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RESEARCH ARTICLE

Unleashing Enviropreneurship Toward Innovation: Unraveling Frugal Innovation and Green Innovation Through Zero Waste Management in Circular Economy

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ABSTRACT

Focused on human well-being and social responsibility, this study explores the complex relationships within sustainable entrepreneurship and explores whether enviropreneurship significantly impacts both frugal innovation and green innovation. The analysis also studies whether there are possible beneficial links between zero waste management, frugal innovation, and green innovation. Additionally, through assessing the level to which these items come together in sustainable strategic actions, the paper shows the correlation among two important topics: Enviropreneurship and zero waste management. The study explores at the relations between zero waste management and frugal innovation as well as green innovation, examining whether these aspects of innovation have a positive relationship with effective waste management techniques in the presences of enviropreneurship. The paper analyses interactions between enviropreneurship, frugal innovation and green innovation, and the mediation role of zero-waste management. A total of 273 managers in the manufacturing sector completed the survey and the results were analyzed applying SPSS 25.0 and structural equation modeling (SEM). The findings confirmed significant association among enviropreneurship, zero waste management, frugal innovation, and green innovation. Furthermore, findings also revealed that zero waste management have positive intervention role between enviropreneurship and frugal and green innovation.

1 | Introduction

In the recent decade, increasing threats of global warming and environmental contamination (Ibrahim et al. 2022), have required economies to safeguard both the environment and human well-being (Sun and Wang 2021; Alola et al. 2023). For this reason, circular economy becomes necessary for organizations, proposing strategies to direct the changing environmental landscape (Naustdalslid 2014; Sauvé, Bernard, and Sloan 2016; Awan et al. 2022). Adopting the model of circular economy enables business organization for the development of significant circle by offering values without wasting of resources such as energy, water and raw material (Awan, Arnold, and Gölgeci 2021). Circular economy is related to the efficient utilization of resources including sharing, repairing, reusing and recycling during the activities of purchasing, manufacturing, services, and reprocessing (Abbate, Centobelli, and Cerchione 2023; Awan et al. 2022). Circular business model is a mechanism mainly based on those business practices and operations, which ensure the protection and sustainability of natural environment (Regmi, Zhang, and Zhang 2023). Therefore, in our study, this broader environmental background underlines the urgency of examining how circular economy principles, including waste management and environmental enviropreneurship, can boost frugal and green innovation. Enviropreneurship is a direction that can create ecological harms and pays attention to community wants while concurrently convention that realize the purpose of companies (Abdulnabi et al. 2022; Cuevas-Vargas and

Parga-Montoya 2022). It can also be considered as the ascetic factor that creates the link and provide foundational role for the improvement of frugal innovation, green innovation and zero-base management (Marina 2020; Ismail 2023).

Existing literature in the field of environmental management documented that commercial landscapes particularly manufacturing sector cannot ignore the strategic importance of enviropreneurship and green environmental practices in recent decade (Abanyam et al. 2023). Enviropreneurship mechanism directs the actions of an organization that ensures to reduce the environmental impact such as recycling and eco-purchase (Albhirat et al. 2024). Enviropreneurship is related with the conservation of environment by adopting practices such as informed consumption, renewable material and energy, conservation practices, and minimizing waste (Ye et al. 2020). Having said that, this study investigates the interrelationships among enviropreneurship, frugal innovation, green innovation, and zero waste management. Uncovering the advantageous correlations between these essential aspects of corporate behavior is the main aim (Hamid, Skinder, and Bhat 2020; Sun and Wang 2021). Therefore, the current study focused on the foundation role of green environmental practices for the improvement of circular target economy.

In the current scenario, the tendencies of stakeholders toward environmental safety employ significant pressure on organizations to create and apply zero waste actions (Kralj 2011; Loučanová 2021; Peters and Samarasinghe 2021). Actually, companies have to consider diverse social and cultural pressures, compelling them to set ecological strategies for the preservation of the environment (Kozel et al. 2018). While researchers extensively explore zero waste practices, there is a gap in empirical studies that delve into the preconditions and determinants of the adoption of this kind of practices (Jiménez-Martínez and García-Barrios 2020; Pietzsch, Ribeiro, and de Medeiros 2017). Therefore, the study in hand focused on the factor that encourage for the inclusion of zero waste practices and the outcomes of these practices.

In our study, positive correlations between enviropreneurship and frugal and green innovation, and zero waste management are hypothesized in the initially proposed set of assumptions (H1–H5). These arguments are predicated on the idea that environmentally conscious business owners are more likely to encourage both sensible inventions and economical fixes (Watson 2015). Green innovation and frugal innovation are an unstoppable discussion for environment research all over the world such topic is more performed in the context (industry). Frugal novelty and green novelty have gained important interest in current years to tackle pressing universal problems in a feasible and gainful manner. Frugal novelty and green novelty contribute to several common values. They highlight competence, affordability, and feasibility of the industry (López-Sánchez and Santos-Vijande 2022). While the relationship between enviropreneurship and green innovation and frugal innovation is inadequately explored in existing literature, some empirical evidence on the direct connection between enviropreneurship and green innovation does exist For instance; frugal innovation is the outcome of, leadership and knowledge management practices, empowering leadership, transformational versus sustainable leadership. Green innovation is the outcome of, ESG performance, extreme weather events, strategic interaction of environmental regulation, and green productivity. However, there is a no inclusive study that integrated enviropreneurship with both frugal innovation and green innovation for achieving environmental performance. There is no comprehensive model of enviropreneurship with frugal innovation and green innovation. This research fills the gap through comprehensive model of enviropreneurship. Consequently, this area represents an emerging and underexplored facet in the field, necessitating thorough empirical investigation to elucidate the intricate relationship between enviropreneurship and both green and frugal innovation.

The primary objective of this study is to address this research gap and contribute empirical insights to this evolving area of inquiry. It is evident that contemporary organizations strive to achieve green and frugal innovation by incorporating corporate-level practices that align with social, economic, and environmental objectives (Endres, Bican, and Wöllner 2022). H6 and H7 consider zero waste management as a mediator. In this paper, the original approach of zero waste practices has raised, highlighting the combination of ecologically practices as a necessary facet in decision-making process (Sun and Wang 2021). While past studies have explored the fact that organizations attain sustainable enhancements for green and frugal innovation through zero waste actions, there is still the need to understand the outcomes of zero waste practices (López-Sánchez and Santos-Vijande 2022; Ismail 2023).

The lack of systematic research into concurrent relationships among enviropreneurship, frugal innovation, green innovation, and zero waste management is an area that requires attention. With CSR becoming more and more important, and companies having to implement sustainable practices (Zhang et al. 2022), the present research has important ramifications for academia and business. The results could offer a theoretical framework for the incorporation of innovation, waste management, and enviropreneurship into organizational strategies if the hypotheses are validated. Furthermore, the research can offer useful information for companies looking to balance environmental responsibility with creative problem-solving. This research provides a timely and essential investigation onto the potentially transformative impact of entrepreneurial approaches on frugal and green innovation, mediated through efficient waste management strategies, as concerns about the environment continue to shape the business landscape.

This research paper is structured into distinct sections. The initial part encompasses the introduction, serving as the opening segment. The second section constitutes a comprehensive literature review that explores the interconnections among frugal innovation, green innovation, and zero waste management, tracing their origins and relationships with enviropreneurship. The third segment outlines the methodology, elucidating various techniques employed to attain enviropreneurship. The analysis section delineates the pivotal aspects highlighted in the article. The ensuing discussion section compares the current findings with previous research within the same domain. The final section encompasses references relevant to the article, providing a comprehensive bibliography.

2 | Literature Review

2.1 | Theory of Circular Economy

The circular economy theory was proposed in 2002 by William McDonough and Michael Braungart to elucidate in what way an enterprise can develop a system through which product and resources can be used for long as possible and with the help of reuse and recycling reduce waste to become ecological (Abbate, Centobelli, and Cerchione 2023). This theory is vastly related to this research model as it focuses on an enterprise's aptitude towards developing green strategies to discourse quickly shifting environmental issues. From the perspective of this research, enviropreneurship and zero waste management can be interpreted as a crucial sustainable green practices and resource efficiency that supports an enterprise to obtain, practice, and use approaches to craft products/services that reduce waste that is, zero waste management, efficiently for boosting frugal and green innovation. Similarly, zero waste management, as supported by enviropreneurship line up with the awareness about the environmental demands of various stakeholders (customers, suppliers, and regularity authorities), and likewise, zero waste management replicates an enterprise capability to leverage green practices (recyclability, longevity, resource consumption, and reducing waste), a vital component of the frugal and green innovation practices. The enviropreneurship, an alternative pivotal notion in the circular economy theory, functions as an ecological aspect that boosts an enterprise's capability to adjust its policies in line with exterior changes, thereby strengthening relationships amid zero waste management, frugal innovation, and the green innovation. The circular economy model offers a resilient theoretical lens with which the interaction of these constructs may be implicit, enlightening the significance of ecological stance and resource reconfiguration and efficiency within determining sustained innovativeness (Awan et al. 2022).

2.2 | Enviropreneurship and Frugal Innovation

Enviropreneurship, also referred to as ecological enterprise, involves the process of establishing and managing businesses with a primary focus on addressing environmental issues, promoting sustainability, and yielding positive environmental outcomes (Regmi, Zhang, and Zhang 2023). Enviropreneurship entails the undertaking and governance of enterprises with a dedicated emphasis on ecological sustainability and social responsibility (Takacs, Brunner, and Frankenberger 2022). Enviropreneur identify and seize opportunities to introduce new ideas, products, services, or mechanisms that address environmental challenges, mitigate environmental impact, and promote sustainable development (Centobelli, Cerchione, and Esposito 2019; Cuevas-Vargas and Parga-Montoya 2022; Abdulnabi et al. 2022).

On the other hand, frugal innovation indicates the process of creating new products/services/procedures that are cost-effective and available for a wider number of individuals, predominantly in emerging marketplace (Cuevas-Vargas and Parga-Montoya 2022; Endres, Bican, and Wöllner 2022). Frugal innovation usually involves reconsidering design and manufacturing processes to decrease expenditures, waste, and energy consumption (Abdulnabi et al. 2022; Takacs, Brunner, and Frankenberger 2022). Ur Rehman et al. (2024) documented that enviropreneurship can boost frugal innovation by facing societal/environmental problems. According to Moleka et al., (2024), enviropreneurs develop sustainable items that decrease waste, preserve resources, and solve environmental issues, thus frugal innovation can help to maximize value with restricted resources by detecting innovative and cost-effective techniques to address different kind of matters. Therefore, we suggest that:

H1. *Enviropreneurship has positive connection with frugal innovation.*

2.3 | Enviropreneurship and Green Innovation

Enviropreneurship focuses on the development of a new approach to entrepreneurship with a focus on setting the bases for environmentally sustainable solutions (Nassani et al. 2023; Albhirat et al. 2024). Entrepreneurs in this field do their best to identify sustainable market opportunities, to contribute to solve environmental degradation and to develop new goods/processes/services that alleviate environmental damage while making profits (Mathushan and Pushpanathan 2020). Zhang et al. (2022) argued that enviropreneurship is strictly linked to green innovation. In fact, green innovation aims to cut the undesirable effects of human actions on the environment and endorse sustainable tactics (Thoo et al. 2014; Burki 2018). Researcher in the field of environmental management posits that enviropreneurship nurtures an attitude of environmental protection and arouses economic advance by allying entrepreneurial notions with sustainability, in so doing it also boosts green innovations (Takacs, Brunner, and Frankenberger 2022; Nassani et al. 2023). The association between enviropreneurship and green innovation stems from their joint objectives of setting solutions to environmental matters (Abanyam et al. 2023). Therefore, the current study suggests that:

H2. *Enviropreneurship has positive connection with green innovation.*

2.4 | Enviropreneurship and Zero Waste Management

Zero waste management is a new managerial approach applied to craft products/services that reduce waste, while, concomitantly, improving natural resource effectiveness and supporting sustainable practice (Mostaghimi and Behnamian 2023; Sarangi et al. 2023). Zero waste management points out the significant role played by responsible producers, as it implies that manufactures and other stakeholders bear the whole responsibility of the lifecycle of products (Lenczuk; Ahmed et al. 2023). Researchers, for example, Abdulnabi et al. (2022) and Sajid, Zakkariya, and Ertz (2024) empirically found that zero waste management is linked with enviropreneurship, but it also pays huge attention on devising innovative solutions to minimize waste and to spread sustainable practices. Enviropreneurs lead zero waste management by fostering new techniques, business approaches, or processes that update waste reduction and recycling practices (Antolin-Lopez, Martinez-del-Rio, and Cespedes-Lorente 2019; Hamada et al. 2023). Enviropreneurship is aimed at creating

services/products with positive environmental effects, attainable through the production of goods created using waste materials. Ye et al. (2020) and Yang et al. (2023), documented that zero-waste management through envirepreneurship focuses on rethinking, recycling and reusing products. Therefore, we suggest that:

H3. *Envirepreneurship has positive connection with zero waste management.*

2.5 | Zero Waste Management and Frugal Innovation

Zero waste management aims to decrease waste by rethinking services/products and processes through the application of principles that endorse reuse, redesign, and waste reduction (Arora et al. 2020; Ebolor, Agarwal, and Brem 2022). Yang et al. (2023) argued that the positive relation between zero waste management and frugal innovation is manifest as frugal innovators support the principles of zero waste management in creating their products. Zero waste management influences green innovation, while saving resources, decreasing waste, and promoting sustainability (Peters and Samarasinghe 2021; Salam et al. 2022). It has a role in the advancement of frugal innovation, trying to reach "more" with fewer raw materials and natural resources (Sajid, Zakkariya, and Ertz 2024). Moreover, zero waste management raises the need of rethinking and recycling resources instead of disposing of them. This approach can encourage frugal innovation to discover original uses for waste materials or recycle current goods to increase their life cycle (Hamid, Skinder, and Bhat 2020). This means that zero waste management inspires frugal innovation, where ideas are set to attend resource restraints while experiencing lower costs (Adomako et al. 2024). Therefore, the current study suggests that:

H4. *Zero waste management has positive relationship with frugal innovation.*

2.6 | Zero Waste Management and Green Innovation

Zero waste management promotes green innovation, where companies adopt the doctrines of zero waste, often guiding the creation and application of innovative solutions that endorse sustainability (Jayaraman, Jayashree, and Dorasamy 2023). Moreover, it presents the framework that fosters the growth of inventive practices and techniques aligning with ecological sustainability. The primary focus of zero waste management is to reduce waste generation and promote resource efficiency by maximizing the utilization of assets and minimizing their disposal, thereby stimulating green innovation (Afum et al. 2022; Zhang et al. 2022). Additionally, zero waste management induces green innovation by establishing a framework that emphasizes resource optimization, circular economy principles, collaboration, and technological development (Mathushan and Pushpanathan 2020). Green innovation encourages businesses to think innovatively, develop sustainable products and processes, and foster collaborations to drive positive environmental change (Maitlo et al. 2022; Yang et al. 2023; Sajid, Zakkariya, and Ertz 2024). This means that zero waste management helps the spread of frugal innovation, lowering waste, stimulating recycling, supporting shared solutions, and sustaining the community wellbeing. Therefore, we suggest that:

H5. *Zero waste management has positive relationship with green innovation.*

2.7 | Zero Waste Management Mediates the Relation Between Envirepreneurship and Frugal Innovation

Envirepreneurship encourages organizations to produce eco-friendly goods, in this manner it is also possible to reduce waste and promote frugal innovation (Endres, Bican, and Wöllner 2022; Jayaraman, Jayashree, and Dorasamy 2023). Starting these premises, the cost reduction offers a chance for companies to further develop frugal innovation strategies that pay attention to environmental matters (Afum et al. 2022; Sirohi 2023). Firms put into practice zero waste strategies and tactics (i.e., waste reduction, composting, and remanufacturing) to reduce costs linked to waste removal and waste management (Endres, Bican, and Wöllner 2022; Ali and Shirazi 2023; Oluleye et al. 2023).

Envirepreneurship boosts resource effectiveness by encouraging waste reduction as part of a wider innovative approach, supporting circular economy pillars, nurturing collaboration among stakeholders, and recognizing market chances that arouse frugal innovation (Adomako et al. 2024; Ali and Shirazi 2023; Sarangi et al. 2023). Envirepreneurship accentuates the rise of organizations that follows ecological sustainability and social responsibility, while frugal innovation is set to create products/services at a low cost, making them reasonably priced and employing minimal amount of resources (Ebolor, Agarwal, and Brem 2022; Ahmed et al. 2023; Ali and Shirazi 2023). Therefore, we formulated that:

H6. *Zero waste management serves as a mediator in the relationship between envirepreneurship and frugal innovation.*

2.8 | Zero Waste Management Mediates the Relation Between Envirepreneurship and Green Innovation

Nowadays, the concepts of envirepreneurship, green innovation, and zero waste management play central roles in promoting sustainability (Thoo et al. 2014). The bond between these items is constantly growing. For this reason, the paper investigates the mediating role of zero waste management between envirepreneurship and green innovation. Envirepreneurship gives precedence to ecological enterprise, while green innovation aims at attaining environmentally friendly methods (Abanyam et al. 2023). The hypothesis suggests that zero waste management can be considered a catalyst, strengthening envirepreneurship and green innovation connection. Green innovation involves the development and implementation of novel goods/services/practices, based on ecological sustainability (Ebolor, Agarwal, and Brem 2022; Jayaraman, Jayashree, and Dorasamy 2023).

The link between enviropreneurship and green innovation is accelerated by zero waste management, considered as a conduit that encourages organizations to search for innovative strategies such as recycling, reuse, minimizing waste and efficient use of resources, aimed to reach environmental and economic objectives (Agrawal et al. 2024). In line with Zhang et al. (2022) and Singh, Singh, and Kumar (2020), zero waste management reflects the enviropreneurship and green innovation approach, sustaining the development of solutions that are both ecologically sustainable and economically viable.

Enviropreneurship, based focuses on the development of a novel approaches to entrepreneurship with a focus on setting the bases for environmentally sustainable solutions, completes the scope of green innovation, which attempts to attain products/services with low environmental impact (Kun 2022). Zero waste management can connect these two approaches, while sustaining the recycling and reuse of waste materials (Zaman and Lehmann 2013). Therefore, the current study formulated that:

H7. *Zero waste management mediates the relationship between enviropreneurship and green innovation.*

2.9 | Theoretical Framework

Figure 1 presents the relationship between study constructs. In the current study we used enviropreneurship as independent variables. Zero waste management is used as a mediating variable between enviropreneurship and frugal and green innovation. Direct and indirect association between independent, mediator and dependent variables are explained in Figure 1.

3 | Methodology

To achieve the study objectives, we use cross sectional design, mostly applied as a research methodology for collection and analyzing data at one specific point. Cross sectional design allows for the examination of associations among study variables without controlling the variables or environment (Creswell and Creswell 2018). As the current study is descriptive in nature, cross sectional design is feasible for both analytical and descriptive (Cohen 1988).

Structural Equation Modeling (SEM) method was use as a statistical tool and to test the study hypotheses. SEM allows the researcher to test theoretical research model with multiple constructs with the complex associations and pathways (Hair et al. 2014). To estimate the multiple association among variables and gain holistic view of collected information, SEM techniques is preferred over traditional regression (Creswell and Creswell 2018). In addition, a correlation analysis was performed to verify the association between the studies constructs. Regardless of the degree to which one variable depended on another and the nature of the association between components in a one-to-one arrangement, the value of the coefficient of correlations determined both. Following the direction confirmation, we carried out a SEM analysis to determine the degree and importance of a variable's dependence on another.

3.1 | Sampling and Data Collection

In the context of our research, we engaged with the Ministry of Chamber of Commerce to articulate our research objectives and secure permission for data collection. The target participants were front-line managers in manufacturing businesses, each possessing a minimum of 3 years of experience. The Ministry provided a comprehensive list comprising 1160 front-line managers, inclusive of their names, mailing addresses, email addresses, and designations. Employing a systematic random sampling approach, we selected every third respondent from this list. Striving to protect the privacy of our participants, we ensured the confidentiality of the information shared during data collection. Utilizing Google Docs, we conducted online surveys in two phases, T1 and T2, with a two-week temporal interval to mitigate common method bias. Survey links were dispatched to the selected respondents via email between January and April 2023. The questionnaire, presented in English for clarity, covered various constructs. During the first wave (T1), 387 respondents were surveyed, yielding 312 useable responses at a response rate of 80.62%. Following a two-week interval, the

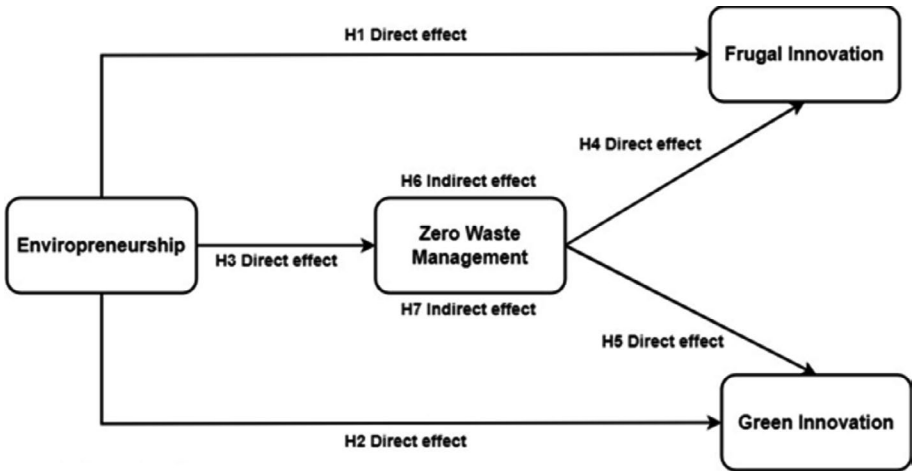

FIGURE 1 | Theoretical framework.

second wave (T2) commenced, with the same 312 respondents targeted. In T2, participants were specifically requested to assess the zero-waste management and innovation practices of respective organizations. Ultimately, 289 responses were deemed complete and included in the final analysis.

3.2 | Measurement

Distinct items were modified from earlier studies so as to determine the study variables, for example enviropreneurship (the factor that is dependent), zero waste management (the mediator), and frugal and green innovation (the independent two). Using a five-item scale that ranges from 1 = highly agrees to 5 = highly disagree; each item's strength was assessed.

3.2.1 | Enviropreneurship

A five-item scale that was modified from Menguc and Ozanne's work was used to measure enviropreneurship as an independent variable. The assessment of the incorporation of sustainable development into entrepreneurial activities, including eco-friendly practices, corporate social responsibility, and environmental orientation, is a key component of enviropreneurship measurement. The instance thing is "Our organization has a high rate of environmentally friendly product introductions."

3.2.2 | Zero Waste Management

We employed seven items from the study survey to get respondents' opinions on the development of zero waste practices. The scale with seven items was modified from Zaman. Evaluating the effectiveness of recycling programs, waste reduction techniques, and efficient utilization of resources within organizational procedures are all part of measuring zero waste management. The question item is "our firm use technologies that prevent waste and environmental pollution."

3.2.3 | Green Innovation

GI was assessed using a 5-item green innovation scale that was modified from (El-Kassar and Singh 2019). This construct assessed the degree to which innovative green policies and practices helped businesses achieve GI. "In our firm, we used cutting-edge technology to preserve waste, gas, and water," is an example item.

3.2.4 | Frugal Innovation

The 10-item scale used to measure frugal innovation was taken from Haffar et al. (2021). Evaluating how much resource- and money-efficient methods and solutions are integrated into organizational and product development processes is part of measuring frugal innovation. "Our firm regularly focuses on basic functionality more enthusiastically compared to different additional functions" is the example question.

4 | Results

4.1 | Confirmatory Factor Analysis (CFA)

CFA was used to investigate the alteration of the study constructs, such as enviropreneurship, zero waste management, frugal innovation and green innovation. This study hypotheses, that is, four-factor model and demonstrate keys such as $\chi^2 = 1024.68$, df = 459, $\chi^2/df = 2.22$, CFI = 0.95, GFI = 0.96, RMSEA = 0.05, displayed the general model competency in Table 1. All values were significant and met the threshold level.

4.2 | Discriminant and Convergent Validity

Table 2 presents the outcomes of the convergent and discriminant validity. Discriminant validity was assessed with the heterotrait-monotrait (HTMT) ration and AVE. The findings shows that the factor loading value was greater than 0.70, whereas the average variance extracted was higher than 0.50. In addition, the CL was higher than 0.60, and the outcomes of the Cronbach alpha were greater than 0.70.

4.3 | Correlation

The Table 3 indicates the outcomes of the SD, mean, and correlation matrix. Table 3 contained the results of correlation among study variables. The findings revealed that enviropreneurship

TABLE 1 | Confirmatory factor analysis.

Model detail	$\chi 2$	df	$\chi 2/df$	RMESA	GFI	CFI
Four-factor model	1378.54	654	2.11	0.04	0.91	0.92
Three-factor model	1254.12	352	3.56	0.08	0.87	0.86
Two-factor model	1456.76	381	3.82	0.07	0.79	0.78
One-factor model	1489.21	360	4.14	0.06	0.65	0.66

TABLE 2 | Convergent and discriminant validity.

Details	Alpha	CR	AVE	F loading
Digital platforms	0.93	0.94	0.77	0.71–0.89
E-knowledge	0.94	0.95	0.72	0.70–0.88
AI adoption	0.85	0.90	0.69	0.71–0.86
BDAC	0.93	0.94	0.66	0.69–0.85
Strategic flexibility	0.91	0.94	0.84	0.73–0.87
Organizational innovativeness	0.96	0.97	0.85	0.72–0.83

TABLE 3 | Correlation.

Construct details		Mean	SD	1	2	3	4
1	Enviropreneurship	3.11	0.75	1.00			
2	Zero waste management	1.75	0.83	0.21	1.00		
3	Frugal innovation	3.68	0.79	0.19	0.23	1.00	
4	Green innovation	3.20	0.81	0.23	0.38	0.12	1.00

TABLE 4 | Direct effect.

Details		Beta	*F*	*t*-value	*p*	Remarks
H1	Enviropreneurship ➔ Frugal innovation	0.19**	11.341	6.511	0.000	Accepted
H2	Enviropreneurship ➔ Green innovation	0.32**	14.119	8.923	0.000	Accepted
H3	Enviropreneurship ➔ Zero waste management	0.26**	18.142	9.143	0.000	Accepted
H3	Zero waste management ➔ Frugal innovation	0.22**	16.182	9.123	0.000	Accepted
H4	Zero waste management ➔ Green innovation	0.28**	19.361	10.821	0.000	Accepted

**sig $p = 0.000$.

TABLE 5 | Indirect effect of E-knowledge.

Model description	Data	Boot	SE	L.V	U.V	Sig
Enviropreneurship➔Zero waste management ➔Frugal innovation	0.22	0.23	0.09	0.2891	0.2922	0.000
Enviropreneurship➔Zero waste management ➔Green innovation	0.31	0.32	0.13	0.2081	0.2103	0.000

have significant direction towards zero waste management (0.21**), frugal innovation (0.19*), and green innovation (0.23**). Moreover, the findings also revealed that zero waste management have significant direction towards frugal innovation (0.23**) and green innovation (0.38*).

4.4 | Hypothesis Testing

The SEM (structural-equation modeling) were utilized to examine the direct impacts of the enviropreneurship on frugal innovation, H1 were accepted ($\beta = 0.19$, $p < 0.000$). Correspondingly, enviropreneurship was significantly linked with the green innovation ($\beta = 0.32$, $p < 0.000$), thereby the H2 was accepted. The findings also revealed positive direct association between enviropreneurship and zero waste management ($\beta = 0.26$, $p < 0.000$), therefore we accept study H3. Moreover, zero waste management also significantly predict frugal innovation ($\beta = 0.22$, $p < 0.000$) and green innovation ($\beta = 0.28$, $p < 0.000$), thereby the H4 and H5 were accepted (Table 4).

4.5 | Outcomes of the Mediation Role of Zero Waste Management

Zero waste management intermediates amid enviropreneurship and frugal innovation (Enviropreneurship➔Zero waste management➔Frugal innovation). Using preacher and Hayes analysis process outcomes are demonstrated analytically. The results confirm that indirect impacts of the zero waste management enviropreneurship and frugal innovation $\beta = 0.22$, $L = 0.2891$ to $U = 0.2922$. Outcomes also showed that zero waste management positively mediate between enviropreneurship and green innovation ($\beta = 0.31$, $L = 0.2081$ to $U = 0.2103$) (Table 5).

5 | Discussion

The positive correlations between frugal innovation, green innovation, zero waste management, and enviropreneurship that are postulated in H1 through H5 suggest harmonious relationships. In addition to encouraging affordable solutions, environmentally conscious entrepreneurs are expected to make major contributions to ecological technologies, waste-reduction, and resource efficiency. A thorough discussion can be used to examine the connections among enviropreneurship, frugal innovation, green innovation, and zero waste management. This research makes an "enviropreneurship Model" based on seven hypotheses. Though, H1 suggests that there is a beneficial correlation between frugal innovation and enviropreneurship. This hypothesis examines the possible connection between frugal innovation and enviropreneurship. A positive correlation would imply that environmentally conscious entrepreneurs are more likely to take part in initiatives that result in the development of affordable solutions. Moreover, H2 proposes a correlation between enviropreneurship and green innovation. This hypothesis investigates the relationship between green innovation and enviropreneurship. A positive correlation would suggest that the awareness and

adoption of green technologies and practices are greatly aided by entrepreneurs who place a high priority on environmental sustainability. Nevertheless, this research H3 explores that the enviropreneurship and zero waste management is directly linked. This hypothesis investigates the connection between zero waste management and enviropreneurship. An affirmative correlation would imply that business owners with an environmental focus actively participate in waste reduction and sustainable waste management initiatives.

Additionally, this study H4 explores a positive correlation between frugal innovation and zero waste management. This hypothesis glances into the possible connection between frugal innovation and zero waste management. A strong correlation would suggest that frugal innovation's resource conscious tenets and effective waste management techniques are compatible. Businesses that incorporate environmental concerns into their entrepreneurial practices tend to show a positive association with both frugal and green innovation, according to previous research by (Arora et al. 2020; Ebolor, Agarwal, and Brem 2022; Peters and Samarasinghe 2021; and Salam et al. 2022). Regarding H5 exposes that there is a beneficial correlation between green innovation and zero waste management. This hypothesis investigates the relationship between green innovation and zero waste management. The objectives of green innovation would be supported by a positive correlation showing that zero waste practices support environmentally friendly processes.

Furthermore, H6 shows that the relationship between frugal innovation and enviropreneurship get mediated by zero waste management. The hypothesis posits that frugal innovation and enviropreneurship are mediated by zero waste management. A favorable outcome would suggest that business owners who prioritize the environment could apply zero waste techniques to improve the creation of affordable solutions in the form of frugal innovation. Furthermore, research has demonstrated that sustainable innovation is facilitated by efficient waste management techniques. H6 and H7, the suggested mediation relationships, support the idea that zero waste management serves as an intermediary between environmental entrepreneurs and the creation of creative, affordable solutions.

This research investigates how zero waste management functions as a mediator between frugal and green innovation. A positive outcome would imply that environmentally conscious product development and economical solutions are closely linked through sustainable waste management practices, supporting a comprehensive and effective approach to innovation. The current study provides a thorough examination of the relationships between enviropreneurship, zero waste management, and different aspects of innovation, building upon and adding to the body of existing knowledge and theory of circular economy.

5.1 | Theoretical Implications

The study has three theoretical ramifications. First, the current study formulated a comprehensive model and incorporated enviropreneurship, zero waste management, frugal innovation, and green innovation as a primary constructs. Second, the positive correlations suggested from hypotheses H1–H5 highlight the interdependence of green innovation, frugal innovation, environmental entrepreneurship, and zero waste management. Based on theories such as resource-based theory, sustainable theory of modernization, and the "circular economy" theory, the study proposes that environmentally conscious entrepreneurs are more likely to effectively utilize resources, adjust to ecological issues to gain a competitive edge, and actively participate in practices that minimize waste. These ramifications highlight how entrepreneurial strategies should incorporate environmental considerations to promote environmentally conscious and economically viable innovation.

Finally, zero waste management has been identified as a mediator between frugal innovation, green innovation, and environmental entrepreneurship in the research's mediating hypotheses (H6 and H7). The implications of theory herein are consistent with the theories of innovation diffusion, circular economy and dynamic capabilities. It is hypothesized that zero waste management mediates the relationship between frugal innovation and green innovation as well as between environmental entrepreneurship and economical creativity. This highlights that companies that manage waste responsibly can boost their capacity of change, which can involve the creation of new approaches to find a balance between the environment, human well-being and the profit.

5.2 | Managerial Implications

Considering the managerial implication of this study, first of all, the correlations that have been found to be positive among environmental entrepreneurship, zero waste management, and ecological innovation, show the benefits that can arise from sustainable green practices. This supports the notion that innovative and competitive business practices can be fostered by sustainable green business practices. Therefore, management should invest in systems and procedures that increase resource efficiency and lessen their environmental impact at the same time, creating a situation where both ecological and economic objectives are met.

Second, the findings reveal that implementing green practices, for example, zero waste strategies enable and encourage management for the optimum utilization of resources, which can direct for innovation in processes and product design. Moreover, management should focus on formulating and implementing zero waste strategies (recycling, reuse, and zero waste material) for the improvement of operational processes, to gain frugal. Third, positive connection between zero waste management and green innovation promotes a green-oriented culture. Management should focus on providing training about green practices to foster this culture.

Finally, the mediation role that zero-waste management suggests that environmentally conscious entrepreneurship and frugal and innovative green ideas are linked through effective waste practices. The practical implications resulting from this demonstrate that companies should give thorough reduction of waste and management strategies the greatest importance so as to foster an innovative environment. Together, businesspeople

and legislators can create and carry out programs that encourage environmentally friendly waste management, potentially with the help of financial incentives and legal restrictions. Additionally, companies should look into joint ventures and partnerships that encourage the sharing of creative concepts and methods, supporting a circular economy. The research's real-world consequences essentially promote a paradigm shift to the direction of sustainable entrepreneurial spirit, where waste management plays a key role in promoting creative and ecologically responsible business practices.

5.3 | Limitations and Future Directions

There are a few important limitations to be aware of, even though this study sheds light on the relationships between green innovation, frugal innovation, environmental entrepreneurship, and zero waste management. The majority of the data used in the research comes from surveys, which may be biased by respondents' answers and may not accurately reflect the nuances of organizational procedures. Furthermore, the study's cross-sectional design makes it more difficult to prove causation. To further explore the dynamics examined in this study, longitudinal approaches and qualitative techniques could be used in future research.

Furthermore, the study's emphasis on a particular sector or area might restrict how broadly the results can be applied. For example, to strengthen the external reliability of the findings, future research projects ought to investigate a variety of industries and geographical settings. Regarding future directions, scholars are urged to investigate the intricate mechanisms that underlie the suggested mediation effects and consider the interactions between environmental entrepreneurship and innovation and particular waste management techniques. Moreover, studies of interventions and policies that support the incorporation of environmentally friendly procedures through entrepreneurial endeavors could yield practical knowledge for companies and legislators who want to promote environmental and economic goals.

6 | Conclusion

To sum up, this research clarifies the complex connections among frugal innovation, green innovation, environmental entrepreneurship, and zero waste management. The findings revealed that enviropreneurship significantly influence the zero waste management, frugal, and green innovation in a positive way. Furthermore, the results confirmed that zero waste management also positively predicts the frugal and green innovation mechanism of organizations. Finally, the outcomes of SEM techniques confirmed that enviropreneurship positively predict frugal and green innovation in the presence of zero waste management.

The advantageous correlations emphasized the possible advantages of incorporating eco-friendly practices into entrepreneurial tactics, promoting economical resolutions and eco-friendly inventions. Sustainable waste management techniques could act as a catalyst to connect ecological business with innovative aspects, according to the intermediary significance of zero waste management. The findings have practical significance for entrepreneurs and policymakers who aim to navigate the nexus between ecological responsibility and innovation in the entrepreneurial landscape, as businesses increasingly acknowledge the importance of sustainability.

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