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Greening Human Resource Management in Manufacturing Organizations: A Fuzzy TOPSIS Approach to Prioritizing Sustainable Practices in Western Odisha

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ABSTRACT
The incorporation of environmental sustainability into human resource management (HRM) processes has become a crucial strategy for organisations, especially those in the industrial sector, in the current dynamic business climate. With a focus on industrial companies in Western Odisha, India, this study explores and prioritises green HR practices in these settings. Using the fuzzy Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) technique and a thorough literature assessment, this study attempts to assess and rank manufacturing companies according to how well they execute green HR policies. The literature study emphasises how important green HRM is for improving organisational performance and environmental stewardship. Though the significance of green HR practices is increasingly acknowledged, there is still disagreement on the best approaches to evaluate and rank them in organisations, especially in non-Western settings.

The two stages of the suggested technique are the ranking of manufacturing companies and the identification of GHRM practices. The first part comprises identifying the most important GHRM practices through expert consultations and a review of the literature. The second phase entails gathering primary data from manufacturing firms and using fuzzy TOPSIS analysis to evaluate them according to how well they execute these practices.
The study's conclusions show that manufacturing companies in Western Odisha have adopted green HR practices at significantly different rates. Stronger commitment to green HR practices is exhibited by higher rated organisations, which set an example for others in the sector. A systematic way for assessing and grading green HR practices is offered by the fuzzy TOPSIS methodology, which helps decision-makers make sustainable choices.

This study emphasises the significance of incorporating environmental concerns into HRM methods, which advances ethical corporate practices. Manufacturing companies can improve their competitiveness, reduce environmental concerns, and uphold their corporate social responsibility by utilising the study's conclusions. Subsequent investigations ought to persist in investigating the utilisation of fuzzy TOPSIS and additional multi-criteria decision-making methodologies for the assessment of sustainability procedures in various industries, hence promoting the progression of conscientious business practices worldwide.

Keywords
Green HR Management, Fuzzy TOPSIS, Manufacturing Organizations, Environmental Sustainability, Responsible Business Practices

Introduction

The need for businesses to adopt sustainability has grown in importance in today's quickly changing corporate environment. The incorporation of environmental factors into human resource management has become a critical area of focus among the many components of sustainable business practices. This research endeavours to explore and prioritize(Moktadir et al., 2020) green human resource (HR) practices within manufacturing organizations, with a specific emphasis on those situated in Western Odisha.

It is impossible to exaggerate the importance of integrating environmental sustainability into HR procedures. The implementation of green HR solutions not only supports corporate social responsibility goals but also offers observable advantages in the form of cost savings, employee engagement, and brand reputation as businesses negotiate the challenges of global competition and regulatory demands. In the manufacturing industry, where environmental impact and resource utilisation are critical considerations, implementing green HR practices has the potential to create a culture of sustainability throughout the entire organisational ecosystem and spark revolutionary transformation.

It is impossible to exaggerate the importance of integrating environmental sustainability into HR procedures. As businesses manoeuvre In light of this, the purpose of this study is to clarify the usefulness of fuzzy Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) as a methodological framework for assessing and prioritising green HR practices in manufacturing organisations (S. Gupta et al., 2019; Haddad et al., 2021; Irvanizam,

2021; Piya et al., 2022; H. Gupta, 2018). Fuzzy TOPSIS provides a strong method for making multi-criteria decisions while taking into account the subjectivity and inherent uncertainty in evaluating sustainability projects.

Despite its continued importance to organisations, human resource management (HRM) has received little attention, particularly in non-Western contexts (Masri & Jaaron, 2017). The majority of research that has already been done is either a review of the literature or it looks into the connection between different organisational outcomes and HRM practices. This study will analyse the body of research on green HR practices and how they affect organisational performance through a thorough literature analysis, incorporating ideas from theoretical frameworks and practical investigations. This study aims to add to the continuing conversation on sustainable HR management by identifying gaps in the literature, particularly with relation to the use of fuzzy TOPSIS in evaluating green HR practices.
In keeping with these goals, the following sections of this study will outline the research methodology, which includes the reasons behind the selection of fuzzy TOPSIS, the sample plan for Western Odisha's manufacturing organisations, and the procedures for gathering and analysing data. The fuzzy TOPSIS analysis results will be presented, together with a nuanced interpretation of the results, practical consequences, and directions for further research.
Notably, there is a dearth of studies on HRM practice rankings. In order to close these gaps, the following goals will be pursued by this study:
Recognising GHRM Practices in the Indian Environment: The goal of this study is to identify and catalogue the variety of HRM practices pertinent to the Indian organisational environment by a thorough evaluation of the literature and knowledgeable consultations.
Evaluation of the Performance of Manufacturing Organisations: This study ranks manufacturing organisations according to how well they implement the recognised GHRM practices using Fuzzy TOPSIS, providing information about their HRM plans and performance results. The goal of this study is to make a substantial contribution to the improvement and comprehension of HRM practices in the context of Indian organisations.

Literature Review
A increasing corpus of research has been done in recent years to examine how human resource management (HRM) and sustainability interact, especially in the context of green HR practices. Initiatives to include environmental considerations into several HR operations, such as hiring, training, performance management, and employee engagement, are collectively referred to as "green HRM" (D. W. S. Renwick et al., 2013). According to Jackson et al. (2011), these procedures are thought to be crucial parts of business sustainability plans since they improve organisational performance and environmental stewardship. Green human resource management, or GHRM, is the use of HRM techniques to encourage environmental sustainability and a commitment to environmental issues among staff members. It entails incorporating the concepts of environmental management into HR programmes to improve operational effectiveness and promote environmental performance, which helps to lower employees'

Green Recruitment and Selection
In contrast to conventional methods, green recruitment and selection (GRS) places a higher priority on candidates' compliance with sustainability pledges and environmental ideals (Adjei-Bamfo et al., 2020). As a reflection of the company's commitment to environmentally friendly procedures, GRS places a strong emphasis on hiring people with environmental knowledge and awareness (Renwick et al., 2013). Recruiting people with environmental knowledge and consciousness, using green branding techniques to draw in environmentally conscious talent, and giving preference to applicants that give sustainability factors top priority when evaluating possible employers are all important components of GRS (Ren et al., 2018). GRS also entails modifying job responsibilities to incorporate environmental issues and elevating internal applicants with green competences (Masri and Jaaron, 2017). According to Renwick et al. (2013), it is crucial to communicate the organization's environmental goals in a transparent manner during the hiring process. Using online resources like video conferencing also makes this process more effective.

Green Training and Development
In contrast to conventional methods, green recruitment and selection (GRS) places a higher priority on candidates' compliance with sustainability pledges and environmental ideals (Adjei-Bamfo et al., 2020). As a reflection of the company's commitment to environmentally friendly practices, GRS places a strong emphasis on hiring people with environmental awareness and expertise (Renwick et al., 2020). Training is a crucial component of skill development for staff members, supporting their knowledge growth and encouraging creativity. However, organisations are giving green training efforts more priority as environmental concerns grow. The objective of green training is to provide staff members with the knowledge and abilities needed to tackle environmental issues and support the goals of the organisation about sustainability (Jackson et al., 2011;Jabbour, 2011; Tang et al., 2017). It's an important channel by which HRM can help companies make environmental progress and support the shift to sustainability(Jabbour, 2013). The development of specialised environmental management training programmes, the provision of online training materials to minimise paper usage, the holding of energy management workshops, special sessions on waste management and recycling, the involvement of staff in environmental problem-solving exercises, and the adoption of

job rotations in green assignments are some of the key characteristics of green training and development, or GTD (Sathasivam et al., 2021;Ogbeibu et al., 2020;Arulrajah & Opatha, 2016;D. Renwick & Robertson, 2008).

Green performance management system

It includes a method for gauging how well-versed staff members are in environmental management techniques (Jabbour et al., 2008). Through behaviour and performance monitoring, HR managers can advance the organization's environmental objectives by using green performance ratings as a tool to evaluate workers' job performance connected to environmental issues (Kapil, 2015; Sharma and Gupta, 2015). In contrast to conventional performance management approaches that tend to ignore sustainability issues and prioritise profit maximisation, green performance management places particular emphasis on the organization's and its employees' capacity to accomplish sustainable and environmentally friendly objectives (Tapamoy, 2008; Ramasamy et al., 2017). The green performance management system (GPS) has several important features, such as integrating green performance indicators into appraisals, establishing green goals and targets for managers and staff, enacting negative appraisals for failing to meet environmental goals, and performing employee assessment (Kapil, 2015; Sharma and Gupta, 2015; Masri and Jaaron, 2017; Nejati et al., 2017; Renwick et al., 2008, 2013; Prasad, 2013; Jackson and Seo, 2010; Jackson et al., 2011; Arulrajah et al., 2016).

Green Performance and Reward

The concept of Green Pay and Reward (GPR) systems serves as a mechanism to incentivize employees to contribute to the environmental objectives of the organization through both financial and non-financial means, thereby aiming to retain talented individuals and attract new employees with expertise in green practices (Jabbour et al., 2008; Mandip, 2012). Modern organizations strategically reward employees who actively participate in achieving environmental goals (Ahmad, 2015; Ramasamy et al., 2017). Consistently acknowledging and rewarding employees for their eco-initiatives helps maintain their motivation and alignment towards environmental practices (Daily and Huang, 2001; Renwick et al., 2013). Key attributes of GPR include offering green travel benefits, providing financial incentives and tax cuts, recognizing employees for environmental management efforts, granting bonus pay for exceeding environmental targets, and rewarding innovative environmental suggestions (Alavi & Aghakhani, 2023;Yong et al., 2020;Rawashdeh, 2018;Saeed et al., 2019;Masri & Jaaron, 2017)

According to previous research, adopting green HR practices has special potential and problems for manufacturing organisations in particular(Piwowar-Sulej, 2022;Sarode & Patil, 2016;Yusliza et al., 2017). Although the manufacturing industry is frequently linked to noteworthy environmental consequences, it also has the ability to stimulate innovation and transformation via sustainable methodologies (Jabbour, Jabbour, Govindan, Teixeira, & de Sousa Jabbour, 2013). Research indicates that implementing green human resource management (HRM)(Piwowar-sulej, 2021) can result in increased productivity, decreased resource usage, and better employee satisfaction and retention (Jabbour et al., 2014; Jiang, Zhao, & Ning, 2012). The implementation of green HR practices is still unequal across industries and organisations, despite the potential benefits. According to research by Bansal and Roth (2000), institutional pressures, resource availability, and leadership commitment are examples of organisational elements that significantly influence how sustainability projects are implemented. Furthermore, there is disagreement about the best methods for ranking and assessing green HR practices in businesses (Renwick et al., 2013).

The lack of methodological frameworks that can help with the systematic evaluation of green HR practices is highlighted by this gap in the literature. A method that has acquired popularity in the field of multi-criteria decision-making (MCDM) is fuzzy Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) (Hwang & Yoon, 1981). Fuzzy TOPSIS is ideally suited for analysing complicated and ambiguous phenomena like green HRM since it integrates the subjective judgements and uncertainties present in sustainability assessments (Jiang et al., 2012).
In conclusion, research on green HRM emphasises how critical it is to incorporate environmental factors into HR procedures, especially in the manufacturing industry. Although there is data supporting the potential advantages of green HRM, further study is required to create reliable methods for (Alipour et al., 2019)ranking green HR practices in organisations.

Integration of MCDM and Green HRM

Using MCDM techniques in conjunction with green HRM provides a methodical framework for ranking environmental activities according to their importance within HRM frameworks. Organisations can evaluate the viability and efficacy of various green HRM strategies based on a variety of factors, including cost-effectiveness, employee acceptability, and environmental impact, by utilising MCDM approaches like fuzzy TOPSIS(Sahu et al., 2023). Because of this integration, organisations may more easily make evidence-based decisions and determine the best ways to use HRM programmes to promote environmental sustainability(Saeidi et al., 2022).

Research Methodology

In this study, we propose a two-phase methodology to effectively rank Green Human Resource Management (GHRM) practices and assess the performance of manufacturing firms in this domain(Masri & Jaaron, 2017).

Phase 1: Identification of GHRM Practices

In the first phase, we focus on identifying key Green Human Resource Management (GHRM) practices through a rigorous process involving expert consultation and literature review.

Selection of Experts: Five HR management experts renowned for their expertise in manufacturing contexts were selected based on their contributions to HR literature and practical experience in the field.

Delphi Method: We employed the Delphi technique, a structured communication method, to engage the selected experts in iterative discussions(Wang et al., 2022;(Mojumder et al., 2022). Initially, a comprehensive literature review helped identify a broad spectrum of potential GHRM practices. These practices were then presented to the experts for further refinement and consensus-building. Through multiple rounds of deliberations, the experts distilled the initial pool of practices into a concise set that encapsulates the most pertinent and impactful aspects of GHRM within manufacturing firms.

Phase 2: Ranking of Manufacturing Firms

Having identified the key GHRM practices, we proceed to the second phase to rank manufacturing firms based on their performance in implementing these practices.

Data Collection: Primary data on GHRM practices were collected from a sample of manufacturing firms using a structured questionnaire. This questionnaire was designed to capture various aspects of GHRM practices, categorized into specific criteria.

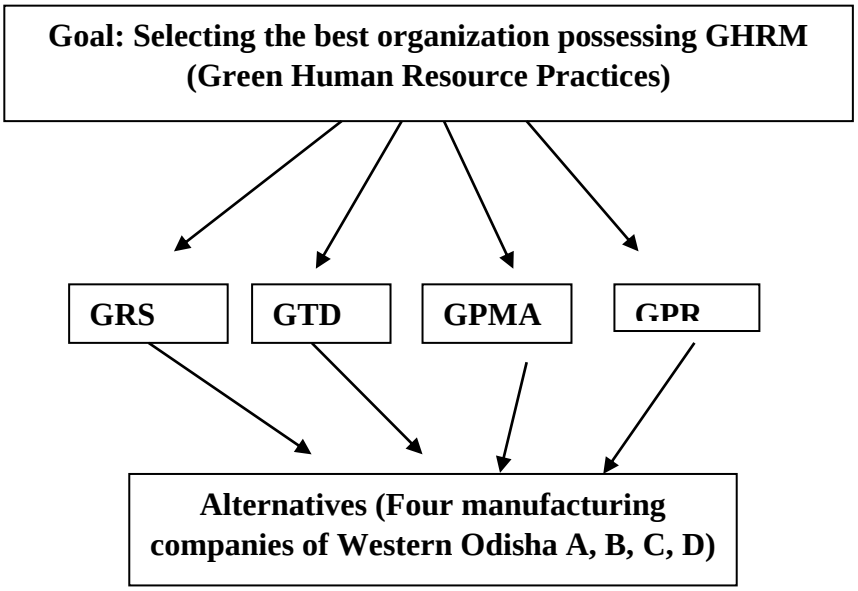
Data Analysis:

Data Transformation: The collected data were transformed into a standardized scale to facilitate meaningful comparison across firms.

Fuzzy Linguistic Conversion: Subsequently, the standardized data were converted into fuzzy linguistic values using specialized software to accommodate linguistic uncertainty(Haddad et al., 2021).

Fuzzy TOPSIS Analysis: Fuzzy TOPSIS methodology, renowned for its effectiveness in ranking alternatives under uncertain conditions, was employed to rank the manufacturing firms based on their performance in GHRM practices.

The application of the proposed methodology resulted in comprehensive rankings of manufacturing organizations based on their performance in GHRM practices. These rankings offer valuable insights into each firm's commitment to environmental sustainability and HRM integration. Such insights can inform strategic decision-making processes, guiding firms towards the adoption of best practices and the enhancement of their overall sustainability performance.



Results and discussions

The Steps of the Fuzzy TOPSIS Method:

Step 1: Create a decision matrix
In this study there are 4 criteria and 4 alternatives that are ranked based on FUZZY TOPSIS method. The table below shows the type of criterion and weight assigned to each criterion.
Characteristics of Criteria

	name		weight
1	COMPANY A		(0.250,0.250,0.250)
2	COMPANY B		(0.250,0.250,0.250)
3	COMPANY C		(0.250,0.250,0.250)
4	COMPANY D		(0.250,0.250,0.250)

The following table shows the fuzzy scale used in the model.
Fuzzy Scale

Code	Linguistic terms	L	M	U
1	Very low	1	1	3
2	Low	1	3	5
3	Medium	3	5	7
4	High	5	7	9
5	Very high	7	9	9

The alternatives in terms of various criteria are evaluated and the results of the decision matrix are shown as follows. Note that if multiple experts participate in the evaluation, then the matrix below represents the arithmetic mean of all experts.
Decision Matrix

	GRS	GTD	GPMA	GPR
	(3.400,5.400,6.867)	(4.867,6.733,7.800)	(3.800,5.667,7.267)	(3.400,5.267,6.733)
	(4.067,6.067,7.800)	(3.933,5.800,7.400)	(3.933,5.933,7.533)	(3.000,4.733,6.467)
	(3.800,5.800,7.400)	(4.333,6.333,7.933)	(3.000,4.733,6.733)	(2.867,4.467,6.200)
	(3.000,4.467,6.200)	(4.867,6.867,7.933)	(3.933,5.667,7.133)	(3.133,4.867,6.600)

Step 2: Create the normalized decision matrix
Based on the positive and negative ideal solutions, a normalized decision matrix can be calculated by the following relation:

$\tilde{r}_{ij} = \left(\frac{a_{ij}}{c_j^*}, \frac{b_{ij}}{c_j^*}, \frac{c_{ij}}{c_j^*}\right)$; $c_j^* = max_i\ c_{ij}$; Positive ideal solution

$\tilde{r}_{ij} = \left(\frac{a_j^-}{c_{ij}}, \frac{a_j^-}{b_{ij}}, \frac{a_j^-}{a_{ij}}\right)$; $a_j^- = min_i\ a_{ij}$; Negative ideal solution

The normalized decision matrix is shown in the table below.
A normalized decision matrix

	GRS	GTD	GPMA	GPR
A	(0.436,0.692,0.880)	(0.614,0.849,0.983)	(0.504,0.752,0.965)	(0.505,0.782,1.000)
B	(0.521,0.778,1.000)	(0.496,0.731,0.933)	(0.522,0.788,1.000)	(0.446,0.703,0.960)
C	(0.487,0.744,0.949)	(0.546,0.798,1.000)	(0.398,0.628,0.894)	(0.426,0.663,0.921)
D	(0.385,0.573,0.795)	(0.614,0.866,1.000)	(0.522,0.752,0.947)	(0.465,0.723,0.980)

Step 3: Create the weighted normalized decision matrix
Considering the different weights of each criterion, the weighted normalized decision matrix can be calculated by multiplying the weight of each criterion in the normalized fuzzy decision matrix, according to the following formula.

$\tilde{v}_{ij} = \tilde{r}_{ij}.\tilde{w}_{ij}$

Where $\tilde{w}_{ij}$ represents weight of criterion c_j

The following table shows the weighted normalized decision matrix
The weighted normalized decision matrix

	GRS	GTD	GPMA	GPR
A	(0.109,0.173,0.220)	(0.153,0.212,0.246)	(0.126,0.188,0.241)	(0.126,0.196,0.250)
B	(0.130,0.194,0.250)	(0.124,0.183,0.233)	(0.131,0.197,0.250)	(0.111,0.176,0.240)
C	(0.122,0.186,0.237)	(0.137,0.200,0.250)	(0.100,0.157,0.223)	(0.106,0.166,0.230)

D	(0.096,0.143,0.199)	(0.153,0.216,0.250)	(0.131,0.188,0.237)	(0.116,0.181,0.245)

Step 4: Determine the fuzzy positive ideal solution (FPIS, A*) and the fuzzy negative ideal solution ($\boldsymbol{FNIS, A^-}$)
The FPIS and FNIS of the alternatives can be defined as follows:

$$A^* = \{\tilde{v}_1^*, \tilde{v}_2^*, \dots, \tilde{v}_n^*\} = \left\{\left(\max_j v_{ij} \,|\, i \in B\right), \left(\min_j v_{ij} \,|\, i \in C\right)\right\}$$

$$A^- = \{\tilde{v}_1^-, \tilde{v}_2^-, \dots, \tilde{v}_n^-\} = \left\{\left(\min_j v_{ij} \,|\, i \in B\right), \left(\max_j v_{ij} \,|\, i \in C\right)\right\}$$

Where $\tilde{v}_i^*$ is the max value of i for all the alternatives and $\tilde{v}_1^-$ is the min value of i for all the alternatives. B and C represent the positive and negative ideal solutions, respectively.
The positive and negative ideal solutions are shown in the table below.
The positive and negative ideal solutions

	Positive ideal	Negative ideal
GRS	(0.130,0.194,0.250)	(0.096,0.143,0.199)
GTD	(0.153,0.216,0.250)	(0.124,0.183,0.233)
GPMA	(0.131,0.197,0.250)	(0.100,0.157,0.223)
GPR	(0.126,0.196,0.250)	(0.106,0.166,0.230)

Step 5: Calculate the distance between each alternative and the fuzzy positive ideal solutionand the distance $\boldsymbol{A^*}$ between each alternative and the fuzzy negative ideal solution$\boldsymbol{A^-}$
The distance between each alternative and FPIS and the distance between each alternative and FNIS are respectively calculated as follows:

$S_i^* = \sum_{j=1}^n d(\tilde{v}_{ij}, \tilde{v}_j^*)$ i=1,2,…,m

$S_i^- = \sum_{j=1}^n d(\tilde{v}_{ij}, \tilde{v}_j^-)$ i=1,2,…,m

d is the distance between two fuzzy numbers , when given two triangular fuzzy numbers (a_1, b_1, c_1) and (a_2, b_2, c_2), e distance between the two can be calculated as follows:

$$d_v(\tilde{M}_1, \tilde{M}_2) = \sqrt{\frac{1}{3}[(a_1 - a_2)^2 + (b_1 - b_2)^2 + (c_1 - c_2)^2]}$$

Note that $d(\tilde{v}_{ij}, \tilde{v}_j^*)$ and $d(\tilde{v}_{ij}, \tilde{v}_j^-)$ are crisp numbers.
The table below shows distance from positive and negative ideal solutions

Distance from positive and negative ideal solutions

	Distance from positive ideal	Distance from negative ideal
A	0.036	0.097
B	0.043	0.088
C	0.08	0.052
D	0.066	0.067

Step 6: Calculate the closeness coefficient and rank the alternatives
The closeness coefficient of each alternative can be calculated as follows:

$$CC_i = \frac{S_i^-}{S_i^+ + S_i^-}$$

The best alternative is closest to the FPIS and farthest to the FNIS. The closeness coefficient of each alternative and the ranking order of it are shown in the table below.

Closeness coefficient

	Ci	rank
A	0.731	1
B	0.671	2
C	0.392	4
D	0.504	3

Findings:
The fuzzy Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) analysis yielded insightful findings regarding the prioritization of green human resource (HR) management practices in manufacturing organizations of Western Odisha.
Ranking of Alternatives: The fuzzy TOPSIS analysis ranked the manufacturing organizations A, B, D, and C, with A being the highest ranked and C being the lowest ranked. This ranking provides a relative assessment of these organizations' adoption of green HR practices.
Identification of Best Practices: Organizations ranked higher in the analysis exhibit stronger adherence to green HR practices, as evidenced by their proximity to the positive ideal solution and distance from the negative ideal solution. These organizations likely have implemented initiatives such as energy conservation, waste reduction, and employee training on environmental sustainability.
Implications: The results suggest significant variation in the adoption of green HR practices among manufacturing organizations in Western Odisha. Higher-ranked organizations may serve as role models for others, demonstrating the feasibility and benefits of integrating environmental sustainability into HR management.

Conclusion:
In this study, we embarked on a journey to delve into the realm of green human resource management (HRM) practices within manufacturing organizations, with a focused lens on those operating in Western Odisha. Our exploration was grounded in the recognition of the pivotal role played by environmental sustainability in reshaping contemporary HR strategies. Through a comprehensive review of literature and the application of fuzzy Technique for Order Preference by Similarity to Ideal Solution (TOPSIS), we sought to not only identify but also prioritize green HR practices, shedding light on their significance in organizational contexts.

Our findings underscored the multifaceted nature of green HRM, illuminating its potential to drive transformative change in manufacturing firms. By integrating environmental considerations into HR functions such as recruitment, training, performance management, and reward systems, organizations can not only bolster their sustainability credentials but also enhance operational efficiency and employee engagement. The nuanced insights gleaned from our analysis revealed the varying degrees of adoption of green HR practices among manufacturing organizations in Western Odisha, offering valuable benchmarks for comparison and inspiration.

Moreover, our study contributes methodologically by showcasing the efficacy of fuzzy TOPSIS as a robust framework for evaluating and ranking sustainability practices within HRM. This approach, characterized by its ability to accommodate uncertainties and subjectivities inherent in sustainability assessments, holds promise for guiding evidence-based decision-making in organizational sustainability initiatives.

Looking ahead, our research paves the way for future endeavors aimed at advancing responsible business practices and fostering a culture of sustainability in manufacturing organizations. By leveraging the insights gleaned from this study, organizations can chart a course towards greener pastures, reaping the manifold benefits of aligning HR strategies with environmental imperatives. As we navigate the complexities of the contemporary business landscape, the imperative for organizations to embrace sustainability as a strategic imperative cannot be overstated. Through collaborative efforts and continued scholarly inquiry, we can catalyze a paradigm shift towards a more sustainable and resilient future.

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