameters to be maximized, and $B_i = \prod_{j=g+1}^{n} x_{ij}\,; i = 1, 2, \cdots, m$ denotes the multification of negitive parameters of the i_{th} option to be minimized with $n - g$ being the number of parameters to be minimized.

Table 9: Computed weight stabilizes values of S_i linking FWWB's *O-S*-parameters corresponding to FWWB points.

FWWB's *O-S*-parameters	P^1	P^2	P^3	P^4	P^5
TDS	0.2540	0.0000	0.0200	0.6060	0.6620
SS	0.1320	0.0100	1.0000	0.6680	0.3640
P	0.3870	0.7910	0.7000	0.0000	0.8520
ALK	0.0000	0.0360	0.0710	0.6010	0.4220
COD	0.0630	0.2300	0.0850	0.2620	0.0000
BOD	0.3060	0.6120	0.9000	0.7950	0.0000
ND	0.0730	0.0380	0.2500	0.4340	0.0270
CGR	0.1540	0.0000	0.0200	0.6060	0.6620
TGE	0.1320	0.0100	0.0000	0.5600	0.3640
CE	0.4870	0.7910	0.7000	0.0000	0.8520
TS	0.0000	0.0360	0.0710	0.7010	0.5220

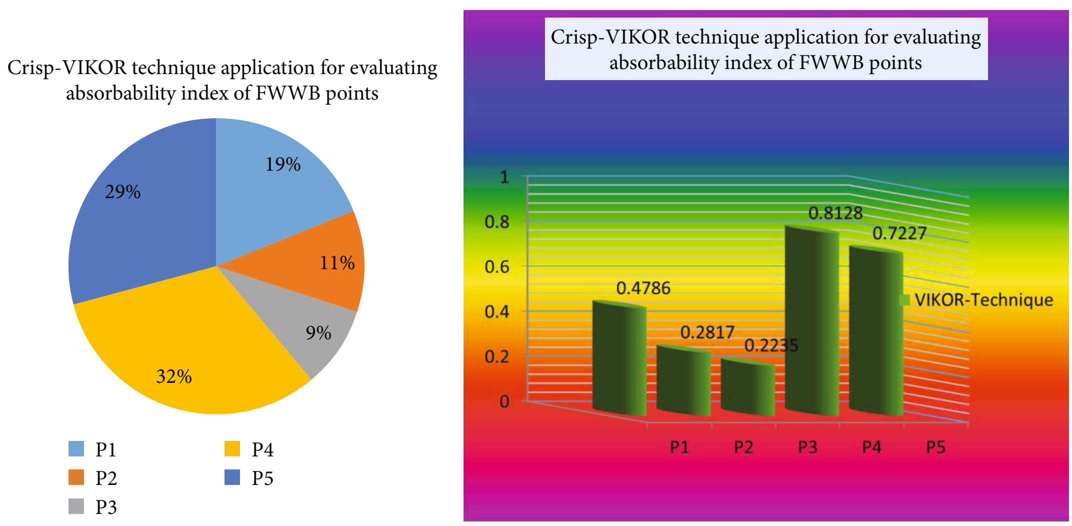
5. FWWB Parameter Model Development

The proposed FWWB's parameter model is developed on investigation of a real case study of a group of farmers. The case study is conducted in Mungali, Bilaspur, (200 Acres), Chhattisgarh, India, and was not compared with the cases of other countries. The scientific problem with justification is detailed below:

An experienced group of farmers was facing a problem related to evaluate the best FWWB fertilizer point among available FWWB fertilizer points such as Narendr Rice Mill-P^1, Liese Mahamaya Rice Mill-P^2, Vijay Rice Mill-P^3, Mahim Rice Mill-P^4, and Dhansingh Rice Mill-P^5. The motive for evaluating the best FWWB fertilizer is to mix the evaluated FWWB with FsCSs for absorbing the toxic macro and microorganisms or pollutants from FsCS, reducing emission of toxic pollution from FsCS and serve the superior life to food's cropping land.

Table 10: Tabulated cumulative values corresponding to FWWB points.

FWWB points	S_i	R_i	Absorbability index of FWWB points ($\nu = 0.5$) Crisp-VIKOR technique	Ranking	Absorbability index of FWWB points Crisp-FMF technique	Ranking	Comparative analysis dominance theory
P^1	1.82	0.691	0.4786	3	0.0013	3	3
P^2	0.758	0.712	0.2817	2	0.0015	2	2
P^3	1.004	0.487	0.2235	1	0.0018	1	1
P^4	3.365	0.795	0.8128	5	0.0011	5	5
P^5	2.225	0.752	0.7227	4	0.0012	4	4



(a) (b)

Figure 1: Crisp-VIKOR application for evaluating absorbability index of respective FWWB points vs. FsCS, shown by (a) pie and (b) bar chart.

The farmers proposed the objective (O), i.e., physical, chemical, and S-parameters, i.e., biological parameters corresponding to their characteristics, which was executed for constituting FWWB's parameter model. Next, the Objective (O) and Subjective (S) information were proposed by same group of farmers against FWWB points or fertilizers such as P^1-P^5. The concluded FWWB parameter model is depicted in Table 1.

6. Procedure to Solve the Framed FWWB's Parameter Model: Real Case Research

The further steps are depicted here to solve the framed model:

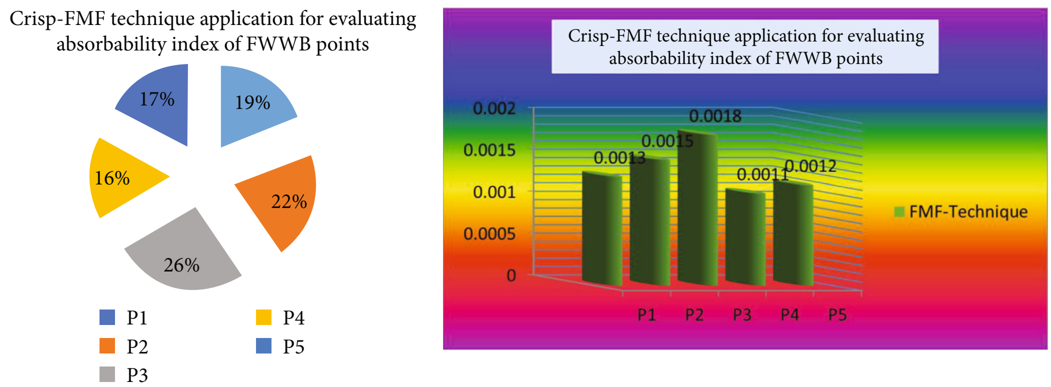
Step 1. An experienced group of seven farmers, located at Mungali, Bilaspur, Chhattisgarh, India, as discussed in Section 6 willingly participated in the context of evaluating the best FWWB fertilizer or points. The farmers were proposed the five FWWB fertilizer points (P^1-P^5) such as Narendr Rice Mill-P^1, Liese Mahamaya Rice Mill-P^2, Vijay Rice Mill-P^3, Mahim Rice Mill-P^4, and Dhansingh Rice Mill-P^5 along with O-S parameters and their characteristics. The proposed FWWB's parameter model is shown in Table 1.

Step 2. The same farmers proposed the O-data against characteristics of O-parameters, i.e., physical and chemical for P^1-P^5 that are shown in Table 2.

Step 3. To assign the appropriateness rating against characteristics of S-parameter, i.e., biological for P^1-P^5, and the authors assisted the farmers with a five-point TFN scale and is shown in Table 3.

Step 4. The farmers assigned fuzzy appropriateness ratings against characteristics of S-biological parameter corresponding to P^1-P5 and fuzzy priority weights against characteristics of both O-S parameters. After evaluating information against characteristic of O-S parameters for P^1-P^5, Equations (4) and (8) were employed to aggregate the TFNs and formulated FWWB evaluation problem. The fuzzy ratings, priority weight and aggregated fuzzy ratings, and weights vs. FWWB O-S-parameters are shown in Table 4 and Table 5.

Step 5. Later, the aggregated ratings in the forms of TFNs against characteristics of S-parameters and aggregated



(a) (b)

Figure 2: Crisp-FMF application for evaluating absorbability index of respective FWWB points vs. FsCS, shown by (a) pie and (b) bar chart.

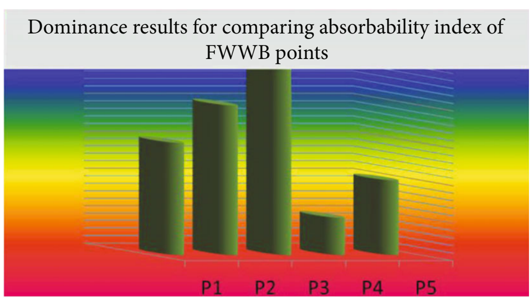


Figure 3: Dominance theory application for evaluating absorbability index of respective FWWB points vs. FsCS, shown by bar chart.

priority weights in the forms of TFNs against characteristics of *O-S* parameters is converted into crisp value or defuzzified by exploring Equation (11), shown in Table 6.

Step 6. After obtaining (Table 6), the authors carried out the normalization of crisp values against *O–S* characteristics of parameters by employing Equation (12). The calculated values are exhibited in Table 7. Next, the values of S_i linking *O–S* characteristics of parameters are computed by using Equations (13)–(15), revealed in Table 8, and Q_i is calculated by using Equations (16) and (17), shown in Table 9.

Step 7. Next, the FMF technique (Equation (18)) is brought into use, and the normalized values of *O–S* characteristics of parameters (shown Table 7) are multiplied with its crisp weights. Then, the normalized weighted values are multiplied with respect to beneficial and non eneficial characteristics of parameters corresponding to $P^1 - P^5$. The results are revealed in Table 10. The dominance theory was applied to robustly evaluate results that are shown in Table 10.

7. Summary

The absorbability index of respective FWWB fertilizer points is calculated by using crisp-VIKOR. The results are summarized in Table 10. The crisp-VIKOR ranks the FWWBs in prioritizing the minimum value (is better). The results are graphically represented by Figure 1(a)-pie and bar charts. Later, the absorbability index is computed by using crisp-FMF. The results are summarized in Table 10. The crisp-FMF used to rank the FWWBs in prioritizing the maximum value (is better). The results are graphically represented by Figure 2(a)-pie and bar charts. As discussed that reliability and consistency of calibrated results were the highly concern by farmers, therefore, the authors eventually applied dominance approach to conduct the comparative analysis between the results, gathered by crisp-VIKOR and FMF techniques, and are shown by Figure 3-bar chart. The P^3 (Vijay Rice Mill) is determined as the best FWWB fertilizer point on application of the dominance technique. All the results are shown in Table 10. The farmers are advised by authors to prioritize the Vijay Rice Mill FWWB fertilizer point under FWWB's parameter model. The suggested point aids the farmers to improve the fertility of FsCS.

8. Conclusions

The assessment and evaluation of productive, ecooriented, and effective FWWB fertilizer alternative among many alternatives for improving the fertility of FsCS under *O-S* parameters became the complicated task for current researchers. It is determined that the best FWWB acts as a potential fertilizer for rapid growth of FsCS and high food's production. In the presented research work, the authors developed and proposed the FWWB parameter model (combined *O*-physical, chemical, and *S*-biological parameters) corresponding to case studied FWWB points, i.e., $P^1 - P^5$. The model is simulated by executing the MPO (crisp-VIKOR and FMF) technique for evaluating the best and effective FWWB fertilizer among many FWWB alternatives. The results, obtained by application of MPO technique, are revaluated by applying the dominance theory. The Vijay Rice Mill P^3 is found as the best FWWB fertilizer, and farmers are advised to choose P^3 FWWB fertilizer point as it encompasses the rich absorbability index than others. The evaluated P^3 fertilizer aids the farmers to absorb the toxic macro and microorganisms from FsCS, decreasing emission of toxic pollutants, help for the fast growth of good quality of foods, and build the healthy ecosystem etc.

Furthermore, the model is acceptable by global researchers to resolve aforesaid problem; however, the FWWB parameter model is found flexible in nature. It can solve many problems such as evaluation of important fertility elements of soil, evaluation of suitable BS pant location, soil evaluation under different soil *O-S*-parameters, and BS option or choice evaluation. The model has no access to solve the single and multivariable linear programming problem of FWWBs under boundary conditions.

Data Availability

The data used to support the findings of this study are available in Table 10.

Conflicts of Interest

The authors declare that there is no conflict of interest regarding the publication of this manuscript.

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References

[1] S. A. Costa, S. Vilela, D. Correia, M. Severo, C. Lopes, and D. Torres, "Consumption of packaged foods by the Portuguese population: type of materials and its associated factors," *British Food Journal*, vol. 123, no. 2, pp. 833–846, 2021.

[2] M. H. Koksal, "Segmentation of wine consumers based on level of involvement: a case of Lebanon," *British Food Journal*, vol. 123, no. 3, pp. 926–942, 2021.

[3] T. Barrett and Y. Feng, "Content analysis of food safety implications in online flour-handling recipes," *British Food Journal*, vol. 123, no. 3, pp. 1024–1041, 2021.

[4] E. U. Wirawan and S. W. Yan, "Consumers' perception and physicochemical properties of novel functional cookie enriched with medicinal plantStrobilanthes crispus," *British Food Journal*, vol. 123, no. 3, pp. 1121–1132, 2021.

[5] Z. Fozouni Ardekani, M. Akbari, G. Pino, M. Á. Zúñiga, and H. Azadi, "Consumers' willingness to adopt genetically modified foods," *British Food Journal*, vol. 123, no. 3, pp. 1042–1059, 2021.

[6] D. K. Z. Ag Majid, S. Abdul Hanan, and H. Hassan, "A mediator of consumers' willingness to pay for halal logistics," *British Food Journal*, vol. 123, no. 3, pp. 910–925, 2021.

[7] W. Zhang, P. Weng, and Z. Wu, "Interaction profile of a mixed-culture fermentation ofIssatchenkia orientalisandSaccharomyces cerevisiaeby transcriptome sequencing," *British Food Journal*, vol. 123, 2020.

[8] N. Novita and J. Rowena, "Determinant factors of Indonesian people's fish purchase intention," *British food journal*, vol. 123, no. 6, pp. 2272–2277, 2021.

[9] K. M. Thomé, G. Cappellesso, and G. M. Pinho, "Food consumption values and the influence of physical activity," *British Food Journal*, vol. 123, no. 3, pp. 943–957, 2021.

[10] C. Aqueveque and P. Rodrigo, ""This wine is dead!": unravelling the effect of word-of-mouth and its moderators in price-based wine quality perceptions," *British Food Journal*, vol. 123, no. 3, pp. 869–883, 2021.

[11] M. T. Rashid, D. Barry, and M. Goss, "Paper mill biosolids application to agricultural lands: benefits and environmental concerns with special reference to situation in Canada," *Soil & Environment*, vol. 25, no. 2, pp. 85–98, 2006.

[12] White, S. I. Torri, and R. S. Corrêa, "Biosolids soil application: agronomic and environmental implications," *Applied and Environmental Soil Science*, vol. 2011, Article ID 928973, 3 pages, 2011.

[13] Arulrajah, M. M. Disfani, V. Suthagaran, and M. Imteaz, "Select chemical and engineering properties of wastewater biosolids," *Waste Management*, vol. 31, no. 12, pp. 2522–2526, 2011.

[14] Oleszkiewicz and Mavinic, "Wastewater biosolids: an overview of processing, treatment, and management," *Canadian Journal of Civil Engineering*, vol. 1, 2011.

[15] Gerba and Pepper, "Wastewater treatment and biosolids reuse," in *Environmental Microbiology*, pp. 503–530, Academic Press, 2012.

[16] K. Deepa, C. Prasad, N. V. V. Jyothi et al., "Adsorptive removal of Pb(II) metal from aqueous medium using biogenically synthesized and magnetically recoverable core-shell structured AM@cu/Fe3O4 nanocomposite," *Desalination and Water Treatment*, vol. 111, pp. 278–285, 2018.

[17] G. Matta, A. Kumar, A. K. Tiwari, P. K. Naik, and R. Berndtsson, "HPI appraisal of concentrations of heavy metals in dynamic and static flow of ganga river system," *Environment, Development and Sustainability*, vol. 22, 2020.

[18] G. Matta, A. Kumar, P. K. Naik, A. K. Tiwari, and R. Berndtsson, "Ecological analysis of nutrient dynamics and phytoplankton assemblage in the ganga river system, Uttarakhand," *Taiwan Water Conservancy*, vol. 66, 2018.

[19] W. Wang, L. Huang, Y. Zhu et al., "Decision support system toward evaluation of resilient supplier," *Kybernetes*, vol. 49, no. 6, pp. 1741–1765, 2019.

[20] C. A. Cimá-Mukul, Y. Abdellaoui, M. Abatal, J. Vargas, A. A. Santiago, and J. A. Barrón-Zambrano, "Eco-Efficient Biosorbent Based on Leucaena leucocephala Residues for the Simultaneous Removal of Pb(II) and Cd(II) Ions from Water System: Sorption and Mechanism," *Bioinorganic Chemistry and Applications*, vol. 2019, Article ID 2814047, 13 pages, 2019.

[21] D. N. Pajoudoro, D. Lissouck, B. Ateba Amana et al., "Antioxidant Properties of Lapachol and Its Derivatives and their Ability to Chelate Iron (II) Cation: DFT and QTAIM Studies," *Bioinorganic Chemistry and Applications*, vol. 2020, 10 pages, 2020.

[22] M. F. Mosquillo, P. Smircich, A. Lima et al., "High Throughput Approaches to Unravel the Mechanism of Action of a New Vanadium-Based Compound against Trypanosoma Cruzi," *Bioinorganic Chemistry and Applications*, vol. 2020, Article ID 1634270, 10 pages, 2020.

[23] Kumar, A. K. Chopra, and A. Kumar, "A review on sewage sludge (biosolids) a resource for sustainable agriculture," *Archives of Agriculture and Environmental Science*, vol. 2, no. 4, pp. 340–347, 2017.

[24] Sharma, A. Sarkar, P. Singh, and R. P. Singh, "Agricultural utilization of biosolids: a review on potential effects on soil and plant grown," *Waste Management*, vol. 64, pp. 117–132, 2017.

[25] Liu, P. Zhao, Y. Xu, and X. Jia, "Mg-Al Mixed Oxide Adsorbent Synthesized Using FCT Template for Fluoride Removal from Drinking Water," *Bioinorganic Chemistry and Applications*, vol. 2019, Article ID 5840205, 11 pages, 2019.

[26] J. F. Cárdenas González, A. S. Rodríguez Pérez, J. M. Vargas Morales et al., "Bioremoval of Cobalt(II) from Aqueous Solution by Three Different and Resistant Fungal Biomasses," *Bioinorganic Chemistry and Applications*, vol. 2019, Article ID 8757149, 8 pages, 2019.

[27] WHO, "World health organization standard for drinking water," WHO, France, 2002, Guidelines for Drinking Water Quality, Recommendation.

[28] AWWA, *Standard methods for the examination of water and waste water*, American Water Works Association, Washington, DC, USA, 2006.

[29] R. Kumar Sharma, M. Agrawal, and F. Marshall, "Heavy metal contamination of soil and vegetables in suburban areas of Varanasi, India," *Ecotoxicology and Environmental Safety*, vol. 66, no. 2, pp. 258–266, 2007.

[30] S. Al-Bahry, I. Mahmoud, S. Al-Rawahy, and J. R. Paulson, "Egg Contamination as an Indicator of Environmental Health," in *Impact of Egg Contamination on Environmental Health*, Nova Science Publisher, Inc., New York, NY, USA, 2011.

[31] BIS (Bureau of Indian Standards) 10500, *Specification for Drinking Water*, Indian Standards Institution, New Delhi, 2012.

[32] J. Biswas, "Assesment of physicochemical quality of food waste water of Raipur Area," *International Journal of Engineering Research*, vol. 3, 2015.

[33] A. T. Odularu and P. A. Ajibade, "Dithiocarbamates: Challenges, Control, and Approaches to Excellent Yield, Characterization, and their Biological Applications," *Bioinorganic Chemistry and Applications*, vol. 2019, Article ID 8260496, 15 pages, 2019.

[34] Ma, S. Wu, N. V. R. Shekhar, S. Biswas, and A. K. Sahu, "Determination of Physicochemical Parameters and Levels of Heavy Metals in Food Waste Water with Environmental Effects," *Bioinorganic Chemistry and Applications*, vol. 2020, Article ID 8886093, 9 pages, 2020.

[35] Kannan, A. B. L. d. S. Jabbour, and C. J. C. Jabbour, "Selecting green suppliers based on GSCM practices: using fuzzy TOPSIS applied to a Brazilian electronics company," *European Journal of Operational Research*, vol. 233, no. 2, pp. 432–447, 2014.

[36] Kannan, K. Govindan, and S. Rajendran, "Fuzzy axiomatic design approach based green supplier selection: a case study from Singapore," *Journal of Cleaner Production*, vol. 96, pp. 194–208, 2015.

[37] A. K. Sahu, A. K. Sahu, and N. K. Sahu, "Appraisements of material handling system in context of fiscal and environment extent: a comparative grey statistical analysis," *International Journal of Logistic Management*, vol. 28, no. 1, pp. 1–30, 2017.

[38] Valeris, "Design to doc framework: a model to support aircraft direct operating cost reduction," *Journal of the Brazilian Society of Mechanical Sciences and Engineering*, vol. 37, pp. 1183–1196, 2016.

[39] N. Mazzella, J.-F. Dubernet, and F. Delmas, "Determination of kinetic and equilibrium regimes in the operation of polar organic chemical integrative samplers: Application to the passive sampling of the polar herbicides in aquatic environments," *Journal of chromatography A*, vol. 1154, no. 1-2, pp. 42–51, 2007.

[40] Y. Li, H. Cheng, R. J. S. Beeton, T. Sigler, and A. Halog, "Sustainability from a chinese cultural perspective: the implications of harmonious development in environmental management," *Environment, Development and Sustainability*, vol. 18, no. 3, pp. 679–696, 2016.

[41] L. A. Zadeh, "Fuzzy sets," *Information and Control*, vol. 8, no. 3, pp. 338–353, 1965.

[42] Sahu, A. K. Sahu, and A. K. Sahu, "Green supply chain management assessment under chains of uncertain indices," *Journal of Modeling in Management*, vol. 13, no. 4, pp. 973–993, 2018.

[43] L. A. Zadeh, "The concept of a linguistic variable and its application to approximate reasoning–I," *Information Sciences*, vol. 8, no. 3, pp. 199–249, 1975.

[44] Sahu, A. K. Sahu, and A. K. Sahu, "Cluster approach integrating weighted geometric aggregation operator to appraise industrial robot," *Kybernetes*, vol. 47, no. 3, pp. 487–524, 2018.

[45] K. Tanaka, *An Introduction to Fuzzy Logic for Practical Applications*, Springer, New York, NY, USA, 1997.

[46] P. P. Mohanty and S. S. Mahapatra, "A compromise solution by VIKOR method for ergonomically designed product with optimal set of design characteristics," *Procedia Materials Science*, vol. 6, pp. 633–640, 2014.

[47] Sayadi, M. Heydari, and K. Shahanaghi, "Extension of VIKOR method for decision making problem with interval numbers," *Applied Mathematical Modelling*, vol. 33, no. 5, pp. 2257–2262, 2009.