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Strategic sustainability: Unveiling the crucial role of solid waste management in environmental balance

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Abstract: This research investigates sustainable solid waste management practices at the State Company for the Manufacture of Medicines and Medical Supplies in Samarra. Using Statistical Package for the Social Sciences (SPSS) ver. 23, key variables such as education, participation, implementation, and policy were analysed to assess their impact on environmental balance. A sample of 62 staff members was surveyed from a population of 785, ensuring reliability and representative insights. The study revealed high internal consistency and validity for the analysed variables. Sustainable management dimensions were thoroughly explored, and the average score for sustainable management was found to be 3.102, indicating a strong level of agreement among participants regarding these dimensions. Specific hypotheses related to education, participation, implementation, and policy were confirmed through robust statistical analyses. Variation analysis revealed statistically significant differences in sustainable management dimensions and their impact on environmental balance. Regression analysis demonstrated relationships between participation, implementation, policy, and environmental balance, with R^2 (coefficient of determination) values indicating the explanatory power of these relationships. The results underscore the critical role of education, participation, implementation, and policy in achieving environmental balance within the context of sustainable waste management practices. This study contributes valuable insights into effective strategies for promoting environmental sustainability in waste management initiatives, emphasising the importance of targeted interventions in education, participatory engagement, implementation strategies, and policy frameworks.

Keywords: environmental balance, pollution, recycling solid waste, solid waste, sustainable management

INTRODUCTION

The State Company for the Manufacture of Medicines and Medical Supplies in Samarra is striving to minimise waste and promote sustainability in alignment with the global economic shift towards sustainable development. Recognising the environmental impact and depletion of natural resources, the company aims to address the accumulation of solid waste through international efforts, considering medical waste as a potential economic resource and energy source. The quality and quantity of solid waste generation are influenced by socio-economic factors, cultural habits, urban structures, population, and commercial activities (Ghacha, Ammari and Ben Allal, 2020). Public service systems must include integrated solid waste management. Proposals and evaluations of better waste management systems are needed to improve waste process activities and raise sustainable performance (Tsai *et al.*, 2020; Malinowski *et al.*, 2021).

The negative impact of industrial and technological development, coupled with the misuse and rapid depletion of natural resources, has raised global concerns about the threat to humanity. The international community has responded by emphasising environmental balance as a crucial aspect of sustainable development at all levels. The contemporary focus on environmental protection and management is underscored as a significant theme in scientific research and international conferences. The aim is to formulate development plans that mitigate environmental degradation while promoting economic and social integration (Kaczmarek, *et al.* 2022). On this basis, global interest in and good governance of the environment in the context of sustainable development has been strengthened through international platforms that have sought to engage

a few experts and actors in environmental balance management. There will always be a need for leaders who can work together in harmony to promote environmental awareness and long-term development. According to the conditions in which we find ourselves, the decision to integrate peacefully is based on local needs (Ikegbu, 2017; Ge, Yang and Fekete, 2021).

The attainment of ecosystem and environmental balance relies on implementing environmental policy perspectives and adhering to the principles of environmental sustainability. This entails a nuanced understanding of macroeconomic and microeconomic actions, alongside effective leadership for policy management and sustainability. Introducing the concept of environmental capitalism, it advocates for recognising nature's inherent capital, termed natural capital or environmentally profitable ecosystems. Governments are urged to adopt this perspective and utilise existing policy tools to tackle environmental challenges. Sustainability, broadly defined, entails promoting human well-being while preserving environmental and natural system capacities. The three pillars approach underscores the pursuit of economic, social, and environmental sustainability goals in businesses. Ethical treatment of individuals, both within and outside organisations, is deemed critical for achieving sustainability. "Corporate sustainability" encompasses diverse efforts by firms to enhance stakeholders' lives and benefit communities, with a focus on conserving resources, protecting the environment, and addressing employee needs at the corporate level. These principles are supported by studies such as those by Ghabbour (1992), Dyllick and Hockerts (2002), Rheede van and Blomme (2012), Pérez and Bosque del (2014), and Eslami *et al.* (2022).

Solid waste management must be done in a way that protects community health and the environment by utilising an integrated, complex, multicomponent, and interconnected system supplied by the environmental leader (Abad *et al.*, 2023; Nejatian *et al.*, 2023). As a result, it is important to take the right steps, taking into account what resources and conditions are available, and choosing the best solutions that meet environmental policy and sustainability criteria at the lowest cost and recovery possible. The long-term sustainability of a company's environmental impact is heavily influenced by the values held by environmentally conscious managers, as emphasised by Park and Kim (2014) and Han *et al.* (2015). Altruistic behaviour, rooted in environmental values, plays a crucial role in pro-environmental activities. The norm-activation theory of altruism, as proposed by Schwartz (1977) and further supported by Nordlund and Garvill (2002), suggests that an individual's values activate altruistic conduct through moral norms or responsibilities. The theory of environmentalism based on values, beliefs, and norms (VBN), as outlined by Stern (2000), argues that individuals with strong environmental values are more likely to be environmentally aware, take personal responsibility for their actions, and support or engage in pro-environmental efforts. As companies have gained prominence, there is a growing recognition of their responsibility to address environmental challenges (Metcalf and Benn, 2013). According to Epstein and Buhovac (2014), the development and communication of sustainability plans are crucial for long-term success. The literature emphasises the role of responsible leadership in improving a company's social and environmental performance (Voegtlin, Patzer and Scherer, 2012), defined by Maak (2007) as the ability to build trusting relationships and coordinate responsible action toward a shared corporate purpose. Environmental leadership is characterised as the skill of engaging both internal and external stakeholders in pursuit of the company's environmental sustainability goals. Effective communication is crucial for environmentally responsible leadership, necessitating engagement with both internal and external stakeholders. Leaders responsible for a company's environmental decisions must consider the impacts on all stakeholders and employees (Voegtlin, Patzer and Scherer, 2012; Epstein and Buhovac, 2014). An essential skill for environmentally conscious leaders is the ability to persuade employees about the importance of environmental sustainability as a core company value (Shacheri *et al.*, 2022). This skill fosters employee recognition of environmental issues in their daily routines, encouraging active participation in environmental initiatives (Farrukh *et al.*, 2022). Previous research, such as the work by Hoogh De and Hartog Den (2008), has established a connection between leadership style and company performance. Voegtlin, Patzer and Scherer (2012) emphasise the association between a company's social or environmental performance and socially responsible leadership. In the context of Indian managers, Khuntia and Suar (2004) found a strong correlation between empowerment and altruistic leadership styles, suggesting that environmentally conscious leaders are more likely to exhibit commitment to environmental issues. Shifting to the broader perspective of sustainable development goals, UN-HABITAT (2010) highlights sustainable solid waste management as a crucial strategy. However, many nations face challenges in solid waste management due to a lack of knowledge and regulatory infrastructure, as indicated in the literature this evaluation focuses on.

In the context of discussing previous knowledge efforts, the review of past studies examines an orthographic view, revealing the contemporary nature of the subject due to its crucial applications. Additionally, past knowledge efforts have played a vital role in shaping a shared vision of management science in environmental sciences. This is achieved through the study and analysis of sustainable management variables and solid waste management. Furthermore, the identification of specific models in organisations, prioritising some over others, enhances the relevance of the topic in the examination of the researched organisation. The current research emphasises sustainable management as a key instrument for implementing environmental policy and ensuring long-term sustainability. Focusing on aspects such as environmental culture and solid waste management, it underscores the importance of a comprehensive, integrated system led by environmental leaders to safeguard community health and the environment. The approach involves considering available resources and conditions to select cost-effective solutions that align with environmental policy and sustainability criteria.

MATERIALS AND METHODS

SUSTAINABLE SOLID WASTE MANAGEMENT STRATEGIES IN SAMARRA'S PHARMACEUTICAL INDUSTRY

The methodology for this study was structured to address the problem, significance, aims, and hypotheses outlined in the research.

1) **Problem statement.** How the dimensions of sustainable management for solid waste could be achieved by the State Company for the Pharmaceutical Industry and Medical Appliances in

Samarra was investigated. The gap between management and environmental research in businesses was closed. Long-term solid waste management for a safer working environment in green businesses was focused on. Environmental consciousness was raised by expanding knowledge among affected individuals.

2) **Aims of the research.** The progression of study variables was followed through description, interpretation, and analysis. The reality of the company's solid waste management application within the model was diagnosed. Environmental balancing data for the implementation of solid waste management was evaluated. The significance of scientific and modern solid waste management and disposal was emphasised.
3) **Hypotheses for research.** Sustainable management could address environmental aspects, eliminate waste, and achieve environmental balance.
4) **Research goals.** (i) Investigate the potential for sustainable management dimensions related to education in the company. (ii) Explore the potential for sustainable management dimensions related to participation in the company. (iii) Examine the potential for sustainable management dimensions related to implementation in the company. (iv) Assess the potential for sustainable management dimensions related to politics in the company.
5) **Expected outcome.** Statistically significant differences in sustainable management and environmental balance within the researched company were anticipated. Statistical moral differences in sustainable management in the education domain of the researched organisation were anticipated. Statistical moral differences in sustainable management in the participation domain of the researched organisation were predicted. Statistical moral differences in sustainable management in the implementation domain of the researched organisation were expected. Statistical moral differences in sustainable management in the politics domain of the researched organisation were predicted. Statistical moral differences in sustainable management in the implementation domain of the researched organisation were expected. Statistically significant differences were anticipated in sustainable management within the political domain of the researched organisation. Section 2.2 covers the Methods of Information Gathering.

In defining research variables, the researcher employed theoretical description, logical analysis, and statistical analysis approaches. Data gathering methods included an inquiry into desk research sources and the distribution of a questionnaire to staff across medical, technical, and administrative disciplines. Out of 70 distributed questionnaires, 62 valid responses were obtained for subsequent statistical analysis.

PRACTICAL BASIS OF RESEARCH

The research involves describing and diagnosing variables using SPSS Ver23, including iterations, percentages, arithmetic settings, and standard deviations. The theoretical aspects of the model (education, participation, implementation, and politics) are discussed, focusing on the investigated corporation. A simple random sample of 62 administrative and medical staff was selected from a community of 785 to gain insights into sustainable management. The resolution's stability and reliability were assessed with a sample size of 30, revealing acceptable values for both the independent variable (0.867) and the dependent variable (0.906), exceeding the minimum acceptance rate of 0.60. This indicates the resolution's suitability for the study sample. The information on various variables and dimensions assessed in the research, along with relevant statistics.

1. **Education:**
   a) number of questions (4): this variable, focusing on educational aspects, comprises four questions within the survey;
   b) Alpha-Kronbach coefficient (0.894): the high coefficient (0.894) signifies strong internal consistency among the questions related to education in the survey;
   c) validity (0.945): the validity score of 0.945 indicates that the questions effectively measure the intended educational aspects.
2. **Participation:**
   a) number of questions (4): this variable, assessing participation-related aspects, includes four questions;
   b) Alpha-Kronbach coefficient (0.884): the coefficient of 0.884 demonstrates high internal consistency among the questions related to participation;
   c) validity (0.940): the high validity score (0.940) implies that the questions effectively capture the intended participation-related dimensions.
3. **Implementation:**
   a) number of questions (4): this variable, examining implementation-related factors, comprises four questions;
   b) Alpha-Kronbach coefficient (0.876): the coefficient of 0.876 indicates strong internal consistency among the questions related to implementation;
   c) validity (0.935): with a validity score of 0.935, the questions are deemed effective in measuring the intended implementation-related aspects.
4. **Politics:**
   a) number of questions (4): this variable, focusing on political aspects, includes four questions;
   b) Alpha-Kronbach coefficient (0.904): the high coefficient (0.904) reflects strong internal consistency among the questions related to politics;
   c) validity (0.950): the validity score of 0.950 indicates that the questions effectively measure the intended political dimensions.
5. **Sustainable management:**
   a) number of questions (16): this variable, encompassing various aspects of sustainable management, is composed of 16 questions;
   b) Alpha-Kronbach coefficient (0.867): The coefficient of 0.867 suggests a high internal consistency among the questions related to sustainable management;
   c) validity (0.931): The validity score of 0.931 indicates that the questions effectively measure the intended dimensions of sustainable management.

APPLIED STATISTICAL APPROACHES

The collected data underwent tabulation, audit, and processing using SPSS and statistical methods. Variables were measured based on recent references, ensuring consistency in presentation with some adjustments for content. The researcher utilised the Likert five scale and applied statistical methods, including the arithmetic

average to gauge variable importance, standard deviation for answer concentration, Test T, Test F, and variance analysis.

This study employs a quantitative research design to analyse the impact of the educational dimension (X_1) within the sustainable management variable on environmental balance (Y) (Eq. 1). A simple random sample of 62 administrative and medical staff from a community of 785 within the State Company for the Manufacture of Medicines and Medical Supplies in Samarra participated in the study.

$$Y = a_0 + a_1 X_1 + e \quad (1)$$

where: Y = dependent variable (environmental balance), X_1 = independent variable (educational dimension), a_0 = intercept, a_1 = estimated regression coefficient, indicating the change in Y for a one-unit change in X_1, e = error term.

Collected data were analysed using simple linear regression to estimate the relationship between the educational dimension and environmental balance. The null hypothesis assumed no significant relationship, while the alternative hypothesis suggested a significant impact. The significance level was set at 0.05. The study provides insights into the strength and significance of the relationship through the estimated regression tilt, significance level (sig), and R-squared value (the coefficient of determination), indicating the proportion of variability in environmental balance explained by the educational dimension. Ethical considerations were ensured throughout the research process.

THEORETICAL AND CONCEPTUAL FRAMEWORK

Sustainable management of solid waste

The paragraph highlights the global shift towards sustainable solid waste management practices, emphasising waste as a valuable resource for conserving landfill space and natural resources. Producers are urged to take responsibility for product life cycles, promoting sustainability at every stage. The need for skilled professionals in light of advancing technologies is underscored. A systematic approach to waste management is outlined, emphasising waste avoidance, cleaner technology use, recycling, and proper treatment and disposal methods. Sustainability, defined as meeting current needs without compromising future generations' ability to meet their own, is a central theme. Governments increasingly focus on sustainable development, aiming to preserve environmental quality for future generations. Implementing responsible waste management technologies contributes to long-term economic and ecological stability. Social sustainability goals include empowerment, equity, and poverty alleviation. However, globalisation poses challenges to waste management, impacting public health, economic progress, and the environment. Sustainable waste management is crucial for environmental quality and the well-being of future generations, aligning with sustainable development goals (Papa, 2014; Oghenekohwo and Akporehwe, 2015; Assuah and Sinclair, 2021; Sharma *et al*., 2021).

Environmental balance achievement

Environmental balance management requires the involvement of various stakeholders, including the state, to preserve and sustain the environment in line with the principles of sustainable development. The environmental planning process, emphasising the integration of the environmental dimension into a participatory framework involving the state, civil society, and citizens, represents a key practice in environmental management. This participatory approach involves collective contributions to compensate affected environmental parties, utilising mechanisms like liability insurance and compensation funds. The international community aims to achieve a balance between environmental protection and natural resource conservation for economic and social well-being through the development of programs, schemes, and legal mechanisms integrated into a comprehensive development strategy, engaging all actors.

Solid waste management model

The critical role of waste management in organisations is to mitigate potential negative environmental impacts and protect public health. Diagnostic and control tools, such as solid waste management indicators, play a crucial role in decision-making, supporting information, and enhancing public health (Moreira *et al*., 2018). However, it highlights that weak waste management initiatives can lead to public health deterioration. Organisations address socio-environmental issues through environmental management systems, aiming to reduce natural resource consumption. The paragraph notes that these tools are insufficient for waste management decisions and lack sensitivity (Peng, Botelho and Matinlinna, 2012). It concludes by introducing the four basic dimensions of solid waste management models: education, participation, implementation, and policy, forming a composite indicator with subsets of variables (Moreira *et al*., 2018).

1. **Education.** Integral to the organisation's solid waste management model, the relationship between a company and environmental issues in employee training was emphasised. The obligation to build knowledge, train the community, and address societal challenges, such as climate change, was highlighted. Global efforts by green organisations and the adoption of environmental management systems (EMS) for environmental friendliness were observed by many European countries.
2. **Participation.** Post-participation criteria were employed to illustrate organisational responsibility in preparing new leaders based on sustainability principles. The community was engaged in everyday activities to foster a sustainable culture. Criteria for assessing solid waste management achievements, including considerations of sustainability culture, individual orientation, and professional development, were detailed (Yanthi *et al*., 2019).
3. **Implementation.** Day-to-day operations, solid waste treatment, process appraisal, and measurement of waste generated were encompassed. Organisations were morally obliged to lead efforts in proper solid waste management. Varied approaches, including long-standing waste management plans in industrialised nations and effective recycling programs in the United States, were observed (Vega De, Benítez and Barreto, 2008).
4. **Politics.** The paragraph emphasises the importance of criteria for policy and management in solid waste activities, as highlighted by McCartney (2003). The criteria involve assessing policy support and senior management's focus on transitioning to sustainable waste management. To conduct a comprehensive evaluation of waste management solutions, trustworthy data and tables are crucial at every step. Arazo (2015) stresses that a thorough understanding of the organisation's

waste structures, processing, and disposal processes is essential for organisational sustainability. Effective solid waste management requires an in-depth knowledge of the processes leading to waste generation, emphasising the need for various methods to gather quantitative data on waste amount, location, and characteristics. These methods include reviewing waste management files, visual assessments, and in-depth interviews with waste management staff.

Understanding trash generation is crucial for effective solid waste management. Identifying the sources of waste is paramount for a successful program. Organisations are morally obligated to lead in responsible waste management due to the global expansion of enterprises leading to increased waste. The introduction of solid waste management systems is imperative. Recycling and waste reduction projects, as highlighted by He *et al.* (2022), have proven to be highly effective in addressing the growing issue of solid waste.

The determination and measurement of the dependent variable, environmental balance, involved establishing specific metrics related to waste management practices and environmental indicators. This encompassed both quantitative and qualitative methods, including surveys, on-site observations, and analysis of waste management records. Quantitative data underwent statistical analyses, while qualitative aspects involved subjective assessments based on environmental guidelines and industry best practices.

STUDY AREA

This paper focuses on the State Company for the Manufacture of Medicines and Medical Supplies in Samarra, established in 1965 through a cooperation agreement with the former Soviet Union. Positioned as a major player in the pharmaceutical industry, the company is headquartered in Samarra and aspires to become a key pharmaceutical business in the region. The current waste management method involves regular collection from buildings across the site, utilising plastic boxes distributed in functional areas. Collected garbage, approximately 750 Mg daily, is transported to a nearby disposal facility.

The study revealed the daily volumes of waste produced from various sources within a particular organisation or location. The mess area contributes 250 Mg of waste per day. Waste generated from residential areas amounts to 200 Mg daily. The company building itself produces 170 Mg of waste each day. Various site areas and miscellaneous sources contribute an additional 120 Mg of waste per day. In summary, the data highlights the distribution of waste generation across different sources within the specified context, providing insights into the daily waste management requirements of the organisation or location. Data was collected from the management of the company concerned with waste management.

RESULTS AND DISCUSSION

DESCRIPTION OF SUSTAINABLE MANAGEMENT DIMENSIONS

Two key aspects are addressed: firstly, to describe the dimensions of sustainable management in the company, and secondly, to test the main premise, "The possibility of sustainable management in the company under study." The survey sample's perspectives on sustainable management were thoroughly analysed. Notably, the average score for the sustainable management variable was 3.102, surpassing the hypothetical average of 3. This signifies the general agreement among sample members with the statements on sustainable management. The standard deviation of 1.048 indicates homogeneity in the responses of sample members, with a relative importance of 62.03%. The first main hypothesis is affirmed based on the results. The arithmetic average of the educational dimension is 3.153, surpassing the hypothetical average, with a relative importance of 63.06%. This signifies a particular interest in the educational dimension of sustainable management. The low standard deviation (1.027) indicates homogeneity in sample members' responses. Specific paragraphs, such as "Practice awareness projects focused on waste management," received high average scores (3.548 and 70.96% relative importance), demonstrating the company's focus on awareness and guidance. The analysis confirms the first hypothesis: "The possibility of achieving the sustainable management dimensions of education in the company under study."

Table S1 summarises findings on sustainable management dimensions. **1) Participation:** average (3.230), indicating significant interest (64.5% relative importance); standard deviation (1.035) suggests response homogeneity; the highest average (3.339) confirms interest in waste management programs, while the lowest (3.065) suggests clarity in business performance. **2) Implementation:** average (3.044) reflects interest (60.89% relative importance), with a standard deviation (1.067) indicating response homogeneity; the highest average (3.194) highlights focus on environmental balance, while the lowest (2.919) suggests a vision for environmental conservation. **3) Policy:** average (2.984) indicates interest (59.68% relative importance), with a standard deviation (1.066) suggesting response homogeneity; the highest average (3.065) implies a management vision for waste management, the while lowest (2.839) suggests a weak stance in sustainable planning.

These results provide insights into the company's focus and performance in each dimension of sustainable management, supporting or confirming specific hypotheses.

In the second main premise test, we conducted a one-way variation analysis to explore statistically significant differences in the dimensions of sustainable management and environmental balance (Y) within the researched company. Simple linear regression, with an estimated regression tilt value of 0.349, was employed to assess how changes in sustainable management (X) influenced environmental balance (Y). The analysis of the sustainable management variable revealed a probability value (sig = 0.0000) lower than the statistical morale value (α = 0.05), supporting the acceptance of the second main hypothesis. The R^2 value for the sustainable management variable was 0.455, signifying that 45.5% of the variability in environmental balance was explained by the sustainable management variable alone, while the remaining 54.5% was attributed to other unexamined variables. For the first hypothesis related to education (X_1) and environmental balance (Y), a similar approach was taken. The estimated regression tilt (0.385) indicated the change in environmental balance (Y) with a one-unit change in the educational dimension (X_1) within the sustainable management variable. The variation analysis of the educational dimension supported the hypothesis, with a probability value (sig = 0.0000) below

the statistical morale value (α = 0.05). The R^2 value for the educational dimension was 0.435, revealing that 43.5% of the variability in environmental balance was explained by the educational dimension alone, leaving 56.5% attributed to other unexamined variables according to the study sample members' perspectives.

Anticipates statistical moral differences in sustainable management in participation (X_2) and environmental balance (Y). The estimated regression tilt (0.267) suggests a change in environmental balance Y with a one-unit change in participation dimension X_2. The variation analysis indicates statistical significance (sig = 0.0000), accepting the hypothesis. The R^2 value for participation is 33.2%, indicating that this dimension alone explains that proportion of the environmental balance, with the remaining 66.8% attributed to other variables. This predicts statistical moral differences in sustainable management in implementation (X_3) and environmental balance (Y). The estimated regression tilt (0.208) suggests a change in environmental balance Y with a one-unit change in the implementation dimension X_3. The variation analysis shows statistical significance (sig = 0.0000), accepting the third hypothesis. The R^2 value for implementation is 21.3%, explaining that proportion of the environmental balance, with the remaining 78.7% attributed to other variables. This expects statistical moral differences in sustainable management in policy (X_4) and environmental balance (Y). The estimated regression tilt (0.232) suggests a change in environmental balance Y with a one-unit change in the policy dimension X_4. The variation analysis shows statistical significance (sig = 0.0000), accepting the fourth hypothesis. The R^2 value for policy is 14.4%, explaining that proportion of the environmental balance, with the remaining 85.6% attributed to other variables (Tab. 1).

Table 1. Variance analysis of sustainable management impact on environmental balance: focusing on education, participation, implementation, and policy

Independent variable	*a*	*β*	R^2	*F*-value	sig
Education	2.174	0.385	0.435	23.730	0.000
Participation	2.161	0.267	0.332	28.854	0.000
Implementation	2.259	0.208	0.213	63.073	0.000
Policy	2.539	0.232	0.144	39.243	0.000
The sustainable management	2.127	0.349	0.455	60.985	0.000

Explanations: a, β = regression coefficients, R^2 = coefficient of determination, sig = statistical significance level.
Source: own study.

In summary, the study finds support for the hypothesised relationships between sustainable management dimensions (participation, implementation, policy) and environmental balance, as indicated by significant regression tilts and acceptance of hypotheses. The R^2 values highlight the proportion of environmental balance explained by each dimension individually.

The study's actionable recommendations encompass multifaceted approaches to enhance sustainable waste management within the researched organisation. Initiatives include implementing awareness projects and training programs to fortify employee knowledge. Encouraging active participation, especially among professional and technical staff, is vital, alongside reinforcing cultural interventions and technical training for a coherent business policy. Supporting waste reduction programs, engaging company management in environmental conservation, and enforcing comprehensive waste management policies are crucial for effective implementation. Regular assessment and improvement, coupled with policy updates, ensure alignment with cutting-edge waste management practices, fostering environmental balance. These recommendations collectively aim to optimise waste management strategies and contribute to a more sustainable organisational framework.

EXPLORING SUSTAINABLE MANAGEMENT DIMENSIONS: INSIGHTS AND IMPLICATIONS FOR ENVIRONMENTAL STEWARDSHIP

The findings reveal a notable level of interest and engagement in sustainable management dimensions within the company, as evidenced by the average scores and relative importance values. Particularly, the emphasis on education, participation, implementation, and policy aspects underscores a holistic approach towards sustainable waste management. The high scores in areas such as awareness projects and waste reduction programs indicate a proactive stance towards environmental stewardship and resource conservation. These results align with global trends highlighting the growing importance of corporate sustainability initiatives in mitigating environmental impacts and promoting responsible business practices. Moreover, the homogeneity in responses suggests a consistent understanding and alignment among stakeholders regarding the importance of sustainable management practices (Martin *et al*., 2022).

In the context of world literature, these findings resonate with studies emphasising the crucial role of education, participation, and policy frameworks in fostering sustainable development and environmental conservation efforts. Numerous research works have highlighted the positive correlation between effective waste management strategies and improved environmental outcomes (Koul, Yakoob and Shah, 2022). Additionally, insights from developed countries, where advanced waste management technologies and policies have led to significant environmental improvements, further validate the significance of the observed trends in the present study (Atiya, Chung and George, 2023). Overall, the results contribute to the growing body of knowledge on sustainable management practices and provide practical insights for organisations seeking to enhance their environmental performance and societal impact.

CONCLUSIONS

The discourse on environmental balance and sustainable management highlights several critical considerations. The adoption of participatory methods emerges as pivotal, ensuring the integration of the environmental dimension into broader economic and social development strategies. Despite the importance of environmental assessments in averting damage from developmental activities, challenges such as financial constraints and limited scientific oversight by authorities persist. The need for an evaluative approach extends beyond the establishment of new

waste management systems to include a comprehensive assessment of existing conditions, utilising available tools with awareness of persistent gaps and challenges. The substantial contribution of waste recycling to environmental protection, pollution prevention, and resource preservation is underscored, drawing parallels with successful models observed in developed nations. The study underscores the significant role of sustainable solid waste management variables in shaping corporate environmental balance, with the hypotheses shedding light on positive relationships within the theoretical framework. While most variables exhibit high values, the third-place ranking of participation signals potential shortcomings in the company's waste management practices.

However, the limitations of the study include the focus on a specific company and industry, potentially limiting generalisability to other contexts. The sample size of 62 participants might also be considered relatively small, impacting the broader applicability of the results. Additionally, the study relies on self-reported data, which could introduce response bias.

SUPPLEMENTARY MATERIAL

Supplementary material to this article can be found online at https://www.jwld.pl/files/Supplementary_material_Aldouri.pdf

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CONFLICT OF INTERESTS

The author declares no conflict of interests.

REFERENCES

Abad, S.S.A.M.K. *et al.* (2023) "Green synthesis of Pd@ biochar using the extract and biochar of corn-husk wastes for electrochemical Cr (VI) reduction in plating wastewater," *Journal of Environmental Chemical Engineering*, 11(3), 109911. Available at: https://doi.org/10.1016/j.jece.2023.109911.

Arazo, R.O. (2015) "Compositions of solid wastes generated from a school campus," *International Journal of Research in Engineering and Technology*, 04(10), pp. 263–267. Available at: https://doi.org/10.15623/ijret.2015.0410046.

Assuah, A. and Sinclair, A.J. (2021) "Solid waste management in western Canadian First Nations," *Waste Management*, 129, pp. 54–61. Available at: https://doi.org/10.1016/j.wasman.2021.05.007.

Atiya, S., Chung, Y.J. and George, G. (2023) "A comparative study on e-waste management systems in developed and developing countries: Legislative compliances and initiatives," in A.M. Rawani *et al.* (eds.) *Sustainable approaches and strategies for e-waste management and utilization*, pp. 90–121. Hershey: IGI Global, pp. 90–121. Available at: https://doi.org/10.4018/978-1-6684-7573-7.ch006.

Dyllick, T. and Hockerts, K. (2002) "Beyond the business case for corporate sustainability," *Business Strategy and the Environment*, 11(2), pp. 130–141. Available at: https://doi.org/10.1002/bse.323.

Epstein, M.J. and Buhovac, A.R. (2014) *Making sustainability work 2nd edition: Best practices in managing and measuring corporate social, environmental, and economic impacts*. San Francisco: Berrett-Koehler Publishers.

Eslami, H. *et al.* (2022) "On how defining and measuring a channel bed elevation impacts key quantities in sediment overloading with supercritical flow," *Acta Geophysica*, 70(5), pp. 2511–2528.

Farrukh, M. *et al.* (2022) "Fostering employee's pro-environmental behavior through green transformational leadership, green human resource management and environmental knowledge," *Technological Forecasting and Social Change*, 179, 121643. Available at: https://doi.org/10.1016/j.techfore.2022.121643.

Ge, D.N., Yang, Y. and Fekete, A. (2021) "Sustainable water management strategies from a historical landscape-case study of Ganzhou, China," *Teka Komisji Urbanistyki i Architektury Oddział PAN w Krakowie*, 49, pp. 325–332. Available at: https://doi.org/10.24425/tkuia.2021.138719.

Ghacha, A., Ammari, M. and Ben Allal, L. (2020) "Sustainable sewage sludge management in Morocco: Constraints and solutions," *Journal of Water and Land Development*, 46, pp. 71–83. Available at: https://doi.org/10.24425/jwld.2020.134199.

Ghabbour, S.I. (1992) "Book reviews: Caring for the Earth: A Strategy for Sustainable Living," *Environmental Values*, 1(2), pp. 171–173. Available at: https://www.jstor.org/stable/30301275 (Accessed: October 12, 2023).

Han, H. *et al.* (2015) "Guests' pro-environmental decision-making process: Broadening the norm activation framework in a lodging context," *International Journal of Hospitality Management*, 47, pp. 96–107. Available at: https://doi.org/10.1016/j.ijhm.2015.03.013.

He, R. *et al.* (2022) "Global knowledge base for municipal solid waste management: Framework development and application in waste generation prediction," *Journal of Cleaner Production*, 377, 134501. Available at: https://doi.org/10.1016/j.jclepro.2022.134501.

Hoogh De, A.H.B. and Hartog Den, D.N. (2008) "Ethical and despotic leadership, relationships with leader's social responsibility, top management team effectiveness and subordinates' optimism: A multi-method study," *The Leadership Quarterly*, 19(3), pp. 297–311. Available at: https://doi.org/10.1016/j.leaqua.2008.03.002.

Ikegbu, E.A. (2017) "Harmonious complementarity in leadership: A necessary tool for environment and sustainability," *European Journal of Sustainable Development*, 6(3), 141. Available at: https://doi.org/10.14207/ejsd.2017.v6n3p141.

Kaczmarek, I. *et al.* (2022) "A machine learning approach for integration of spatial development plans based on natural language processing," *Sustainable Cities and Society*, 76, 103479. Available at: https://doi.org/10.1016/j.scs.2021.103479.

Khuntia, R. and Suar, D. (2004) "A scale to assess ethical leadership of Indian private and public sector managers," *Journal of Business Ethics*, 49(1), pp. 13–26. Available at: https://doi.org/10.1023/B:BUSI.0000013853.80287.da.

Koul, B., Yakoob, M. and Shah, M.P. (2022) "Agricultural waste management strategies for environmental sustainability," *Environmental Research*, 206, 112285. Available at: https://doi.org/10.1016/j.envres.2021.112285.

Maak, T. (2007) "Responsible leadership, stakeholder engagement, and the emergence of social capital," *Journal of Business Ethics*, 74(4),

pp. 329–343. Available at: https://doi.org/10.1016/j.envres.2021.112285.

Malinowski, M. *et al.* (2021) "A GIS and AHP-based approach to determine potential locations of municipal solid waste collection points in rural areas," *Journal of Water and Land Development*, 51, pp. 94–101. Available at: https://doi.org/10.24425/jwld.2021.139019.

Martin, C. *et al.* (2022) "Implementation of a more sustainable waste management policy in the operating room," *Anesthesiology*, 137(6), pp. 749–751. Available at: https://doi.org/10.1097/ALN.0000000000004367.

McCartney, D.M. (2003) "Auditing non-hazardous wastes from golf course operations: moving from a waste to a sustainability framework," *Resources, Conservation and Recycling*, 37(4), pp. 283–300. Available at: https://doi.org/10.1016/S0921-3449(02)00077-0.

Metcalf, L. and Benn, S. (2013) "Leadership for sustainability: An evolution of leadership ability," *Journal of Business Ethics*, 112(3), pp. 369–384. Available at: https://doi.org/10.1007/s10551-012-1278-6.

Moreira, R. *et al.* (2018) "Solid waste management index for Brazilian higher education institutions," *Waste Management*, 80, pp. 292–298. Available at: https://doi.org/10.1016/j.wasman.2018.09.025.

Nejatian, N. *et al.* (2023) "Evaluation of the vulnerability and pathways of groundwater pollution in the Zanjanrud river basin by an integrated modeling approach," *Modeling Earth Systems and Environment*, 10, pp. 2295–2308. Available at: https://doi.org/10.1007/s40808-023-01897-x.

Nordlund, A.M. and Garvill, J. (2002) "Value structures behind proenvironmental behaviour," *Environment and Behavior*, 34(6), pp. 740–756. Available at: https://doi.org/10.1177/001391602237244.

Oghenekohwo, J.E. and Akporehwe, N.J. (2015) "Perspectives on waste management and community health promotion in urban cities in Nigeria," *British Journal of Education*, 3(8), pp. 70–77.

Papa, F. (2014) *A clientelistic perspective of managing municipal solid waste system: An analysis of the social impact of clientelism on the municipality of Palermo*. PhD Thesis. University of Palermo.

Park, J. and Kim, H.J. (2014) "Environmental proactivity of hotel operations: Antecedents and the moderating effect of ownership type," *International Journal of Hospitality Management*, 37, pp. 1–10. Available at: https://doi.org/10.1016/j.ijhm.2013.09.011.

Peng, J.-Y., Botelho, M.G. and Matinlinna, J.P. (2012) "Silver compounds used in dentistry for caries management: A review," *Journal of Dentistry*, 40(7), pp. 531–541. Available at: https://doi.org/10.1016/j.jdent.2012.03.009.

Pérez, A. and Bosque del, I.R. (2014) "Sustainable development and stakeholder relations management: Exploring sustainability reporting in the hospitality industry from a SD-SRM approach," *International Journal of Hospitality Management*, 42, pp. 174–187. Available at: https://doi.org/10.1016/j.ijhm.2014.07.003.

Rheede van, A. and Blomme, R.J. (2012) "Sustainable practices in hospitality: A research framework," in J.S. Chen (ed.) *Advances in hospitality and leisure, 8*. Leeds: Emerald Group Publishing Limited.

Schwartz, S.H. (1977) "Normative influences on altruism," *Advances in Experimental Social Psychology*, 10, pp. 221–279. Available at: https://doi.org/10.1016/S0065-2601(08)60358-5.

Shacheri, F. *et al.* (2022) "Surface dense discharge from rectangular and trapezoidal channels," *Flow Measurement and Instrumentation*, 87, 102213. Available at: https://doi.org/10.1016/j.flowmeasinst.2022.102213.

Sharma, H.B. *at al.* (2021) "Circular economy approach in solid waste management system to achieve UN-SDGs: Solutions for post-COVID recovery," *Science of The Total Environment*, 800, 149605. Available at: https://doi.org/10.1016/j.scitotenv.2021.149605.

Stern, P. (2000) "New environmental theories: Toward a coherent theory of environmentally significant behavior," *Journal of Social Issues*, 56(3), pp. 407–424. Available at: https://doi.org/10.1111/0022-4537.00175.

Tsai, F.M. *et al.* (2020) "A performance assessment approach for integrated solid waste management using a sustainable balanced scorecard approach," *Journal of Cleaner Production*, 251, 119740. Available at: https://doi.org/10.1016/j.jclepro.2019.119740.

UN-HABITAT (2010) *Solid waste management in the world's cities: Water and sanitation in the world's cities 2010*. London: United Nations Human Settlements Programme (UN-HABITAT) 2010.

Vega De, C.A., Benítez, S.O. and Barreto, M.E.R. (2008) "Solid waste characterization and recycling potential for a university campus," *Waste Management*, 28, pp. S21–S26. Available at: https://doi.org/10.1016/j.wasman.2008.03.022.

Voegtlin, C., Patzer, M. and Scherer, A.G. (2012) "Responsible leadership in global business: A new approach to leadership and its multi-level outcomes," *Journal of Business Ethics*, 105(1), pp. 1–16. Available at: https://doi.org/10.1007/s10551-011-0952-4.

Yanthi, N. *et al.* (2019) "Green Campus Initiative (Where do we start?)," *Proceedings of the 3rd Asian Education Symposium (AES 2018)*, pp. 39–44. Available at: https://doi.org/10.2991/aes-18.2019.10.