

Connecting women's empowerment and environmental sustainability: A review



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Abstract This literature review critically examines the intersection of women's empowerment, environmental sustainability, and waste management, exploring how women's roles in the waste sector are both a source of vulnerability and a potential avenue for ground breaking transformation. Women, particularly in marginalized communities, often face heightened risks due to environmental degradation, including exposure to harmful waste and inadequate waste management systems, which exacerbates their socio economic and health burdens. The review highlights the link between women and the environment, drawing attention to how their roles in waste management, often unrecognized and undervalued, contribute significantly to environmental sustainability. Drawing on global examples, it illustrates how women's participation in waste management initiatives—through cooperatives, self-help groups, and grassroots environmental movements—has improved their financial stability, social status, and access to basic services like education and health insurance. For instance, the case of women waste-pickers in India demonstrates how collective action, through organizations like the Kagad Kach Patra Kashtakari Panchayat has led to legal recognition, better working conditions, and improved livelihoods. However, the review also underscores persistent barriers faced by women, including gender-based discrimination, stigmatization, and the undervaluation of their labor. Despite these challenges, the review argues that integrating gender-responsive policies and recognizing women as key stakeholders in waste management and environmental policy-making is crucial for fostering sustainable development. It concludes by emphasizing that the full empowerment of women, particularly in the context of waste management, is imperative for achieving broader environmental sustainability and social equity, positioning women as vital force of change in addressing global environmental challenges.

Keywords: gender, environment, waste management, sustainable development

1. Introduction

The past several decades have seen significant changes in the historical evolution of women's involvement in environmental stewardship. Over time, our understanding of women's roles in development and the environment has changed dramatically (Rathgeber, 1990). Early approaches, such as women in development (WID), aimed to increase women's economic status by providing access to resources such as education and credit. While well-intentioned, WID was criticized for its narrow perspective on gender dynamics (Ray, 2007). Building on this evolution, in the early 1970s, a major shift occurred in the development discourse, with an emphasis on analyzing the fundamental causes of development issues and seeking alternative methods to engage with the global community and developing nations. This new approach placed women and the environment at the forefront of development strategies, emphasizing the interdependence of gender equality, environmental sustainability, and development (Mondal, 2022). The Women, Environment, and Development (WED) framework subsequently emerged, underscoring women's unique relationships with the environment. However, WED also faced criticism for oversimplifying women's experiences and essentializing women's ties to nature (Ray, 2007; Leach, 2007). These early perspectives paved the way for the more intricate Gender and Development (GAD) approach, which emerged in the 1980s and 1990s (Miller & Razavi, 1995). GAD involves the complex interplay of gender, class, and ethnicity in shaping women's lives and their interactions with the environment (Miller & Razavi, 1995; Ray, 2007).

The World Women's Congress for a Healthy Planet, held in Miami in 1991, played a pivotal role in creating the "Global Action for Women Toward Sustainable and Equitable Development." This document recommended redefining productivity to prioritize ecological value and life sustainability (Dankelman, 2009). Following this, key events such as the 1992 Rio Earth Summit reinforced women's role in sustainable development, as reflected in Agenda 21 (Grubb et al., 2019). The Rio Conference emphasized the importance of incorporating women into public life by eliminating various societal barriers. The vision statement, "Women, Procreation, and Environment," profoundly energized the ecofeminist movement, drawing the attention of intellectuals and policymakers to these critical issues (Dankelman, 2009). As our understanding has deepened, it has become clear that women's roles in environmental stewardship and sustainable development are molded by complex historical, social, and ecological factors. Gender analysis reveals sophisticated interactions between gender, ecology, and



colonial politics, challenging oversimplified narratives often seen in ecofeminist and WED approaches. The intersection of gender with class, caste, and local ecology creates wide-ranging experience among women in their environmental relationships. Gendered access to property rights and resources significantly impacts women's involvement in environmental management. Colonial policies further shaped these dynamics in various contexts. (Leach & Green, 1997). The study of gender in environmental history reveals the complex and evolving roles that women have played in shaping environmental attitudes, policies, and activism. From early conservation efforts to modern environmental justice movements, women's contributions have been significant yet often overlooked. Gender analysis sheds light on how prescribed roles, cultural norms, and societal expectations both empowered and constrained women's environmental engagement (Unger, 2014). This approach challenges simplistic ecofeminist narratives, instead emphasizing the need to reflect on the intersections of gender with race, class, and ethnicity. Contributing to this evolving understanding, Carolyn Merchant argues for including gender analysis in environmental history. She suggested adding a fourth level, reproduction, to Donald Worster's framework of ecology, production, and cognition. Merchant emphasized how gender roles have shaped human interactions with nature throughout history, from indigenous societies to industrial capitalism, affecting both the environmental impact and the power dynamics between sexes (Merchant, 1990). Intersectional approaches, which acknowledge the varied viewpoints of women across various social, economic, and cultural contexts, have gained prominence more recently. This trend exemplifies the growing awareness that women are active agents of change in terms of environmental conservation and sustainable development globally, in addition to being affected by environmental degradation (Kaijser & Kronsell, 2014). By examining women's diverse experiences across different historical and cultural contexts, we gain a more nuanced understanding of the gendered dimensions of human-environment interactions, which are vital for addressing current environmental challenges (Unger, 2014). This comprehensive approach allows us to consider broader social, economic, and political contexts, and gain a nuanced understanding of women's agency and contributions to ecological preservation, revealing both constraints and instances of innovation in response to changing conditions (Leach & Green, 1997).

This review provides a critical analysis of women's multifaceted roles in environmental sustainability, examining their contributions across various domains, including agriculture, entrepreneurship, environmental management, and biodiversity conservation. It also explores women's cultural and scientific contributions, as well as the influence of societal norms on their environmental attitudes and behaviors. Special attention is given to women's involvement in waste management, a sector that presents both significant challenges and opportunities for empowerment and sustainable development. By synthesizing various research findings, this review offers an in-depth understanding of the complex and evolving relationship between women and environmental stewardship. It aims to contribute to the growing body of literature on gender and the environment by providing a nuanced analysis of the gendered dimensions of human-environment interactions. As global environmental challenges continue to escalate, recognizing and leveraging women's unique contributions to sustainability have become increasingly essential.

To identify relevant literature this review utilized databases such as Google Scholar and Scopus. A comprehensive set of keywords was employed to capture diverse perspectives, including "women and the environment," "women in biodiversity conservation," "women in waste management" etc. The majority of the studies included in this review are highly cited, ensuring the incorporation of authoritative and impactful research. This paper adopts a narrative review approach rather than a systematic review. The narrative approach was chosen to allow flexibility in synthesizing insights from both qualitative and quantitative studies.

2. Women as Catalysts for Environmental Sustainability

Women and men approach environmental protection problems differently, and are influenced by social customs, adopted values, the social environment, ethical guidelines, and societal stereotypes. Women often initiate waste management activities within households and play a significant role in shaping environmental awareness and the ecological culture of younger generations (Nikolic & Stojanovic, 2014; Obadina, 2016). This difference in approach is not merely a matter of personal preference but is deeply rooted in societal roles and experiences. Women's traditional responsibilities in many cultures, such as managing household resources and caring for family health, often lead to a more intimate understanding of local environmental issues. In addition to their domestic responsibilities, women are at the forefront of natural resource management and conservation efforts. Their in-depth knowledge of local ecosystems, rooted in daily interactions with the environment, provides valuable insights for conservation and sustainable resource management (Churchman, 2000; Tyagi, 2020). This hands-on experience with natural resources often translates into a unique perspective on environmental management. According to various studies, women's roles in agriculture, water collection, and forest product collection in many parts of the world give them firsthand knowledge of environmental changes and challenges (Agarwal, 1997; Agarwal, 2009; Njiriri, 2013). In the field of biodiversity, many examples demonstrate women's knowledge of regional ecosystems, their adherence to various conservation methods, and their willingness to protect species. Throughout the world, indigenous women appear to be the guardians of local biodiversity. Moreover, the regular contact of women with their surroundings shows the symbiotic connection that occurs between the ecosphere (the physical environment) and the sociosphere (the social environment) (Dankelman, 2009).

Upon closer inspection of the seemingly neutral relationship between human society and the physical environment, it becomes apparent that there is a bias present because sociocultural constructs differentiate between the experiences of women and men, resulting in distinctive connections between each gender and the environment. Male respondents' attitudes toward policy shape their lifestyles, but female respondents' pro-environmental behaviors are guided by societal norms and lifestyles (Wut et al., 2021). These findings suggest that a more sophisticated understanding of how gender shapes environmental interactions and perceptions is necessary. This insight is crucial for developing gender-sensitive environmental policies. Recognizing that environmental issues affect and are perceived differently by men and women allows for more targeted and effective interventions.

3. Overcoming Barriers to Women's Participation

Although women offer unique perspectives and potential contributions, they encounter numerous hurdles that hinder their full participation in environmental initiatives and decision-making processes (Balabantaray, 2023). Addressing these barriers is crucial for harnessing the full potential of women's involvement in environmental sustainability. Women are often the first to feel the impact of environmental destruction and are frequently enthusiastic about participating in projects aimed at enhancing living standards. However, they face numerous barriers to full engagement, including cultural practices, religious regulations, social institutions, literacy challenges, and heavy domestic workloads (Vineeshiya & Mahees, 2016). These barriers not only limit women's personal development but also deprive society of critical insights and contributions to environmental management. Overcoming these obstacles requires a multidimensional approach that addresses both practical and systemic issues. In addition to social barriers, women's knowledge and adoption of sustainable practices can be limited by factors such as lack of awareness, financial constraints, and technical knowledge gaps. This is clearly evident in areas where women play dominant roles in primary agricultural production (Fakoya et al., 2007). For sustainable practices, targeted education and training programs, as well as initiatives to improve women's access to financial resources and technology, are essential for effectively integrating rural women into technology sectors (Hemson & Peek, 2017).

Historically, women have been excluded from decision-making powers, leading to uneven access to education and diminished authority at various levels. This exclusion not only affects individual women but also impacts entire communities, as valuable perspectives and insights are lost in policy-formulation and community development processes (Mago & Gunwal, 2019). The analysis of these findings indicates that the systemic nature of this exclusion calls for fundamental changes in governance structures and societal attitudes. It is not just about adding women to existing frameworks but about reimagining decision-making processes to be truly inclusive and representative. Mondal (2022) addressed the persistent aspects of gender-based inequality that are embedded in various countries' legal systems and societal norms. The study underscores the necessity of SDG5 as a stand-alone target while also insisting that achieving other SDGs depends on giving women's demands the same priority as men's demand. Therefore, for women to occupy positions of authority, they must better organize themselves (Mondal, 2022). This highlights the interconnected nature of gender equality and sustainable development. This suggests that empowering women is not just a matter of fairness, but also a strategic necessity for achieving broader development goals.

4. Psychological and Economic Empowerment

Beyond just removing hindrances, empowering women for environmental sustainability calls for proactive measures to increase their ability, self-assurance, and financial independence. The ability of women to become successful change agents in the environment is strongly dependent on this multifaceted empowerment (Lawal, Ayoade, & Taiwo, 2016). Women's empowerment is a process that involves creating a discrimination-free environment where they can live with dignity and promote their ability to take charge of their own lives, actively participating in the changes they wish to see in society (Mitten et al., 2018). The UNFPA Guidelines define women's empowerment as encompassing five elements: women's self-worth, ability to make choices, access to opportunities and resources, ability to govern their own lives, and capacity to shape social change. This comprehensive definition highlights the multidimensional nature of empowerment (United Nations Population Fund, 2024). Understanding empowerment in these broad terms helps us appreciate the complexity of the task and the need for holistic approaches that address all aspects of women's lives. According to Kaufman et al. (2001) and Stromquist (2015), psychological empowerment is crucial for women's participation in environmental management. Creating spaces for women to collectively explore and reframe their memories of nature can be transformative in building new relationships with the environment. This approach recognizes that women's empowerment requires action in multiple interconnected dimensions: economic, political, psychological and knowledge/education (Kaufman et al., 2001; Stromquist, 2015). This insight underscores the importance of community-based initiatives and support networks in promoting women's empowerment. This suggests that collective action and shared experiences can be powerful tools for building confidence and agency.

The core indicators of women's empowerment include family structure, marriage benefits, financial independence, self-determination, and engagement in the economy. These indicators provide a framework for assessing progress in women's empowerment across different cultures and contexts (Kabeer, 1999). By identifying these key indicators, we can better target interventions and measure the effectiveness of empowerment initiatives. It also helps in recognizing the interconnected nature

of various aspects of women's lives. For rural women, socioeconomic skill acquisition is essential for sustainable development. It helps women overcome discrimination, disability, and inequality, while providing access to opportunities for self-reliance and equality with men. This holistic process of empowerment consists of decision-making autonomy, self-strengthening, and increasing freedom of choice within an accountable, inclusive, and participatory society (Chakrabarty, 2012; Haruna Ojo Bane, 2022). This point highlights the particular challenges and opportunities for empowerment in rural contexts. It emphasizes the need for skill development programs that are tailored to the specific needs and circumstances of rural women. Research shows that in the realm of entrepreneurship, women are more likely to emphasize social value creation goals and take part in social and environmental entrepreneurial activities than traditional economic entrepreneurship (Hechavarria et al., 2012). This focus on social and environmental outcomes suggests that encouraging women entrepreneurs could lead to more socially and environmentally responsible businesses, further contributing to sustainable development goals. This tendency reflects a broader pattern in which women prioritize holistic, community-oriented approaches in their business projects, often leading to groundbreaking solutions that balance profit with social and environmental responsibility.

5. Women in Leadership and Decision-Making

These widely accepted gender expectations, which are culturally established, might lead to the perception that women are weak and unfit in leadership posts. These perceptions can have a domino effect, leading to women engraining other people's misgivings and doubting their own leadership potential. Women who doubt their ability to carry out jobs that defy their gender standards are often low in confidence since leadership is seen as resting outside of traditional female gender norms (Shinrot et al., 2019). Enhancing women's representation in leadership and decision-making roles is crucial for ensuring that environmental policies and practices are more inclusive and effective in the context of environmental stewardship (Kakade et al., 2024). Women's leadership can provide unique insights in to and approaches to environmental management. Research shows that companies with women as CEOs or chairpersons demonstrate greater commitment to sustainability methods aligned with sustainable development goals, particularly when combined with greater gender diversity in management teams. Women's leadership facilitates companies' transformation towards sustainability by encouraging environmental and social practices through traits such as holistic thinking, coping with complexity, and an inclusive approach to leadership (Pierli et al., 2022; García-Sánchez et al., 2023). This suggests that promoting gender diversity in corporate leadership could be an effective strategy for advancing corporate sustainability practices. Women in top management are associated with key indicators such as the development of eco-friendly products and a commitment to resource minimization. However, their influence tends to be weaker in firms with lower environmental performance and high growth opportunities, suggesting that these firms may adapt to organizational expectations rather than fully leveraging women's leadership on environmental issues (Burkhardt et al., 2020). This nuanced finding highlights the complexities of women's leadership in different organizational contexts. This suggests that while women's leadership can drive sustainability, its effectiveness may be influenced by existing organizational cultures and priorities (Shinbrot et al., 2019). To fully leverage women's potential in environmental leadership, equal weight must be given to women's voices in environmental and climate talks, and they must be supported to actively participate in advocacy group work. The next step is to identify applicable means of including women in the design, development, and enforcement of policies for climate adaptation for a sustainable future (Mukherjee, 2013). This point emphasizes the need for systemic changes to ensure women's meaningful participation in environmental decision-making at all levels. Although stereotypically masculine descriptions are used for leadership, studies reveal that perceptions have shifted toward androgynous leadership styles, where there is an equilibrium of both masculine and feminine characteristics (Kakade et al., 2024).

6. The Importance of Women's Empowerment for Environmental Sustainability

Empowering women is essential for promoting gender equality and environmental sustainability through choice, stewardship, economic development, and the effective utilization of human and capital resources. Addressing the unique challenges women face is crucial for achieving the sustainable development goals, particularly SDG5, which focuses on gender equality (Ghosh et al., 2024). Regardless of women's valuable knowledge and contribution to environmental studies and frameworks, their viewpoint has been systematically oppressed. This marginalization has led to the composition of approaches that are intrinsically gender-blind-failing to recognize the relevance of gender related factors such as socialization, roles, needs, opportunities, and interactions. Gender blindness ignores the multifaceted and distinctive effects of gender on people and their lives, assuming that women and men react to a particular phenomenon in the same manner. To address this problem, women's contributions to environmental research must be accepted and amplified. Integrative strategies that consider a range of viewpoints will help to produce more equal and positive results (Gough, 2013; Forman-Rabinovici & Mandel, 2023). Women continue to make significant contributions to environmental management, even while facing challenges such as childcare responsibilities, financial insecurity, and limited access to resources (Mitten et al., 2018). These barriers often translate into limited opportunities for women to adopt innovative and higher-return practices, as seen in a study conducted in Sub-Saharan Africa, where women are more likely to rely on low-risk, low-return traditional climate-smart agricultural practices. In contrast,

men tend to implement higher-return modern techniques. This gender gap, rooted in unequal access to resources and information, underscores the urgent need to empower women by ensuring equal access to land, knowledge, and decision-making power, thereby increasing their agricultural productivity and resilience to climate change (Boudalia et al., 2024). Similarly, a multitier mining license system for artisanal and small-scale mining has been identified as a way to empower women by providing tailored opportunities for participation, promoting sustainable practices, and advancing gender equality in the sector—addressing the shortcomings of the current one-size-fits-all approach (Arthur-Holmes & Ofosu, 2024).

7. Women's Contributions to Agriculture and Natural Resource Management

Women play a crucial role in agriculture and natural resource management, particularly in developing countries. Their knowledge, practices, and innovations are often at the forefront of sustainable resource use and conservation. In the agricultural sector, women farmers often bring unique perspectives and innovative approaches to sustainable farming practices and waste management. These women are more likely to upcycle waste materials into marketable products, demonstrating their resourcefulness and commitment to sustainability (Unay-Gailhard & Bojnec, 2021). This innovative approach to waste management highlights the potential for women to drive circular economy practices in agriculture. These findings demonstrate how empowering women farmers can lead to more sustainable and economically viable agricultural practices. The World Bank recognized in 1991 that "Women play an essential role in the management of natural resources, including water, soil, forests, and energy, and frequently possess significant traditional and contemporary knowledge of the natural world around them." This recognition of women's environmental knowledge and practices has been growing in international development circles for decades (Mondal, 2022). This finding suggests that tapping into this wealth of traditional and contemporary knowledge could significantly enhance our approach to environmental conservation. Additionally, farms managed by young women are more likely to adopt agro-environment-climate measures (AECMs) than farms managed by young men are, highlighting a stronger environmental consciousness among women farmers (Unay-Gailhard & Bojnec, 2021). This finding shows that promoting women's leadership in agriculture could be an effective strategy for advancing sustainable farming practices. This highlights the potential for women to drive the adoption of climate-smart agricultural techniques.

8. Women's Role in Biodiversity Conservation

Women, particularly indigenous women, often play a crucial role in biodiversity conservation. Their traditional knowledge and practices can provide valuable insights for conservation efforts in the field of biodiversity, and many examples demonstrate women's knowledge of regional ecosystems, their adherence to various conservation methods, and their willingness to protect species. Throughout the world, indigenous women appear to be the guardians of local biodiversity (Dankelman, 2009). This recognition of women as "guardians of local biodiversity" highlights the importance of involving women, especially indigenous women, in biodiversity conservation efforts. This suggests that conservation strategies should actively seek to incorporate women's traditional knowledge and practices. Studies have proven that over time, women have played a vital role in transforming conservation movements into all-encompassing endeavors, championing legislation against pollution, reforestation, and species conservation. Their holistic approach to environmental issues has often led to more comprehensive and effective conservation strategies (Peck, 2021). This holistic approach to conservation reflects women's tendency to consider interconnected environmental, social, and economic factors. This suggests that increasing women's involvement in conservation policy-making could lead to more integrated and effective conservation strategies.

9. Women's Scientific and Cultural Contributions

Women's contributions to environmental sustainability extend beyond traditional roles to include significant scientific and cultural contributions. These contributions enrich our understanding of environmental issues and inspire new approaches to sustainability. In the scientific realm, women in conservation science have revealed a passion for the natural world, readiness for cross-disciplinary cooperation, and a desire to motivate other women to engage in conservation efforts (Schulte, 2009). This collaborative and inclusive approach has the potential to significantly advance the field of conservation science. This collaborative approach in conservation science reflects a broader trend of women promoting interdisciplinary and inclusive scientific practices. This suggests that increasing women's participation in the environmental sciences could foster more collaborative and innovative research approaches. Women's literary voices, particularly in autobiographies and eco-feminist works, have amplified the intricate relationship between gender and the environment (Mishra, 2022). These writings provide valuable insights into how women perceive and interact with their natural surroundings, further enriching our understanding of the gender–environment nexus. These cultural contributions highlight the importance of diverse voices in shaping our understanding of environmental issues and promoting women's voices in environmental discourse can lead to a more nuanced and comprehensive understanding of human–environment relationships.

10. The Economic–Environmental Link

The empowerment of women has significant implications for both economic development and environmental sustainability. Understanding this link is crucial for developing policies that can effectively address both gender inequality and environmental challenges. Women's economic empowerment is closely linked to environmental benefits. As women gain more decision-making power, better education, and access to sustainable practices, they are more likely to engage in green entrepreneurship, advocate for environmental policies, and manage resources efficiently (Achuo et al., 2022). Women often make more eco-conscious consumer choices (D'Souza & Taghian, 2017). Therefore, economic empowerment plays a crucial role in making them financially independent and enabling them to make their own purchasing decisions. Bridging the gender disparity by supporting women's access to resources (land, credit, fertilizers, extension services and other productive inputs) can increase yields by 20–30 percent and decrease the global hungry population by 150 million (Huyer, 2016). Women with economic means are better equipped to adapt to and mitigate the impact of climate change so that empowering women economically is crucial for building climate resilience (Md et al., 2022), and the economic empowerment of women is associated with lower fertility rates, which can reduce pressure on natural resources (Phan, 2013; Maja & Ayano, 2021). However, this positive relationship between women's empowerment and environmental sustainability is complex and exists only up to certain economic thresholds, suggesting the need for further research to develop effective policies supporting both gender empowerment and environmental sustainability (Niaghi, 2019). This complex relationship between women's economic empowerment and environmental sustainability highlights the need for nuanced policies that can balance economic development with environmental protection. This suggests that empowering women economically can be a powerful tool for advancing environmental sustainability, but this approach needs to be carefully managed to ensure long-term positive outcomes.

11. Cultural Influences and Women's Environmental Attitudes

Cultural norms and socialization play a significant role in shaping women's environmental attitudes and behaviors. Gaining insight into cultural influences is crucial for developing effective strategies to promote environmental sustainability. Cultural norms and socialization theories have a significant effect on pro-environmental attitudes and behaviors, prompting women to frequently exhibit a more favorable mindset toward the environment and participate in more recycling initiatives (Pearson et al., 2012). This observation underscores the importance of considering the cultural context when developing environmental programs and policies. Leveraging existing cultural norms that promote pro-environmental attitudes among women could be an effective strategy for advancing sustainability goals. Research conducted among senior women in northern Norway has demonstrated how principles of sustainability and recycling were rooted in them as a result of growing up in a resource-poor area, which molds their recycling practices as adults (Grønbech, 2000). This research shows that early life experiences and economic conditions shape long-term environmental behaviors. This highlights the lasting impact of promoting sustainable practices in resource-constrained environments and emphasizes the importance of considering early experiences in environmental education. A comparative study among Jewish and Muslim–Bedouin residents in Israel demonstrated that cultural differences also influence reported recycling behaviors. Social norms and perceived behavioral control act as mediators, illuminating the complex interaction between cultural practices, upbringing, and social norms that shape women's perspectives and recycling behaviors (Kaplan Mintz & Kurman, 2020). This research highlights the need for culturally sensitive approaches to environmental initiatives, that consider not only gender but also cultural and religious backgrounds. This study underscores the importance of considering diverse cultural contexts when designing environmental initiatives. This suggests that effective environmental programs should be tailored to specific cultural norms and practices, rather than adopting a one-size-fits-all approach.

12. The Need for Women's Perspectives in Environmental Management

The incorporation of women's perspectives in environmental management is not just a matter of equality; it is essential for developing comprehensive and effective environmental strategies that address the needs and experiences of all members of society. Examining environmental management from women's perspectives offers new insights, particularly in highlighting the importance of addressing political economy connections and discourses that exacerbate inequalities. This approach recognizes that environmental issues are not gender-neutral and that women's experiences and knowledge can provide valuable perspectives on sustainable solutions (Arora-Jonsson, 2011). This emphasizes the interconnected nature of environmental, economic, and social issues. This suggests that women's perspectives can help identify and address the underlying inequalities that contribute to environmental degradation. Understanding power dynamics and gendered institutions is crucial because women's involvement in the formulation, planning, and execution of environmental policies remains slow (Abulude, 2019). This paradox underscores the need to address structural barriers that hinder women's full participation in environmental decision-making processes and highlights the systemic nature of women's exclusion from environmental decision-making. Therefore, increasing women's participation in environmental management requires addressing deep-rooted institutional and cultural barriers.

13. Environmental Health and Women's Empowerment

The impact of environmental degradation on women's health underscores the critical importance of empowering women in environmental decision-making and management. In India, indoor air pollution is an important driving force of morbidity and mortality, especially among the poorest and most vulnerable populations. Approximately half a million women and children die every year due to indoor air pollution (Singh & Jamal, 2012). Air pollution contributes to stress, anxiety, and depression. Women, often caregivers and homemakers, bear the emotional burden of family health. Women working outdoors face reduced productivity due to respiratory symptoms, fatigue, and frequent illnesses caused by air pollution (Dankelman, 2009). This highlights the interconnected nature of environmental and health issues, particularly affecting women in various roles, and illustrates the complex ways in which environmental issues affect women's physical and mental health, as well as their economic productivity. These findings suggest that addressing environmental health issues could have far-reaching benefits for women's overall well-being and societal contribution. These health impacts demonstrate why empowering women is crucial for environmental sustainability and why women who are empowered with knowledge and resources are better equipped to make decisions that protect their own health and that of their families. For example, they might choose cleaner cooking fuels or advocate for better air quality standards in their communities (Wickramasinghe, 2011). Likewise, women's intimate knowledge of these health impacts can inform more effective environmental policies. When women are included in decision-making processes, they can pay attention to these often-overlooked health consequences of environmental degradation. Empowering women economically can lead to improved living conditions and access to cleaner technologies, directly addressing some of these health concerns. For example, women with greater financial resources might be able to afford cleaner cooking stoves or better ventilation systems in their homes (Shankar et al., 2015). It is clear from this example that educated and empowered women can become powerful advocates for environmental health in their communities, raising awareness and driving collective action to address these issues. This advocacy role is a key aspect of women's empowerment, which involves enabling women to gain control over their lives and inspire societal change. Recognizing the importance of this, the sustainable development goal (SDG-5) aims to achieve gender equality and the empowerment of all women and girls by 2030. However, despite progress toward this goal, significant challenges remain, as women worldwide continue to face discrimination, violence, and limited opportunities, which hinder their ability to fully engage in environmental advocacy and decision-making processes (Yadav, 2023).

14. Women's Role in Environmental Activism and Education

Women's role in environmental activism, education, and community-based initiatives has been significant and multifaceted. The intersection of women's empowerment and environmental conservation is exemplified by movements such as Chipko and Narmada Bachao Andolan in India, which demonstrate how women can be powerful agents of change in protecting natural resources and promoting sustainable development (Tyagi, 2020). These grassroots movements, where women physically protected trees and protested against large dam projects, set a precedent for women's environmental activism globally. This activism is not limited to specific regions; across the globe, women from diverse backgrounds—including educators, activists, enterprise creators, artists, and politicians—have championed outdoor environmental education (OEE) messages, fostering increased awareness and inspiring broader involvement in environmental issues (Mitten et al., 2018). Their varied approaches have enriched the landscape of environmental advocacy and education, showing that environmental stewardship transcends professional boundaries. As societal roles evolve, women's position as primary caregivers has placed them at the forefront of environmental education within families. They shape children's awareness of environmental issues, fostering a culture of sustainability from a young age. This influence is reinforced by the "Mothering Effect," where women's heightened concern for the environment drives them to actively engage in addressing environmental issues, viewing it as a moral obligation to their families. This commitment to environmental stewardship naturally extends beyond the home and into community-based initiatives, with women taking leading roles in various environmental sectors (Singh & Behura, 2022). In this domain, their proactive involvement in implementing sustainable practices such as 5Rs (reduce, reuse, recycle, replant, and recovery) has led to the creation of waste banks, improved municipal waste management, strengthened social cohesion, and generated additional household income. This hands-on approach to waste management demonstrates how women's environmental advocacy translates into practical, community-level solutions (Sultana et al., 2024).

Recognizing this potential, the waste industry is increasingly incorporating gender perspectives into policies and initiatives, ensuring women's active participation in decision-making and developing gender-specific strategies in waste education programs (Muchangos & Vaughter, 2019; Rokis et al., 2022; Amoah et al., 2023). One such example is door-to-door waste collection program in Kerala with the help of women (Nirupama, 2024). This approach not only empowers women but also provides opportunities for skill development and leadership, further reinforcing their role as environmental change-makers. However, despite these positive developments, challenges persist. Gender dynamics in the waste management sector, including the sexual division of labor, gender-based violence, and safety risks, continue to obstruct women's full empowerment, particularly in formal and remote settings (Ogando et al., 2017). Education and training programs aimed at increasing women's skills in waste management practices effectively improve environmental awareness and promote waste management behavior among housewives (Hubaybah et al., 2022; Maqbool et al., 2023; Tanau et al., 2023). These programs have also been successful

in enhancing cognitive activity, awareness, and experience in waste management, prompting positive changes in attitudes and behaviors toward waste disposal (Kasimba et al., 2023).

The PEDULI program is a model initiative that aims at enhancing women's environmental literacy by granting them proper waste management training. This program encompasses diverse approaches such as lectures, interactive games, short videos, and on-the-job training to improve participants' environmental knowledge and awareness by considerably increasing their level of cognitive engagement (Tanau et al., 2023). These initiatives recognize women as essential social capital, capable of influencing their communities to participate in waste management activities. Several studies have demonstrated that local self-governing bodies are increasingly engaging women in waste collection, whereas self-help groups support social empowerment and improve living standards in peri-urban areas (Ismail et al., 2006; Asteria & Herdiansyah, 2022; Kandpal & Saizen, 2022). The impact of women's involvement extends beyond local communities; grassroots women's groups have shown significant potential in amplifying women's roles in environmental management, pushing for policy changes and improving environmental governance and disaster response through their local knowledge and monitoring capabilities (Yonder et al., 2005). To further strengthen women's position, organizing informal workers could provide collective bargaining power and lead to better working conditions (Masood & Barlow, 2013). While empowering women through education, economic opportunities, and social support can lead to significant environmental benefits, this relationship is complex and context-dependent. Further research is needed to fully understand the link between women's empowerment and environmental sustainability, and to develop nuanced policy approaches. Ultimately, recognizing and supporting women's roles in environmental management is crucial for achieving sustainable development goals, as women bring unique perspectives, resourcefulness, and commitment to sustainability, which are essential for addressing contemporary environmental challenges (Yonder et al., 2005; Pearson et al., 2012; Stromquist, 2015).

15. Women in Waste Management: Challenges, Opportunities, and the Path to Sustainable Development

The waste management sector is deeply influenced by existing gender inequalities, responsibilities, norms, stereotypes, and roles. This means that the way we handle waste as a society is not gender-neutral. For example, in many cultures, women are primarily responsible for household waste management, whereas men often dominate decision-making roles in formal waste management systems (Resurrección, 2013). This gendered division of labor in waste management leads us to consider that women play a large role in consumption and waste generation, constituting almost half of any demographic. As primary household managers in many contexts, they are key to changing disposal habits from littering to binning and from binning to recycling. This presents a unique opportunity: by creating campaigns and information geared towards women, we can achieve greater and more effective behavior change in waste management practices (Circular & Conservancy, 2019). Examining women's roles is important, particularly given that their contributions can alter not only the environment but also the community in which they live. Through literacy programs and empowerment, women can also transform society by undertaking productive, domestic, and social roles. Women's participation in the public sector, including waste management, is particularly fascinating because waste management affects the environment in which they live and, therefore, their lives (Jackson, 1993). This understanding leads us to consider the broader implications of gender equality. Bayeh (2016) argues that without gender equality, a country's development is hindered, leading to economic costs, social inequities, and environmental degradation. This underscores the importance of involving women in policy-making, as gender-mainstreamed policies are more effective when women participate in their creation and implementation (Bayeh, 2016). Given this potential, it is crucial to consider that the capacity of local women to facilitate community processes in waste management should not be underestimated. However, they require constant support, particularly from the government. This support is essential because: 1) community management becomes a reality only when decision-making, including financial control, is devolved to women; 2) for women to become active in development, quality facilitation is essential; and 3) once established, a fruitful demand-driven approach can achieve more in a year than a decade of top-down service provision (Ismail et al., 2006). This emphasis on women's involvement is supported by evidence from various countries.

Studies carried out in countries such as Iran, Tanzania, and Zambia have shown that women have a deep bond with the environment and actively participate in solid waste management practices. Women play an indispensable role in improving waste management through various means, such as education, empowerment, and active engagement in waste-related activities (Foster et al., 2012; Almasi et al., 2019; Zand et al., 2020). Further research supports these findings. According to a study by Foster et al., female respondents reported that their participation in solid waste management (SWM) helped them become deeply integrated into their communities and gain recognition from influential members of society. Women often participate in SWM to obtain employment, which is frequently one of their primary sources of income. Many of them cited the benefits of SWM employment, including the ability to cover rent, construct homes, send children to colleges and universities, open businesses, supplement their husbands' incomes, and serve as a major source of income for widows. Nevertheless, despite these advantages, negative social attitudes regarding women in SWM persist, even as organizations express a desire to hire more women (Foster et al., 2012). In many South Asian nations, women have long handled household waste and street cleaning with pride. However, when these jobs become formalized or paid roles, men usually dominate the positions and

decision-making structures, leading to the underrepresentation and marginalization of women in the waste management industry (Dankelman, 2009; Dos Muchangos & Vaughtner, 2019).

Despite these challenges, women's active participation has far-reaching effects. The engagement of women in industries such as trash management is essential in managing matters pertaining to gender equality in local communities. A study by Obadina (2016) revealed that in countries such as Indonesia and Nigeria, women actively participate in waste management by contributing to local waste banks, raising awareness of environmental issues, and earning extra income. This promotes social solidarity and gives women more power, demonstrating how increased female participation can lead to both environmental and social benefits (Obadina, 2016). As women become more involved in waste management they contribute to a broader cultural shift toward environmental responsibility and sustainability. This shift goes beyond just waste management, influencing overall attitudes toward environmental conservation and sustainable living (Shah & Neema, 2021). Women who participate in waste management training programs can dramatically increase their environmental knowledge and awareness. This leads to more efficient waste minimization and recycling practices, which also improve quality of life. This is particularly important because it highlights the far-reaching impacts of women's involvement in environmental initiatives, extending beyond immediate waste management to influence broader societal attitudes and practices (Foster et al., 2012; Almasi et al., 2019; Zand et al., 2020). However, despite these positive impacts, significant challenges remain. The work of women in waste management, especially in the informal sector, is often undervalued and unrecognized. This lack of recognition is a significant barrier to improving working conditions and social status (Dias, 2016). These women are exposed to injuries and infections due to ill-fitting protective equipment, experience stigma and discrimination, face emotional distress, and are vulnerable to sexual harassment, particularly among younger workers. Many resort to unhealthy coping mechanisms such as alcohol consumption and these issues are compounded by factors such as age, marital status, and poverty (Dery et al., 2023). Many women work as waste pickers or in informal recycling, facing hazardous conditions and social stigma despite their crucial role in waste management systems. This undervaluation is closely tied to broader societal issues.

Women's labor is closely connected to the type and availability of waste materials in situations where household survival strategies depend on waste collection and reuse. This connection arises from the societal construction of roles, where social norms often dictate that women bear the brunt of waste management duties in both the public and domestic realms (Dhanalakshmi, 2014; Dos Muchangos & Vaughtner, 2019; Amoah et al., 2023). This gendered division of labor has implications for waste management policies. Waste education program development is profoundly affected by the gender-specific participation of the community in waste management decision-making. This influence is visible in many ways, particularly in how women and other marginalized groups are consistently excluded from meaningful involvement in the planning and implementation of decision-making processes, despite their significant contributions as waste managers and users of natural resources (Muller & Schienberg, 1997; Dos Muchangos & Vaughtner, 2019). The challenges for women in waste management are further complicated by formalization efforts. Sometimes, the formalization of waste collection and management work affects informal waste workers, including women. A study showed that with the introduction of Swachh Bharat (Clean India) in India, only those with resources and power were able to negotiate access to the dump, whereas those situated at lower positions in the hierarchy (in terms of intersecting inequalities) were pushed out of waste work completely (Wittmer, 2023). This is particularly concerning because informal waste work provides livelihoods for many people, particularly women in developing countries, where this work can be a crucial source of income for supporting their families. When these informal workers are displaced, it can lead to increased poverty and social instability (Masood & Barlow, 2013). Women in this sector face numerous challenges that reflect broader issues of gender inequality and environmental health. Inadequate awareness of proper waste disposal methods leads to health risks for waste workers and environmental issues. This situation underscores the need for women's empowerment in addressing environmental health issues through targeted awareness campaigns and improved infrastructure (Bhor & Ponskshe, 2018). Women waste pickers, particularly in developing countries, face severe health issues including respiratory conditions, skin disorders, and musculoskeletal problems (Resurrección, 2013). A lack of proper waste management knowledge is particularly visible in many rural areas, where women often engage in harmful waste disposal practices. For example, they might burn household waste and plastic materials inside their homes or dispose of plastic in regular garbage. These practices, driven by a lack of awareness, significantly contribute to environmental pollution and pose serious risks to human health (Kaur & Kaur, 2012).

The health risks of poor waste management are not evenly distributed as waste sites are frequently situated in economically disadvantaged areas, resulting in disproportionate exposure to pollutants and associated health risks. Historical and sociopolitical factors, coupled with inadequate regulation, further exacerbate these inequities. As a result, waste management has emerged as a significant issue of environmental justice and public health, with women and children often bearing the brunt of its adverse effects (Pellow, 2004). In this context women waste collectors, marginalized economically, cognitively, decisively, and permissively, are more vulnerable to health hazards. Gender biases and historical perceptions influence the recognition of their skilled work and limit their training opportunities. Thus, it is imperative to ensure that modernization policies do not promote inequality for waste workers (Rahman, 2019). The situation is particularly complex in countries such as India. In Ahmedabad, for example, over 95% of the 50,000+ waste pickers are Dalit women. However, new sanitation governance mechanisms and solid waste management practices are altering this dynamic, resulting in the

masculinization of waste labor. This shift brought new difficulties for Dalit women recyclers, including increased physical and financial responsibility and difficulty accessing waste. The intersections of caste, class, and gender play pivotal roles in India's informal waste economy, with women recyclers facing exacerbated challenges due to changing material flows and power dynamics (Wittmer, 2023). The various forms of subjugation experienced by women waste pickers affect their political engagement, earnings, and physical dignity. They are frequently denied access to high-value recyclables and receive less compensation for doing the same tasks as men do (Ogando et al., 2017). Social stigma compounds these challenges, with women waste workers often facing discrimination due to perceptions of their work as "unclean". To promote gender equality in the waste management industry, it is crucial to incorporate gender perspectives into policies and initiatives, ensure women's participation in decision-making, and provide gender-tailored approaches in waste education programs (Amoah et al., 2023; dos Muchangos & Vaughter, 2019).

Despite these challenges, there are positive developments. The experiences of women working in official waste management, who are conventionally dominated by men, are seen as meaningful and significant, despite various challenges and societal judgments they face. By operating trucks, they go beyond just having a job; it symbolizes a form of resistance and radical change. This occurs against the backdrop of global trends in labor feminization, where women are often preferred for certain roles owing to perceived traits such as compliance or less confrontational behavior, arising from neoliberal policies (Fredericks, 2008; Salzinger, 2003). Some regions are making efforts to address these issues. For example, Jordan's initiatives to incorporate more women in leadership and decision-making positions in the solid waste industry have shown potential in opening doors for new sources of job and income opportunities, especially in composting and recycling (Saidan et al., 2020). In India, non-governmental organisations that work with women waste-pickers in Pune exemplifies how organizing marginalized workers can lead to significant improvements. By forming the Kagad Kach Patra Kashtakari Panchayat (KKPKP) trade union, women waste-pickers gained official recognition, better working conditions, and improved livelihoods. They secured identity cards, established cooperatives, gained access to health insurance, and improved their children's education. The formation of self-employed waste collectors (SWaCH), a waste collection cooperatives, further elevated their status from "scavengers" to service providers. This case demonstrates how collective action can empower women in India's informal waste management sector, enhancing their working conditions, social status, and ability to advocate for their rights (Kilby, 2010). Additionally, self-help groups (SHGs) in peri-urban India empower women in waste management, with studies showing positive correlations between SHG participation and local waste management involvement. These groups raise awareness, improve service delivery, and foster community initiatives, suggesting that policy support for SHGs can enhance women's participation in waste management and promote overall sustainability in developing peri-urban areas (Kandpal & Saizen, 2022). Taron et al. (2021) suggested that forming women's cooperatives and associations has helped improve working conditions and social status for women waste workers in some places (Taron et al., 2021). These efforts reflect a broader shift in how women's roles in development are viewed. There has been a transition from seeing women as mere beneficiaries of development to recognizing them as active participants. Ray (2007) argues that women's involvement is now understood as essential for successful development projects. However, he noted that the efficacy of women's participation depends on several factors: project design, social structures, and the specific nature of their involvement. This recognition, according to Ray, has led to more inclusive and participatory approaches in development projects (Ray, 2007).

16. Conclusion

This review provides a critical intersection of the empowerment of women and environmental sustainability, with a specific focus on waste management. It emphasizes that empowering women is not just a matter of social justice but also a crucial factor in achieving environmental sustainability. The transformation from women in development (WID) to gender and development (GAD) approaches has strengthened our understanding of the complex interplay between gender, environment, and development. Women play pivotal roles across various environmental realms, including agriculture, natural resource management, waste management, and biodiversity conservation, contributing unique perspectives shaped by their social roles, cultural contexts, and day-to-day interactions with natural resources. However, they face numerous obstacles, including limited access to resources, decision-making power, and recognition, which are often rooted in broader cultural norms and societal inequalities. The economic empowerment of women is closely connected to environmental benefits, with empowered women being more likely to engage in sustainable practices and advocate for environmental policies. Women's environmental attitudes and behaviors are significantly shaped by cultural influences, highlighting the need to address unique challenges while also demonstrating the significant potential for driving sustainable practices. Environmental degradation disproportionately affects women's health, underscoring the importance of addressing environmental issues as matters of gender equality and public health. Increasing women's representation in environmental leadership and decision-making roles is necessary for developing more inclusive and effective environmental policies and practices. Moving forward, it is necessary to integrate gender perspectives into all levels of policymaking and execution, invest in women's education and skill development in environmental fields, support women's entrepreneurship in green sectors, address health and safety, facilitate women's leadership, and conduct further research on the complex relationships among gender, the environment, and development in various cultural contexts. By acknowledging and supporting women's roles in environmental stewardship, we can not only advance gender

equality but also enhance our collective capacity to address critical environmental problems, making gender equality not just a goal in itself but also a fundamental requirement for achieving global environmental sustainability.

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Conflict of Interest

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