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What Is the Role of Personas in Environmental Sustainability Studies? A Systematic Review of 36 Research Articles

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ABSTRACT

User personas are important tools for user understanding in human-computer interaction (HCI), and understanding how personas contribute to environmental sustainability across research and practice contexts is increasingly important. Our systematic review of 36 articles on persona research in environmental sustainability reveals four key patterns. First, persona research in environmental sustainability primarily focuses on the SDGs of industry innovation, consumption, and climate change, with other SDGs, such as clean water and sanitation (SDG 6) and life below water (SDG 14), not represented in any of the reviewed studies. Second, research is concentrated mainly in the Global North, with 77.8% of articles originating there; this concentration shapes which environmental sustainability priorities, methodologies, and stakeholder perspectives are represented. Third, the main challenges in implementing personas in environmental sustainability research are technical issues (34.6%), reflecting structural challenges. Fourth, methodological adaptations (39.13%) are the primary strategy for overcoming implementation barriers, whereas knowledge sharing and collaboration (4.34%) remain rare, indicating opportunities to leverage collective expertise to advance environmental sustainability goals through persona-centered methodologies.

1 | Introduction

Climate change and environmental degradation represent persistent challenges that continue to demand urgent attention (Bouguerra et al. 2024). These environmental sustainability challenges extend beyond technical aspects and involve issues of environmental justice (Mohai et al. 2009), environmental equity (Deivanayagam et al. 2023), and environmental systemic change (Gorissen et al. 2018). Such challenges have pushed human-computer interaction (HCI) researchers and practitioners to explore how design practices can contribute to environmental sustainability goals (Hansson et al. 2021). This includes, for example, representing user groups' distinct goals, behaviors, and requirements regarding environmental sustainability initiatives (Carey et al. 2019).

Personas are fictitious but realistic characters representing real user groups' distinct goals, behaviors, and requirements (Cooper 1999). Personas are a technique for user understanding and *user-centric design* (UCD) in HCI (Salminen et al. 2021). The use of personas in HCI is an essential practice for assessing user needs and supporting UCD activities across domains, such as software development (Aoyama 2005; Blomquist and Arvola 2002), culture (Qadi et al. 2025), and design (Chen et al. 2011). Personas have traditionally focused on user requirements and preferences to optimize usability and user satisfaction (Cooper 1999). However, as environmental sustainability issues have become increasingly important across domains, the need to represent user groups' goals, behaviors, and requirements has expanded. Environmental sustainability concerns also typically involve several, sometimes conflicting, perspectives that

play a role in understanding and navigating these challenges (Henderson and Loreau 2023). Therefore, personas that "only" represent users may not suffice, and HCI researchers need to shift their attention to a broader understanding of environmental ecosystems, covering various groups of people, including consumers (Syrjälä et al. 2025), buyers (Akre et al. 2019), factory workers (Karwowski et al. 2019), brands (Herskovitz and Crystal 2010), and non-human actors, including endangered species, animals, and nature itself (Nielsen and Neuhoff 2025b; Webber et al. 2023) (see Figure 1).

Despite the growing integration of environmental concerns into persona development and HCI (Bremer et al. 2022), it remains unclear how personas are applied in environmental sustainability research. First, there is no comprehensive review of the literature on the inclusion of SDGs in persona development for environmental sustainability, which makes it difficult to determine how environmental sustainability priorities are represented in current HCI persona development practices. Secondly, the geographic distribution of persona research may vary significantly across global regions due to differences in environmental sustainability research priorities, yet whether geographic disparities exist in persona research remains unexamined. Third, there is limited research examining which implementation barriers arise when applying personas to environmental sustainability initiatives, as well as how different solutions to overcome these barriers reflect environmental sustainability priorities and values in research practice. These research gaps highlight an urgent need in the HCI community for a systematic review to build a knowledge base in this emerging area and to guide future research and practice. To address these gaps, we put forth the following research questions (RQs):

RQ1. *How are UN SDGs represented in persona research on environmental sustainability?*

RQ2. *How does persona research in environmental sustainability vary across global regions?*

RQ3. *What barriers are reported in implementing personas for environmental sustainability initiatives?*

RQ4. *What solutions are reported to address barriers in implementing personas for environmental sustainability initiatives?*

Personas serve as a tool for understanding users; they address diverse environmental sustainability concerns across domains (Guan et al. 2024), but persona research in environmental sustainability lacks a systematic analysis of which SDGs they prioritize. As the dominant framework for sustainability research, the SDGs provide a common taxonomy for researchers to align their work under shared global priorities (Berrone et al. 2023; Dibbern and Serafim 2022). These shared global priorities include, but are not limited to, climate change mitigation (Georgescu et al. 2025; Zheng et al. 2025), clean energy transition (Li et al. 2025), and biodiversity conservation (Mattas et al. 2024), all of which represent pressing environmental challenges. These priorities, together, frame how HCI-driven design can help advance environmental justice, environmental equity, and environmental systemic change. Without a systematic mapping of which SDGs are prioritized in persona research of environmental sustainability, it is difficult to determine whether personas support environmental sustainability in an inclusive and systematic way or only in a specific environmental domain; hence, the need for RQ1.

Furthermore, persona development is shaped by behavioral patterns, socio-technical infrastructure, and cultural differences. The global region exhibits systematic differences in research infrastructure and resource access (Collyer 2018), as well as broader epistemic inequalities in how knowledge is produced and positioned (Castro Torres and Alburez-Gutierrez 2022). These differences influence how personas are developed, which data and technologies are available, and which environmental sustainability challenges are prioritized. Without a systematic examination of where and how persona research in environmental sustainability is conducted, we risk misrepresenting

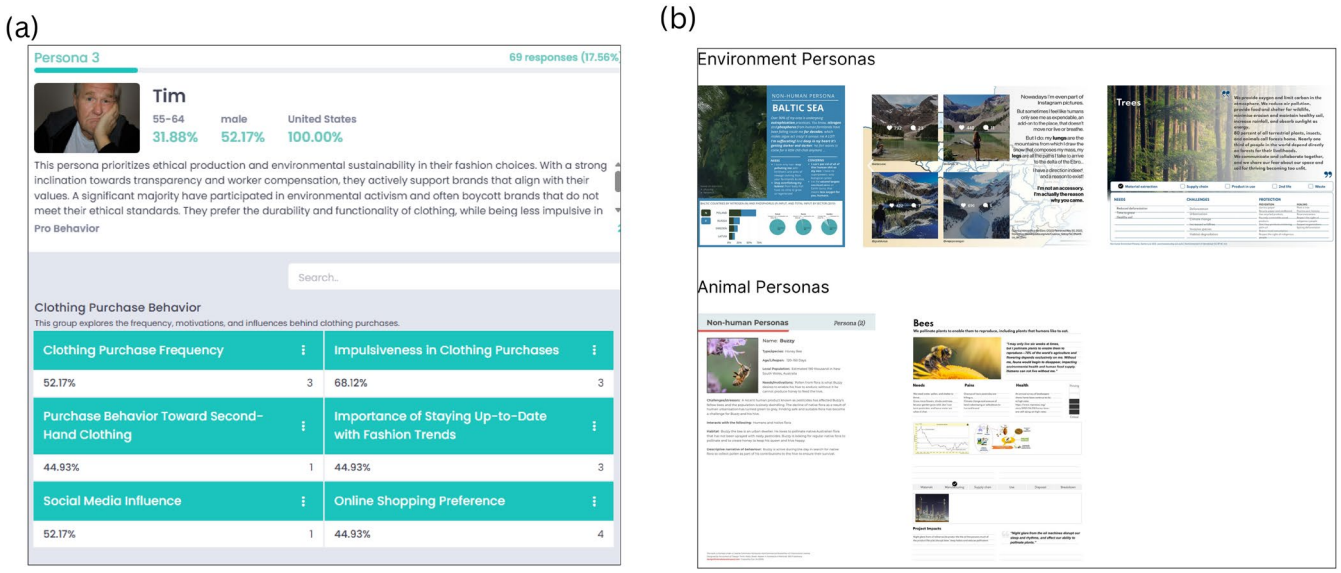

FIGURE 1 | (a) Example of a persona in a sustainability context generated using the Survey2Persona platform (Jung et al. 2025). (b) Non-human personas, including environment and animal personas as featured by Monika Sznel and colleagues in their article on life-centered design (Lutz 2022). A detailed description of these persona examples is provided in Supporting Information: Appendix A.1.

whose environmental sustainability priorities are represented and addressed; hence the need for RQ2. By global regions, we refer to large areas of the world grouped by shared economic, political, or social characteristics. This regional perspective extends beyond RQ2 to RQ3 and RQ4, as the implementation barriers researchers face and the solutions they develop are also influenced by regional context.

While prior work has examined issues of usability and representation in personas (Guan et al. 2024), environmental sustainability concerns may introduce additional implementation barriers that extend beyond traditional HCI concerns. These barriers are particularly concerning because personas directly shape design decisions, including policy interventions and communication strategies, that affect the user entities they represent. If the barriers remain poorly understood, persona-based interventions may be applied inconsistently or fail to achieve their intended impact. Therefore, RQ3 is needed to investigate these implementation barriers reported in persona research on environmental sustainability, acknowledging that persona impact is shaped not only by their creation but also by their use.

Given these potential barriers, it is also important to determine how best to address them in practice. Identifying approaches, frameworks, and best practices for addressing implementation challenges in personas is essential for providing practical recommendations to organizations and policymakers. To map the possible solutions to overcoming environmental sustainability challenges in persona research, RQ4 is essential.

Previous reviews of persona research have focused on quantitative personas (Salminen et al. 2020), data-driven personas (Salminen et al. 2021), and personas for social impact (Guan et al. 2024). While these reviews provide important insights into persona methodologies, they do not focus on environmental sustainability contexts or examine how persona research in environmental sustainability varies across regions and contexts. This gap limits our understanding of how environmental sustainability priorities are represented and implemented in persona research across diverse geographical contexts. To address the RQs and inform the research community about the "state of personas" in environmental sustainability research, we conduct a systematic review of relevant articles published through May 2025 in the fields of HCI, persona development, and environmental sustainability. Our findings contribute to understanding how persona methodologies can support environmental sustainability goals. These insights have implications for designing more inclusive environmental interventions, policies, and technologies that address diverse stakeholder needs across global regions.

2 | Methodology

2.1 | Overview

This study follows the PRISMA guideline for a systematic literature review (Page et al. 2021). We conducted a systematic literature search (Page et al. 2021) in three academic databases: (1) ACM Digital Library (ACMDL), (2) IEEE Xplore, and (3) Web of Science (WoS). To ensure comprehensive coverage and identify any relevant articles that may have been missed, we also conducted supplementary searches on Google Scholar and the SciELO database (a database from the Global South), as well as an author-based search after completing the primary database searches. This review is scoped specifically to environmental sustainability and, therefore, focuses on studies applying personas in these contexts.

Our methodology consisted of (1) systematic search string development and search execution, (2) screening of articles based on inclusion/exclusion criteria, (3) supplementary search, and (4) data extraction and synthesis. The search process began with the development of keyword groups linked to environmental sustainability and persona development. Through screening, we identified 27 (2.80%) relevant articles of the 962 articles found in the databases. Supplementary searching yielded 9 (2.1%) additional relevant articles out of 435 articles after meeting our inclusion criteria. This resulted in a final corpus of 36 articles (see Supporting Information: Appendix B, Table S1, for the complete list of reviewed studies). The details of the search strategy, the screening process, supplementary search, and the analysis are described in the following subsections.

2.2 | Selection of Databases

The search strategy was developed to comprehensively capture literature on sustainable persona development in HCI research across multiple databases. The ACMDL was selected for the breadth of coverage of HCI research, UX design, and computing disciplines. Because personas are grounded in HCI and UCD, ACMDL is a key source of high-quality, peer-reviewed publications detailing the development and use of personas in both theoretical and practical contexts. IEEE Xplore complements the ACMDL with broader technical insights, particularly where environmental sustainability intersects with technology and engineering. WoS was selected for its multidisciplinary, broad coverage of high-impact research across all fields. Including this database in the search process allowed a search for persona research related to environmental sustainability beyond merely technical contexts to social sciences, environmental studies, and business applications. Although Scopus provides broad coverage of journals, it was excluded because ACMDL and IEEE Xplore already ensured comprehensive coverage of research published in both journals and conference proceedings. Adding Scopus would therefore likely have produced largely overlapping results.

2.3 | Search String

The search strings contained predominantly the same keywords, but we tailored them to the specific constraints and formats of the different academic research databases. The strings used were as follows:

For WoS:

("persona" OR "personas") (All Fields) AND ("sustainable" OR "sustainability" OR "environmental impact" OR "environmental conservation" OR "eco-friendly" OR "recycling" OR "waste"

OR “renewable” OR “climate” OR “bioenergy” OR “emission” OR “decarbonisation” OR “green”) (All Fields)

For ACMDL:

Title:(persona OR personas) AND Abstract:(sustainable OR sustainability OR “environmental impact” OR “environmental conservation” OR “eco-friendly” OR “recycling” OR “waste” OR “renewable” OR “climate” OR “bioenergy” OR “emission” OR “decarbonization” OR “green”).

For IEEE Xplore:

(“Full Text Only”:persona OR “Full Text Only”:personas) AND (“Abstract”:sustainable OR “Abstract”: “sustainability” OR “Abstract”: “environmental impact” OR “Abstract”: “environmental conservation” OR “Abstract”: “eco-friendly” OR “Abstract”: “recycling” OR “Abstract”: “waste” OR “Abstract”: “renewable” OR “Abstract”: “climate” OR “Abstract”: “bioenergy” OR “Abstract”: “emission” OR “Abstract”: “decarbonisation” OR “Abstract”: “green”)

For SciELO:

(“persona” OR “personas”) AND (“sustainable” OR “sustainability” OR “environmental impact” OR “environmental conservation” OR “eco-friendly” OR “recycling” OR “waste” OR “renewable” OR “climate” OR “bioenergy” OR “emission” OR “decarbonisation” OR “green”).

The search strings were deliberately kept focused and consistent across different databases to retrieve literature addressing persona research in environmental sustainability contexts. Specifically, the search strings cover environmental sustainability and its interconnected issues, including climate action, resource and waste management, renewable energy, and environmental protection. We used abstract-only searches in IEEE Xplore and ACMDL to maintain manageable result sets and reduce false positives. WoS was searched across all fields, as initial testing showed that abstract-only searches yielded insufficient recall for interdisciplinary sustainability research, likely due to indexing differences across databases. The strategy thus prevents the inclusion of articles that solely mention personas or sustainability without further elaboration on their connection. For full coverage of potentially related terms, we also carried out a search on Web of Science using the terms “user profiles,” “stakeholder archetypes,” or “user segments,” as this database yielded the majority of relevant papers in our initial search. However, this search yielded no additional studies related to personas within the environmental sustainability context.

2.4 | Article Screening

The screening procedure adopted was multi-step and rigorous for selecting relevant, quality publications. The screening process was done with the inclusion/exclusion criteria. Following the initial search in ACMDL, IEEE Xplore, and WOS, 962 articles were found. As shown in Figure 2, we followed the PRISMA framework (Page et al. 2021) and started with an original 962 articles and used a systematic screening process and inclusion–exclusion criteria shown in Table 1 to narrow the selection. Eight (0.83%) duplicate articles were removed, reducing the count to 954 (99.16%) articles. Then, 35

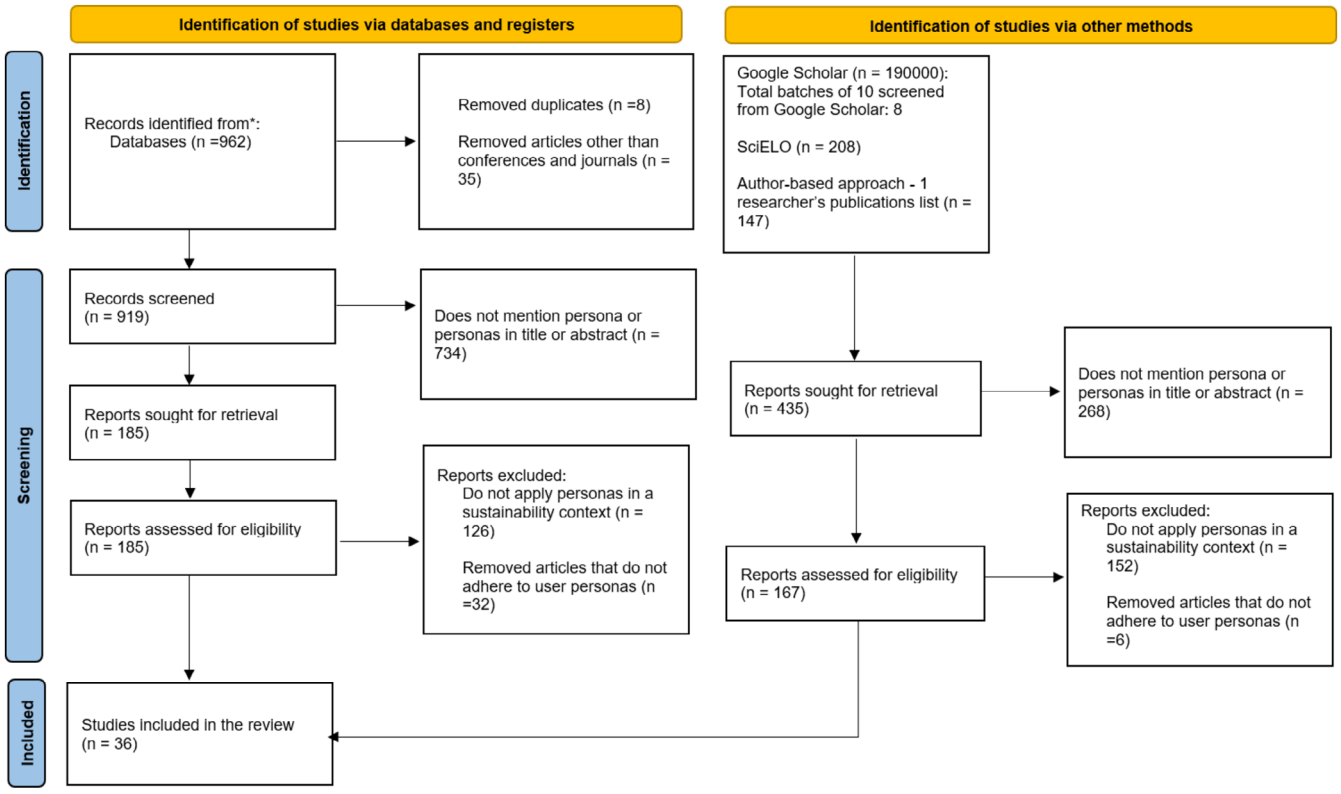

FIGURE 2 | PRISMA flow chart of the screening process (Page et al. 2021).

TABLE 1 | Inclusion–exclusion criteria.

Inclusion criteria	Exclusion criteria
Articles from the Conference and Journals	Non-academic content such as letters, editorials, book reviews, and meeting abstracts
Demonstrated application of environmental sustainability in persona development	Duplicate publications of the same study
Presented an empirical or conceptual study	Research using the term "persona" in non-user-representation contexts

(3.63%) articles that were not conference articles or journal articles were eliminated, leaving 919 (95.53%) articles. We then removed 734 (76.29%) articles that did not have "persona" or "personas" in their title or abstract, reducing the total to 185 (19.23%). This high exclusion rate occurred because database search algorithms retrieved articles in which the term 'persona' appeared in unrelated contexts (e.g., "personal," "personality,"). Manual screening ensured that only articles explicitly discussing persona methodology were retained. We then eliminated 126 (13.09%) articles that did not apply personas in an environmental sustainability context, bringing the count to 59 (6.13%). After a full-text screening, an additional 32 (3.32%) articles were excluded because they did not adhere to user personas (i.e., they did not present fictional characters representing distinct user groups with specific goals, behaviors, and characteristics based on research data). This resulted in a list of 27 (2.80%) articles that met all inclusion criteria. Of these, 1 (0.10%) article was in a language other than English and was translated using Google Translate.

2.5 | Supplementary Search

To identify articles missed by database searches, we employed three supplementary search methods. First, we further reviewed each new research article added to Google Scholar's index that mentioned "personas" and "sustainability" and then manually screened the relevance. Given the impracticality of reviewing all results, we screened in batches of 10 (per Google's results page), and we stopped screening once three consecutive batches produced no additional eligible studies. The saturation occurred after the first 50 records, after which we identified no new inclusions (this is consistent with the long-tail effect, meaning that the first hits are much more relevant than the "long tail" of hits (Wu et al. 2009)). Articles that met the inclusion criteria were included as new articles in our analysis. This process identified 8 articles representing 22.22% of the final corpus that met the inclusion criteria and were added to the corpus.

Second, we conducted a supplementary search in the SciELO database to ensure coverage of the Global South. We applied the exact search keywords used in the three primary databases (ACMDL, IEEE Xplore, and WoS), adapted to SciELO's search functionality. The search yielded 208 results. After applying our inclusion and exclusion criteria through manual screening, no articles met our requirements.

For SciELO:

("persona" OR "personas") AND ("sustainable" OR "sustainability" OR "environmental impact" OR "environmental conservation" OR "eco-friendly" OR "recycling" OR "waste" OR "renewable" OR "climate" OR "bioenergy" OR "emission" OR "decarbonisation" OR "green")

Third, to ensure comprehensive coverage of methodological contributions, we employed author-based searching (Vom Brocke et al. 2015). We identified a researcher (Lene Nielsen) in persona development based on citation count and significant theoretical and methodological contributions, including "10 Steps to Personas" (Nielsen 2019). We reviewed her complete publication lists on Google Scholar and screened each article for relevance to persona-based research on environmental sustainability. This process identified one article (2.7% of the final corpus) that met the inclusion criteria and was added to the corpus. To address potential limitations of author-focused searching, we also conducted forward citation searches to identify relevant work by other researchers that cites, extends, or applies Nielsen's conceptual framework.

2.6 | Data Extraction and Analysis

We developed variables and attributes in this systematic literature review, following best practices as outlined by Okoli (2015). Data extraction attributes were identified by aligning them directly with our research questions to ensure relevance. Then, we created a data extraction sheet with 14 attributes to analyze the chosen articles systematically. As shown in Table 2, we defined specific extraction guidelines for each variable to ensure consistency in coding across articles.

Data extraction was carried out systematically to ensure a comprehensive analysis of the selected studies. We first pilot-tested to verify and improve our extraction attributes using 10 articles. During pilot testing, we inductively identified emergent variables from the data. This phase helped clarify attribute definitions and their variables, and provided a consistent methodology for the complete analysis. Pilot testing revealed several ambiguities in our initial extraction variables, particularly regarding the classification of environmental sustainability focus areas and validation methods, which were subsequently refined. We employed reflexive thematic analysis (Braun and Clarke 2021) to extract complex variables such as "Theoretical framework," "User entities," and "Solution applied" to allow themes to emerge from the complete corpus.

In line with reflexive thematic analysis (Braun and Clarke 2021), the researcher's positionality is as follows: *As a doctoral researcher from the Global South with a marketing background, the researcher has cross-regional perspectives on sustainability research and has knowledge in persona development. This allows him to understand different policy approaches and cultural attitudes toward sustainability and understanding of region-specific contexts. His marketing background influences how he frames*

TABLE 2 | Research questions and data field mapping.

Attribute	Definition	RQs
Application area	The practical domain where a concept or method is used or intended to be used.	Overview
Theoretical framework	The set of ideas or models that guide how research is understood and analyzed.	
Sustainability focus area	The specific aspect of sustainability being addressed, such as energy, climate, or social well-being.	
SDGs	Set of 17 global objectives adopted by the United Nations in 2015.	RQ1
Year of publication	The calendar year when the article was published.	RQ2
Article type	The classification of the article.	
Context region	A spatial area where the study was conducted.	
User entities	The types of people the persona represents.	
Persona type	Type of personas based on Static/Dynamic approach.	
Sample size	The number of participants, observations, or data points analyzed in the study.	
Number of personas	The number of personas created in the study.	
Validation method	The approach used to verify accuracy or reliability.	
Implementation barriers	Challenges faced while applying persona-based solutions.	RQ3
Solution applied	Specific methods, tools, or strategies implemented to overcome implementation barriers.	RQ4

sustainability, potentially emphasizing consumer-focused solutions while recognizing the need to consider broader systemic perspectives. The researcher aimed to remain objective and fair throughout the study procedures of data collection, coding, and analysis. Other research team members, originating from different research and personal backgrounds (including Global North), contributed by actively supervising the doctoral student and his work inputs.

The extraction process was performed by a doctoral student with expertise in HCI, persona methodologies, and sustainability, ensuring consistency across all 36 articles in the final corpus. The student systematically reviewed each article in its entirety, carefully documenting the 14 attributes according to the predefined extraction framework (see Table 2). Two coders (the doctoral student and a postdoctoral researcher) independently analyzed three articles from the corpus to assess inter-rater reliability. Inter-rater reliability was evaluated using data from 9 coded variables (excluding open-ended questions and basic information) across two coders, with Cohen's Kappa indicating substantial agreement ($\kappa = 0.90$).

The information extraction process involved comprehensively reading each article and systematically coding the 14 attributes manually. The coder (i.e., the doctoral student) used a standardized extraction sheet to record the response (see the original coded sheet in the Supporting Information: Online Appendix[1]) and predefined variables, which were assigned to eight attributes (see Table 3). The coded data were then analyzed using both statistical methods (e.g., frequency counts and distributions) and thematic analysis to identify key patterns, trends, and thematic insights across the corpus. To generate thematic insights, codes from the data were aggregated into recurring sub-themes, and these sub-themes were then aggregated into emerging themes through reflexive thematic analysis (Clarke and Braun 2014).

3 | Results

3.1 | Overview of Persona Research in Environmental Sustainability

Prior to addressing our RQs, we conducted preliminary analyses to gain an overall understanding of the application areas of persona research in environmental sustainability, the notable sustainability focus areas, and the theoretical framework employed.

In terms of application areas, we identified persona applications in environmental sustainability research through systematic manual data coding (refer to Table 3), which is made available in the Supporting Information: Online Appendix.[2] The results show that the Design process application ($n = 15$, 26.78%) is the most predominant type. Applications of the Design process include the systematic development of an expert system to improve energy efficiency in manufacturing (Ioshchikhes et al. 2025). User Research ($n = 12$, 21.42%) applications are primarily aimed at identifying user needs and behaviors, including research focused on developing personas of residents in low-income communities (Heidelberger and Rakha 2022). Behavior change ($n = 11$, 19.64%) applications include the creation of personas to understand different user behaviors and perspectives about urban nature (Ricci et al. 2018). Policy making ($n = 8$, 14.28%) includes studies that employ personas to inform micromobility governance, guide regulatory decisions, and support the design of equitable and sustainable e-scooter policies (Dibaj et al. 2021). Product development ($n = 6$, 10.71%) includes research using personas to map stakeholder needs and support the development of user-centred tools and services for SMEs engaged in eco-innovation (Chmielarz 2022). Other ($n = 4$, 7.14%) application areas include energy modeling (Ganz et al. 2024) and energy system transition planning (Dańkowska et al. 2025).

TABLE 3 | Key attributes, variables, and definitions used for systematic data extraction and coding of persona in environmental sustainability research.

Attribute	Variables	Category Frequency	Definition
Application context	Design process	($n = 15$, 26.78%)	A structured, often iterative series of steps for creating functional products or solutions to meet specific goals.
	User research	($n = 12$, 21.42%)	The practice of understanding user behaviors, needs, and motivations through observation, interviews, and surveys.
	Policy making	($n = 7$, 13.20%)	The process of developing, implementing, and evaluating policies and programs to address societal issues.
	Behavior change	($n = 11$, 19.64%)	The process of modifying actions, attitudes, or habits to improve outcomes for individuals or organizations.
	Product development	($n = 6$, 10.71%)	The entire journey of creating a product, from initial ideas through design, development, and launch to the market.
Sustainability focus area	Energy	($n = 17$, 40.47%)	Energy that meets present needs without compromising the ability of future generations to meet theirs
	Climate action	($n = 10$, 23.80%)	Strategies and initiatives aimed at reducing greenhouse gas emissions and addressing climate change.
	Waste management	($n = 6$, 14.28%)	Collecting, treating, recycling, and disposing of waste to reduce environmental impact.
	Resource optimization	($n = 7$, 16.66%)	Using available resources efficiently to maximize productivity and minimize waste.
SDGs	SDG 1—No Poverty	($n = 0$, 0%)	End poverty in all its forms everywhere
	SDG 2—Zero Hunger	($n = 0$, 0%)	End hunger, achieve food security and improved nutrition, and promote sustainable agriculture
	SDG 3—Good Health and Well-being	($n = 4$, 3.73%)	Ensure healthy lives and promote well-being for all at all ages
	SDG 4—Quality Education	($n = 4$, 3.73%)	Ensure inclusive and equitable quality education and promote lifelong learning opportunities
	SDG 5—Gender Equality	($n = 0$, 0%)	Achieve gender equality and empower all women and girls
	SDG 6—Clean Water and Sanitation	($n = 0$, 0%)	Ensure availability and sustainable management of water and sanitation for all
	SDG 7—Affordable and Clean Energy	($n = 12$, 11.21%)	Ensure access to affordable, reliable, sustainable and modern energy for all
	SDG 8—Decent Work and Economic Growth	($n = 0$, 0%)	Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all
	SDG 9—Industry, Innovation and Infrastructure	($n = 13$, 12.14%)	Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation
	SDG 10—Reduced Inequalities	($n = 5$, 4.67%)	Reduce inequality within and among countries
	SDG 11—Sustainable Cities and Communities	($n = 10$, 9.34%)	Make cities and human settlements inclusive, safe, resilient and sustainable

(Continues)

TABLE 3 | (Continued)

Attribute	Variables	Category Frequency	Definition
	SDG 12—Responsible Consumption and Production	($n = 22$, 20.95%)	Ensure sustainable consumption and production patterns
	SDG 13—Climate Action	($n = 19$, 17.75%)	Take urgent action to combat climate change and its impacts
	SDG 14—Life Below Water	($n = 0$, 0%)	Conserve and sustainably use the oceans, seas and marine resources for sustainable development
	SDG 15—Life on Land	($n = 2$, 1.86%)	Protect, restore and promote sustainable use of terrestrial ecosystems
	SDG 16—Peace, Justice and Strong Institutions	($n = 0$, 0%)	Promote peaceful and inclusive societies for sustainable development, provide access to justice for all
	SDG 17—Partnerships for the Goals	($n = 4$, 3.73%)	Strengthen the means of implementation and revitalize the global partnership for sustainable development
Context region	Global North	($n = 28$, 77.8%)	Global North refers to the world's wealthier, developed countries.
	Global South	($n = 8$, 22.2%)	Global South refers to the poorer, developing countries, mainly in Africa, Asia, and Latin America.
Article type	Empirical	($n = 31$, 86.27%)	A research paper that presents findings based on observed, measured, or experimental data.
	Conceptual	($n = 5$, 13.72%)	A research paper that explores or develops theoretical ideas without collecting new data.
Persona type	Static Personas	($n = 35$, 97.23%)	Static personas are fixed, unchanging representations of user types.
	Dynamic Personas	($n = 1$, 2.77%)	Dynamic personas are adaptable user profiles that change based on real-time behaviors, needs, or contexts rather than remaining static.
Validation	Statistical validation	($n = 12$, 50%)	Ensuring that conclusions drawn from statistical tests are accurate and reflect true effects in the data.
	Expert review	($n = 6$, 25%)	Evaluation of a product, process, or survey by subject matter experts to identify issues and suggest improvements.
	User testing	($n = 1$, 4.16%)	Assessing a product or service by observing real users as they complete tasks to identify usability or design issues.
	Field studies	($n = 2$, 8.3%)	Gathering firsthand data by observing and interacting with people or phenomena in their natural environments.
Implementation barriers	Resource constraints	($n = 15$, 28.8%)	Limitations or shortages that affect how resources are allocated or used.
	Technical issues	($n = 18$, 34.6%)	Problems related to the functioning or performance of technical systems or equipment.
	Adoption problems	($n = 11$, 21.2%)	Challenges faced when introducing new products, services, or practices.
	Cultural obstacles	($n = 3$, 5.8%)	Difficulties arising from differences in language, values, beliefs, norms, or stereotypes between cultures

Note: The frequency counts can reflect multi-labeling where articles could belong to multiple categories. RQ4 (solutions) was coded using thematic analysis.

We identified four sustainability focus areas through systematic manual data coding (refer to Table 3), which is made available in the Supporting Information: Online Appendix.[3] Since a study can be coded more than once, the frequencies (n) and percentages are the frequency of occurrence for the categories rather than the unique article number. Results in Figure 3 indicate that the energy-related area was the dominant focus area. Energy-related articles highlight applied work, such as a feedback system on household energy consumption (Beltman et al. 2016). In the Climate Action area, researchers applied innovation diffusion theory to accelerate the adoption of plant-based foods for climate effect reduction (Gonera et al. 2021). In the Waste management area, researchers developed a community-shared medicine service system to reduce medication waste through recycling (Li et al. 2024). In the Resource optimization area, researchers designed prosthetics that cost less to implement for poor Vietnamese amputees using principles of frugal engineering (Lecomte et al. 2013). Other sustainability focus areas include urban nature (Ricci et al. 2018) and a sustainable diet (Gonera et al. 2021).

Through our reflexive thematic analysis (Clarke and Braun 2014) of the coded data, we identified five theoretical frameworks. Results indicate that User-Centered Design and Persona-Based Approaches ($n=14$, 38.88%) are the most dominant framework, emphasizing methodologies that integrate user perspectives directly into environmental sustainability solutions through participatory design (Vestergaard et al. 2016). Behavioral and Psychological Models ($n=12$, 33.33%) incorporate theories like COM-B (Höpfl et al. 2024) and Theory of Planned Behavior (Rasca et al. 2023), and diffusion of innovation (Gonera et al. 2021) to understand and influence sustainable behavior change by addressing underlying psychological factors and motivational triggers. Socioeconomic and Cultural Contexts ($n=5$, 13.88%) examine how social, economic, and cultural factors influence environmental sustainability adoption, particularly focusing on stakeholder engagement (Pambudi et al. 2025) and contextual adaptation of solutions to specific communities (Dańkowska et al. 2025). Finally, Systems Thinking and Ecological Frameworks ($n=5$, 13.88%) apply holistic approaches to environmental sustainability challenges, viewing problems through interconnected systems and emphasizing the relationships between environmental, social, and technical dimensions (Ioshchikhes et al. 2025).

3.2 | RQ1: How Are UN SDGs Represented in Persona Research on Environmental Sustainability?

We identified 10 SDGs through systematic manual data coding (refer to Table 3), which is made available in the Supporting Information: Online Appendix.[4] Since a study can be coded more than once, the frequencies (n) and percentages are the frequency of occurrence for the categories rather than the unique article number. As shown in Table 4, SDG 12 was the dominant one, with applications ranging from sustainable fashion consumption analysis to waste management systems. SDG 13 emerged as the second most prominent area, which includes diverse approaches such as accelerating plant-based food adoption and building emission reduction frameworks. SDG 9 includes smart community development and manufacturing energy efficiency systems. SDG 7 applications include household energy feedback systems, renewable energy adoption personas, and domestic retrofit interventions. SDG 10 focuses on inclusive urban building modeling and age-friendly community design, while studies concerning SDG 11 focused on urban mobility patterns and transit preferences. SDG 3 included community medicine sharing systems and indoor air quality monitoring. SDG 4 explored energy sustainability knowledge among university students and climate science communication.

In summary, persona research in environmental sustainability addresses only 10 of the 17 SDGs, with consumption and production, climate action, and innovation and infrastructure showing the strongest representation. Two SDGs, including clean water and sanitation and life below water, remained unaddressed, while the SDG related to life on land showed limited coverage.

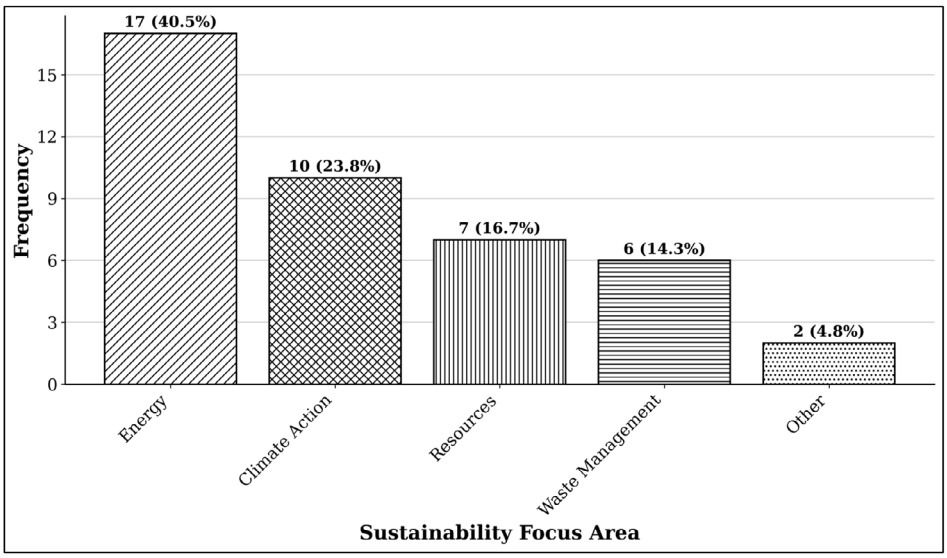

FIGURE 3 | Sustainability focus areas addressed through persona research in environmental sustainability.

TABLE 4 | Frequency distribution of SDGs in persona research on environmental sustainability.

Sustainability development goals	Absolute frequency	Percentage	Related articles	Attention level
SDG 1—No Poverty	0	0%	N/A	None
SDG 2—Zero Hunger	0	0%	N/A	None
SDG 3—Good Health and Well-being	4	3.73%	Li et al. (2024)	Limited
SDG 4—Quality Education	4	3.73%	Lecomte et al. (2013) and Malakhatka et al. (2022)	Limited
SDG 5—Gender Equality	0	0%	N/A	None
SDG 6—Clean Water and Sanitation	0	0%	N/A	None
SDG 7—Affordable and Clean Energy	12	11.21%	Allen et al. (2022) and Beltman et al. (2016)	Substantial
SDG 8—Decent Work and Economic Growth	0	0%	N/A	None
SDG 9—Industry, Innovation and Infrastructure	13	12.14%	Chmielarz (2022) and Wehr and Luccarelli (2019)	Substantial
SDG 10—Reduced Inequalities	5	4.67%	Torma and Aschemann-Witzel (2024)	Limited
SDG 11—Sustainable Cities and Communities	10	9.34%	Ricci et al. (2018)	Limited
SDG 12—Responsible Consumption and Production	21	19.62%	Onel et al. (2018) Wever et al. (2008)	Substantial
SDG 13—Climate Action	19	17.75%	Chandrasenan et al. (2022)	Substantial
SDG 14—Life Below Water	0	0%	N/A	None
SDG 15—Life on Land	2	1.86%	Nielsen and Neuhoff (2025a)	Limited
SDG 16—Peace, Justice and Strong Institutions	0	0%	Wehr and Luccarelli (2019)	Limited
SDG 17—Partnerships for the Goals	4	3.73%	Allen et al. (2022) and Ricci et al. (2018)	Limited

Note: Attention levels categorize research engagement based on number of coded instances: None ($n = 0$), Limited ($n = 1–10$), and Substantial ($n > 10$).

3.3 | RQ2: How Does Persona Research on Environmental Sustainability Vary Across Global Regions?

Our analysis of research methodology on the systematic manual data coding (refer to Table 3) shows that 31 studies (86.10%) employed empirical approaches, while only 5 studies (13.90%) utilized conceptual frameworks for persona research in environmental sustainability. We identified through systematic manual data coding context regions as defined in Table 3. Most studies ($n = 28$, 77.78%) were conducted in Global North contexts, with significantly fewer ($n = 8$, 22.22%) focusing on Global South regions.

In terms of research context distribution across time periods (see Figure 4), we observe differential growth patterns between Global North and Global South studies. Global North contexts dominated the field from 2008 to 2019, with only irregular Global South representation beginning in 2013. The post-2020 period demonstrates increased diversification, with Global South studies appearing more frequently and cross-regional studies (both Global North and South) emerging in 2024. Peak publication activity occurred in 2022 ($n = 8$), with 2022 and 2024 showing the greatest regional diversity across all three context categories. This suggests an emerging trend toward greater geographical diversification in research contexts, with Global South studies experiencing proportional growth compared to Global North studies, though the absolute dominance of Global North research contexts persists across both temporal periods.

Our analysis (Clarke and Braun 2014) of the coded data identified four primary user entities represented by personas. The highest proportion of personas represent End Users, which refers to individual consumers, residents, and direct users of products or services, such as homeowners using energy systems (Simpson et al. 2016) or consumers of sustainable fashion (Zhang et al. 2023). Ecosystem Stakeholders represent external parties who influence or are impacted by outcomes through advocacy,

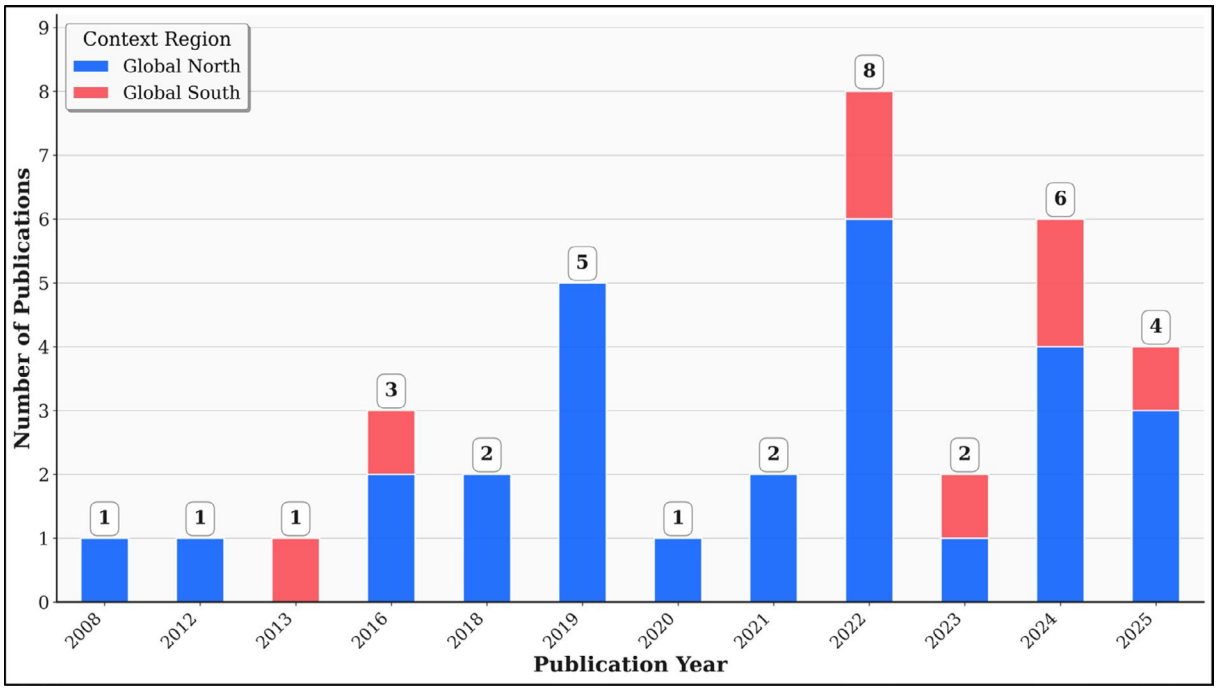

FIGURE 4 | Distribution of publication years from 2008 to 2025, showing the frequency of publications per year.

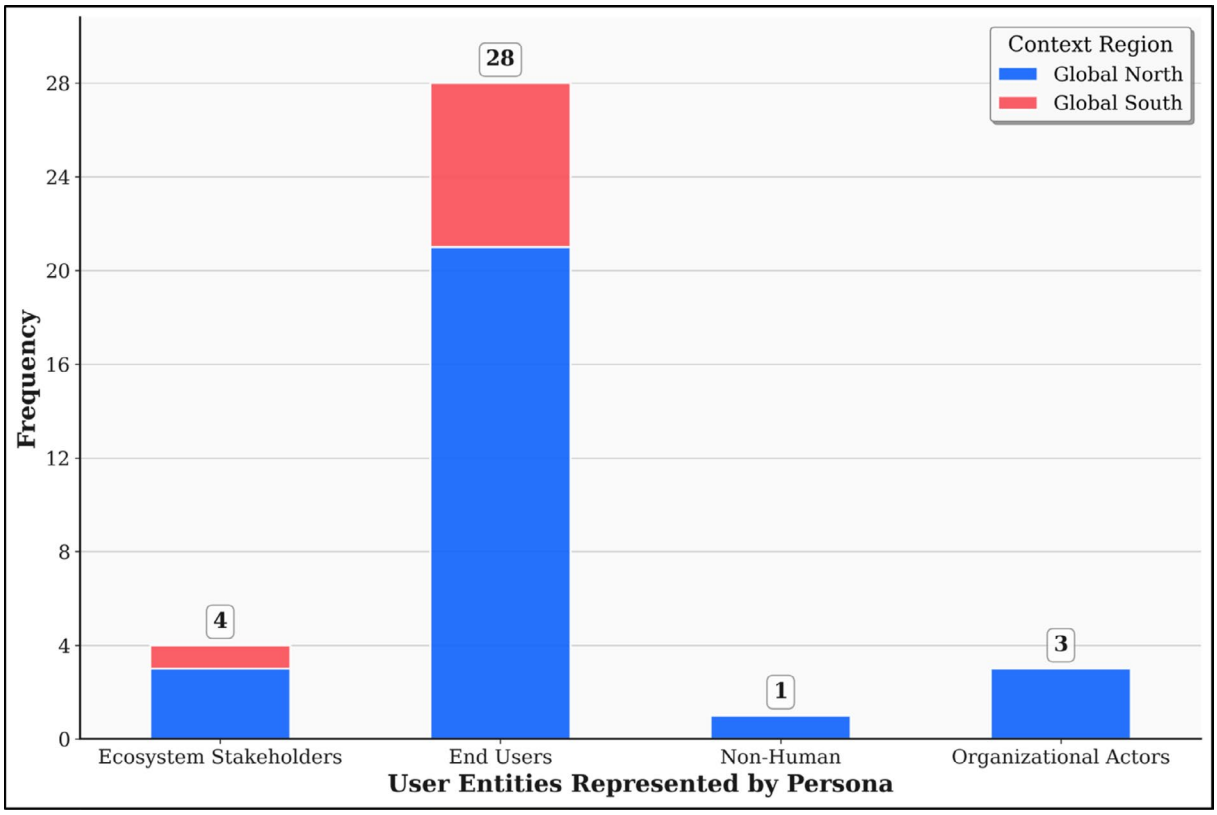

FIGURE 5 | Analysis of user entities represented by personas in environmental sustainability research.

community leadership, or being affected by decisions, which includes urban stakeholders (Guerra and Syed 2024) and general stakeholder groups (Torma and Aschemann-Witzel 2024). Organizational Actors include entities representing formal organizational roles and responsibilities, such as machine operators (Ioshchikhes et al. 2025), government agencies (Allen et al. 2022), and manufacturing SMEs (Chmielarz 2022). Non-human includes entities representing planetary ecosystems (Nielsen and Neuhoff 2025a). We also paid attention to differences in user entities between Global North and South (see Figure 5). It appears

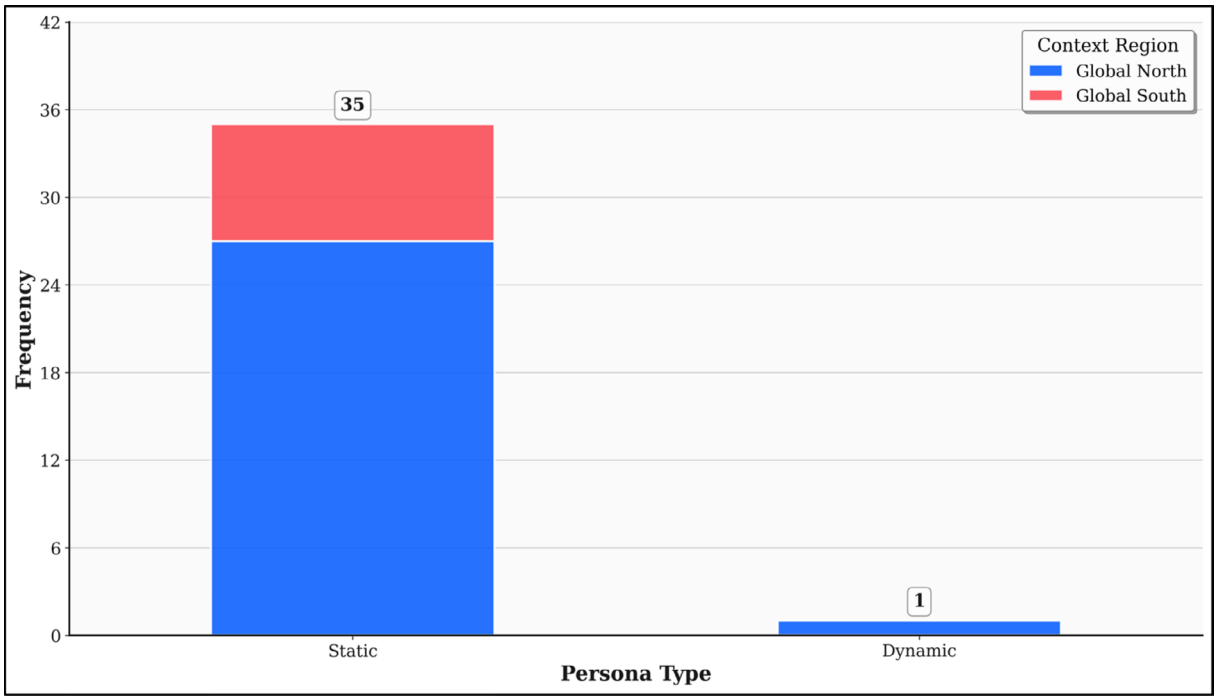

FIGURE 6 | Analysis of persona types used in environmental sustainability research.

that user entity representation shows regional disparities, with Global North studies dominating across all categories, while Global South research demonstrates a more concentrated focus on End Users. In particular, Global South persona research in environmental sustainability was related to community-based contexts, including vulnerable populations such as poor amputees (Lecomte et al. 2013) and occasional medication users (Li et al. 2024), demonstrating diverse perspectives.

We manually coded the types of personas, as defined in Table 3 (full coding sheet is available in the Supporting Information: Online Appendix[5]), into two main types: Static and Dynamic. Static personas ($n = 35$, 97.23%) were more common than Dynamic ($n = 1$, 2.77%) ones. Static personas were developed for wind energy development stakeholders (Allen et al. 2022). Dynamic personas, such as those used in smart green home systems, draw on real-time sensor data to update user profiles and adapt energy-related decisions (Salomons et al. 2012). In terms of persona type distribution across context regions (see Figure 6), Static personas dominate both Global North and Global South studies. The Global North accounts for the majority of Static persona cases. Dynamic personas are represented exclusively in Global North contexts. This suggests limited adoption of dynamic approaches regardless of regional differences in environmental sustainability contexts and research priorities.

Sample sizes for persona creation ($M = 580.88$, Mdn = 294, SD = 882.59, Min = 10, Max = 2950) indicate a severely skewed distribution, as two large samples (2950 and 2907) raise the mean well above the median. Apart from these outliers, other studies utilized comparably moderate-sized samples, as demonstrated by the relatively lower median level of 294 participants. In the SLR, 4 studies did not state the number of personas developed. The descriptive statistics for the number of personas ($M = 5.69$, Mdn = 4, SD = 5.80, Min = 2, Max = 32) indicate that researchers generally develop four personas to capture important user segments in an environmental sustainability context.

Furthermore, the validation of personas in environmental sustainability research employs diverse methodologies. We identified these categories through systematic manual data coding, as defined in Table 3. Since a study can be coded more than once, the frequencies (n) and percentages are the frequency of occurrence for the categories rather than the unique article number. Statistical Validation is the most prevalent method, such as hierarchical cluster analysis, identifying four distinct energy-related personas among university students (Chandrasenan et al. 2022). Expert Review applications include validation of agrivoltaics stakeholder personas to understand innovation adoption needs (Torma and Aschemann-Witzel 2024). User Testing comprises approaches such as those used to validate personas within youth design interventions (Allen et al. 2022). Field Studies include ethnographic methods during an extended stay in an Indian village for waste management system design (Vestergaard et al. 2016). Other specified methods involve the "comparative design study" technique for smart community housing personas (Carey et al. 2019).

We also paid attention to differences in validation between the Global North and South (see Figure 7). It appears that, while Global North studies dominate across all validation methods, Global South research shows proportionally higher engagement with Statistical Validation (57.1%) than with Field Studies (14.3%). Despite the dominance of the Global North, both regions employ multiple validation approaches rather than relying on a single method.

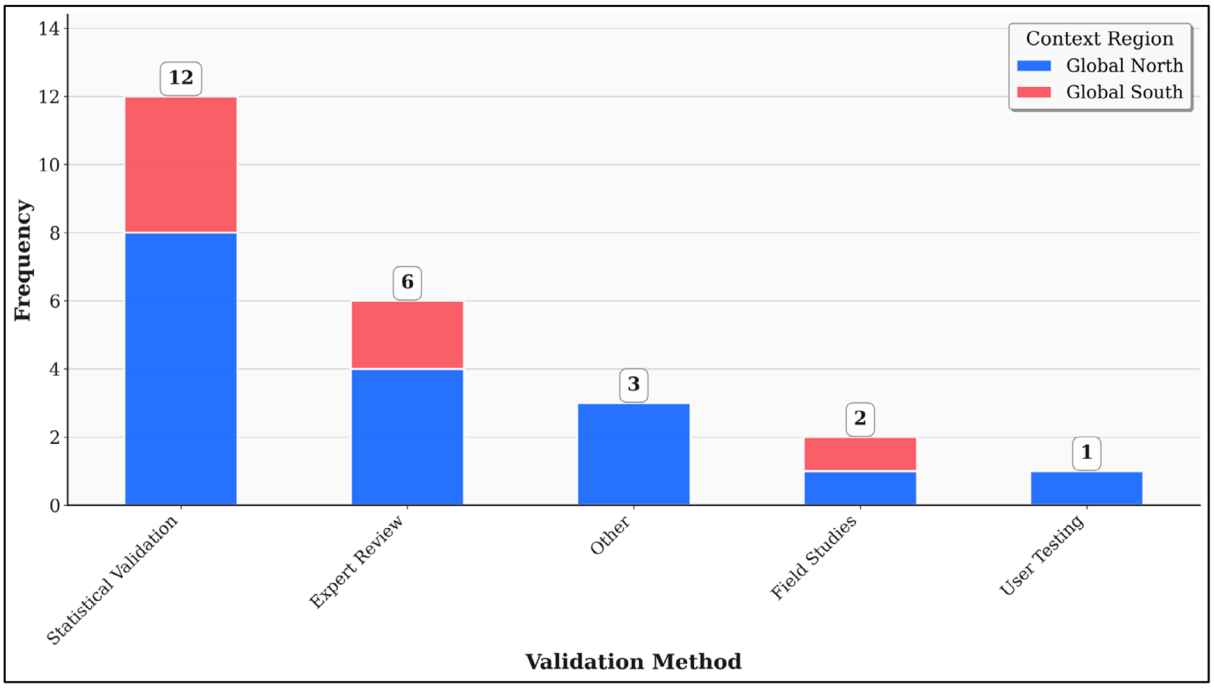

FIGURE 7 | Analysis of validation methods employed in persona research on environmental sustainability.

In summary, the literature on personas demonstrates a preference for static type in persona creation, integrating both quantitative and qualitative data sources. For validation, statistical techniques are most common, often supplemented by expert review and user testing, with sample sizes varying widely across studies.

3.4 | RQ3: What Barriers Are Reported in Implementing Personas for Environmental Sustainability Initiatives?

We identified the implementation barriers through systematic manual data coding, as defined in Table 3 and transparently available in the Supporting Information: Online Appendix.[6] Since a study can be coded more than once, the frequencies (n) and percentages are the frequency of occurrence for the categories rather than the unique article number. The most dominant implementation barriers in persona research in environmental sustainability were technical issues, followed by resource constraints, adoption problems, and cultural obstacles (see Figure 8). Technical issues emerged in the study, which identified the lack of dynamic and flexible tools for updating personas in smart home systems, limiting the system's adaptability to real user behavior (Salomons et al. 2012). Resource constraints included a study in which the need to implement different and sometimes conflicting system features for each persona exceeded available development resources, hindering persona application (Beltman et al. 2016). Adoption barriers included a study that identified resistance from rental property owners as a key barrier (Berzolla et al. 2023). Regarding cultural barriers, a study on sustainable fashion communication found that cultural variations in perceptions of environmental sustainability affected persona reception (Kaner and Baruh 2022). Other challenges included sample constraints in the study and the recruitment of participants representing all clusters of sustainability attitudes (Höpfl et al. 2024).

We also noted differences in implementation barriers between the Global North and South (see Figure 8). It appears that implementation barriers show distinct regional concentrations, with Global North contexts dominating across all barrier types.

3.5 | RQ4: What Solutions Are Reported to Address Barriers in Implementing Personas for Environmental Sustainability Initiatives?

Through our reflexive thematic analysis (Clarke and Braun 2014) of the coded data, we identified solutions for overcoming environmental sustainability implementation barriers. The most used was Methodological Adaptations, while the least utilized was Knowledge Sharing and Collaboration. Methodological adaptations, which involve changes to research, sampling, or analytical methods, primarily addressed resource barriers and adoption problems through approaches such as prioritization of embedding data within local contexts, aiming for local relevance rather than broad representativeness (Dańkowska et al. 2025). UCD approaches, which involve user-centered solution design focused on end-user needs, addressed environmental sustainability initiative adoption problems and technical barriers through methods such as creating personas based on extensive fieldwork and validating them through culturally appropriate media, like film (Vestergaard et al. 2016). Technical and Infrastructure improvements, which involve tools, systems, or infrastructure fixes, addressed technical issues through methods such as standardized templates and web-based tools for urban building energy modeling (Berzolla et al. 2023). Economic and Policy Interventions, which involve incentives, funding, or policy actions, addressed resource constraints in persona implementation through targeted policy measures such as price subsidies for sustainable technologies informed by persona insights (Pambudi et al. 2025). Knowledge Sharing and Collaboration, which involve the exchange of expertise and collaborative

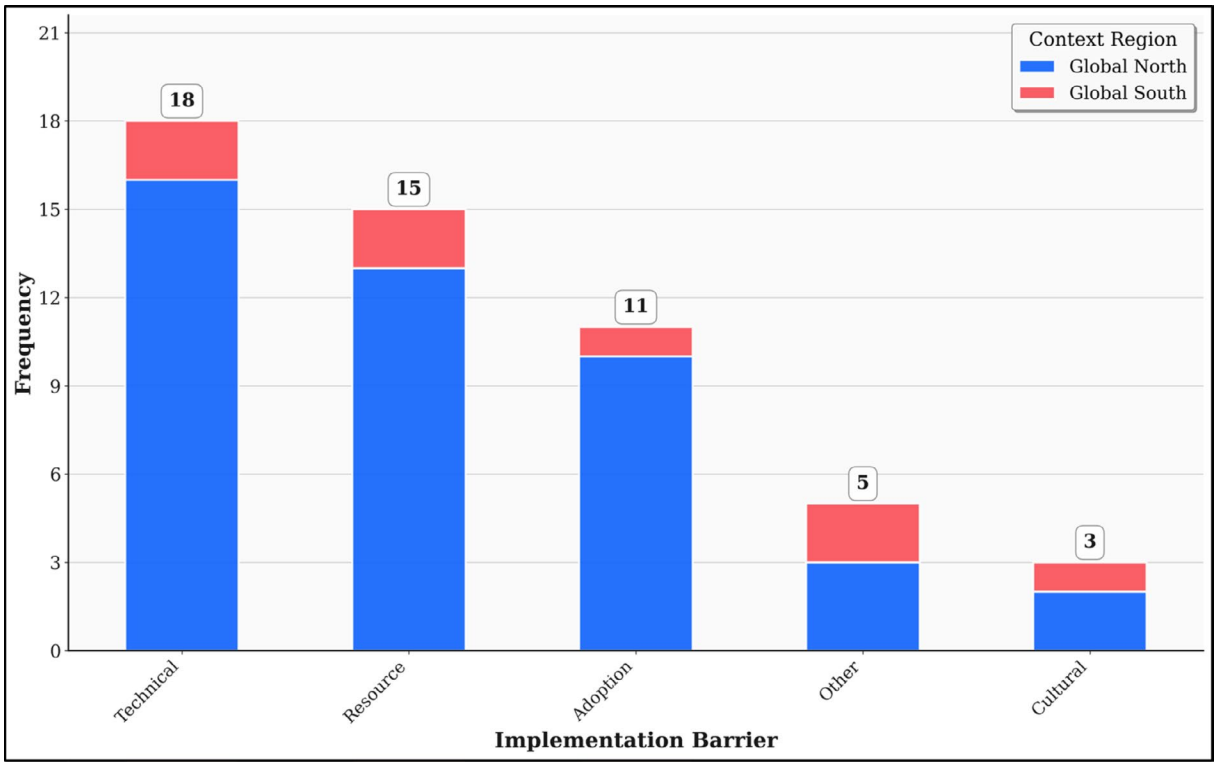

FIGURE 8 | Analysis of implementation barriers in persona research on environmental sustainability.

action, were evident in the ECOLABNET project's provision of expert knowledge and collaboration tools to address resource constraints and technical barriers for SMEs (Chmielarz 2022).

We also examined differences in solutions between the Global North and South (see Figure 9). It appears that Global South studies show consistent but limited representation across most solution categories, contributing one instance each to Methodological Adaptations, UCD approaches, and Economic and Policy interventions. However, Knowledge Sharing and Collaboration solutions appear exclusively in studies from the Global North, suggesting potential regional differences in how collaborative approaches are implemented.

4 | Discussion

This SLR of 36 studies on persona development in environmental sustainability research identifies several significant trends and methodological approaches, while highlighting persistent implementation challenges. The findings provide valuable insights into how personas are being created, validated, and applied in environmental sustainability contexts, offering guidance for future research and practice in this emerging field.

4.1 | Implications for Persona Research in Environmental Sustainability

The findings show that persona research in environmental sustainability focuses on consumption optimization (SDG 12, 19.62%), climate action (SDG 13, 17.75%), and industrial innovation (SDG 9, 12.14%). In contrast, SDG 6 and SDG 14 are not represented in any of the reviewed studies, and SDG 15 (life on land) receives only minimal focus (1.86%), despite the SDGs being inherently interconnected; for example, urban applications (SDG 11) often intersect with energy (SDG 7) and climate (SDG 13) concerns. The absence of SDGs for water and marine suggests that the reviewed literature prioritizes market-oriented environmental solutions over ecosystem protection. This pattern aligns with research showing that market-oriented environmental approaches often fail to protect ecosystem services (Kroeger and Casey 2007). Ecosystem services are central to SDGs 6, 14, and 15, and provide clean water, marine resources, and support terrestrial biodiversity for resource-dependent communities. The market-oriented approach may bias personas by focusing on visible consumption choices and overlooking users without access to energy, affordable options, or decision-making authority over resources.

The dominance of research in Global North contexts suggests a systematic geographic imbalance, which may indicate systematic patterns in how environmental sustainability knowledge is created. The geographic imbalance between the two regions shapes the knowledge on environmental sustainability represented in literature and whose perspectives are heard in the design of environmental sustainability interventions. This imbalance is associated with methodological and implementation barriers, as Global South contexts are often required to adopt approaches developed in and for the Global North. Within the reviewed literature, validation practices in the Global South follow established Global North approaches, such as quantitative methods (statistical validation). Furthermore, the absence of knowledge sharing and collaborative solutions to address the persona implementation barrier in research from the Global South suggests potential gaps in cross-regional methodological

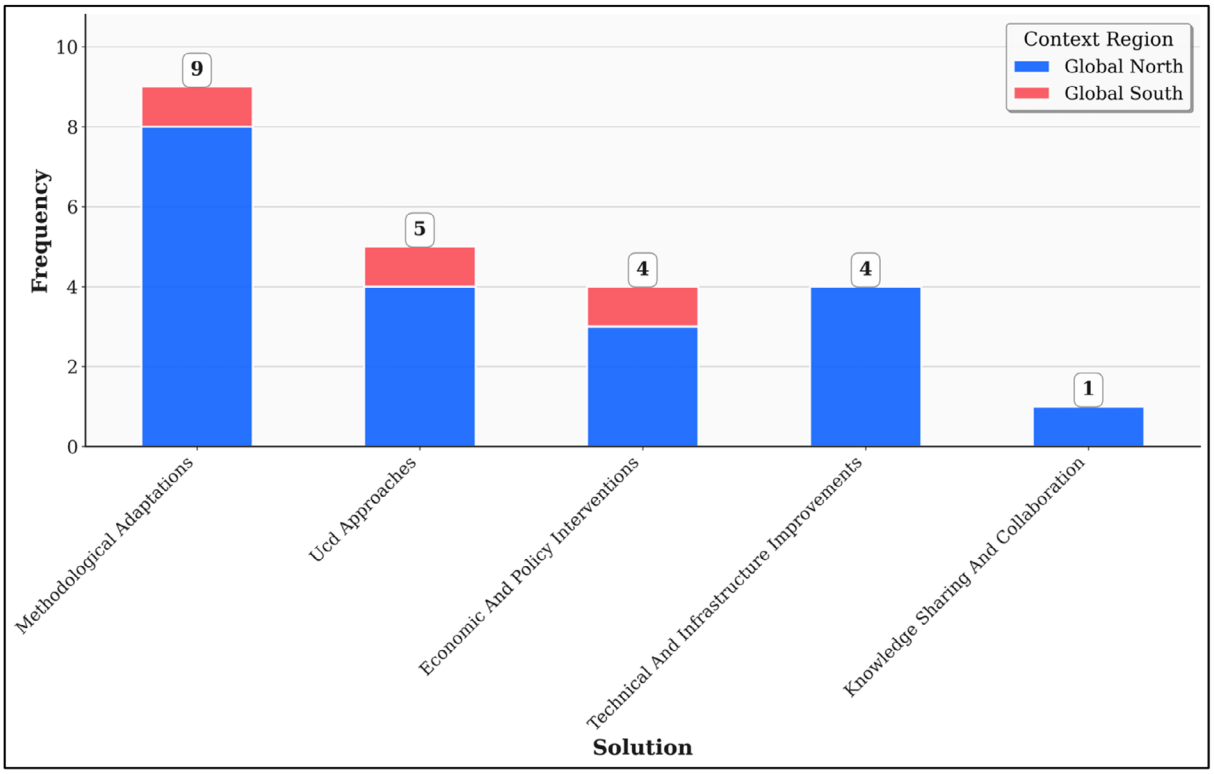

FIGURE 9 | Analysis of solution themes proposed in persona research on environmental sustainability.

exchange. The geographic imbalance within the reviewed literature suggests a focus on environmental sustainability challenges common in the Global North, such as managing energy consumption flexibility and enhancing grid-connected renewables. In contrast, methodological attention is rarely given to energy issues essential to the Global South, such as expanding basic access, ensuring a steady supply, and managing informal or decentralized energy systems.

The suitability of persona types depends on the environmental sustainability use case, particularly the temporal dynamics of user practices, the complexity of socio-technical systems, and the extent to which the stakeholders are included in the design scope. Static personas are appropriate when user behavior remains stable over an extended period, such as in profiling consumer segments in sustainable fashion markets. In contrast, dynamic personas are appropriate when user practices and environmental conditions co-evolve, as in smart green home systems (Salomons et al. 2012). The finding that only 1 (2.77%) study uses dynamic personas suggests infrequent adoption in the energy and climate domains (SDGs 7, 13), where behavioral adaptation is central to the success of persona-based environmental sustainability interventions. Also, an anthropocentric approach neglects nonhuman representation of ecosystems and species as stakeholders in the sustainability transition. Within the reviewed literature, nature appears mostly as a part of human decision-making rather than as a direct stakeholder with its own "voice" whose perspective should be represented. The lack of ecological "voice" related to SDGs 6, 14, and 15 restricts persona-informed design to human consumption optimization and does not engage the ecological system. However, researchers and the design community can leverage technology to more effectively communicate non-human perspectives (see Figure 10), thereby making environmental perspectives more explicit in design processes.

The findings on implementation barriers reveal a misalignment between persona methodologies and the complexity of environmental sustainability. In our findings, implementation barriers are dominated by technical or resource issues, which suggests research in this area frames implementation as primarily a technology-centered problem requiring better tools or more funding. This framing may obscure more fundamental tensions about diverse energy stakeholders that require confronting conflicting interests (e.g., utilities prioritizing revenue vs. households minimizing bills), and addressing cultural specificity in energy practices (heating norms, cooking fuels, and privacy expectations around consumption data). Similarly, strategies aimed at overcoming such barriers emphasize methodological solutions rather than collaboration. This pattern suggests opportunities for persona research to represent systemic tensions more directly, including divergent worldviews and inequitable distributions of environmental harms and benefits, within environmental sustainability transitions.

A growing body of HCI research increasingly aspires to systematically integrate economic, environmental, and social factors (Knowles et al. 2018). This integration has the potential to define environmental sustainability dimensions, such as ecological impact and resource use, that shape the attributes and relevance of personas generated. Such personas could inform the development of technologies, systems, and interventions (e.g., energy-efficient systems, eco-friendly products, or digital tools that promote sustainable behavior) that meet users'

The Forgotten Ones is a 360° Immersive Narrative of the largest dumpsite in Eastern Africa, narrated by the dumpsite itself.

FIGURE 10 | Example of bringing a non-human voice dynamically into persona development (Lutz 2022).

needs while advancing the SDGs. In addition, these personas can represent non-human actors, including nature or endangered species (Nielsen and Neuhoff 2025b). This perspective of non-human personas illustrates how UCD techniques can support sustainable design beyond considering only human stakeholders. Specifically, we propose that the shift in logic can be illustrated as follows: user-centered design (perspective: *software systems*) → human-centered design (perspective: *socio-technical systems*) → sustainability-centered design (perspective: *ecosystems*).

4.2 | Practical Guidelines for Persona Development

There are four practical implications we would like designers and practitioners to take away from this research. First, the absence of SDGs 6 and 14 and limited attention to SDG 15 within the reviewed literature suggests an opportunity to link multiple SDGs to capture a more holistic representation of environmental sustainability concerns. For example, when focusing on industry innovation work (SDG 9), they should also consider Life on land (SDG 15) and Life below water (SDG 14), recognizing that these are interconnected goals rather than mutually exclusive priorities. Furthermore, moving beyond UCD toward broader theoretical frameworks could enhance the multidisciplinary perspectives required to address complex environmental sustainability challenges.

Second, the dominance of persona studies in the Global North suggests the need for greater geographic inclusiveness to represent multi-stakeholder geographies. Researchers must establish collaborative partnerships with institutions in the Global South to include participation from the Global South. This includes transparent reporting of participant profiles, explicit statements about geographic scope, and a commitment to avoid universalizing findings to other regional contexts. Validation practices should shift from statistical validation toward participatory fieldwork and community-led validation processes, where local cultural perspectives take priority. This includes recognizing that Global South research may show different user entity priorities, focusing more on community stakeholders and vulnerable populations rather than individual consumers, which is typical in Global North studies.

Third, the dominance of static personas across all regions indicates missed opportunities for dynamic approaches that could better capture changing environmental sustainability contexts. Researchers should consider developing dynamic personas, particularly for long-term environmental sustainability interventions where user behaviors and environmental conditions evolve over time. This is especially relevant for climate action and energy-related applications, where users' needs, goals, and behaviors change over time. However, the use of dynamic personas requires continuous data collection mechanisms, such as IoT sensors in smart home contexts. The resource and technical expertise requirements for creating dynamic personas necessitate that researchers weigh resource demands against project scope. For example, dynamic personas are valuable in long-term, behavior-dependent interventions, and static personas may suffice for stable consumption patterns.

Fourth, within the reviewed literature, strategies for overcoming implementation challenges remain constrained by technology-focused solutions. The excessive importance of resource limitations, technical problems, and methodological adoption efforts may draw attention away from the structural inequities shaping environmental sustainability performance. To effectively address these challenges, researchers should focus on existing power dynamics of different context regions and integrate economic and policy solutions alongside technical innovations in persona research. In other words, persona development in environmental sustainability needs stronger collaboration with local stakeholders and "following through" the persona lifecycle (Pruitt and Adlin 2006) in environmental sustainability projects is needed. We also propose a partial solution for persona development that

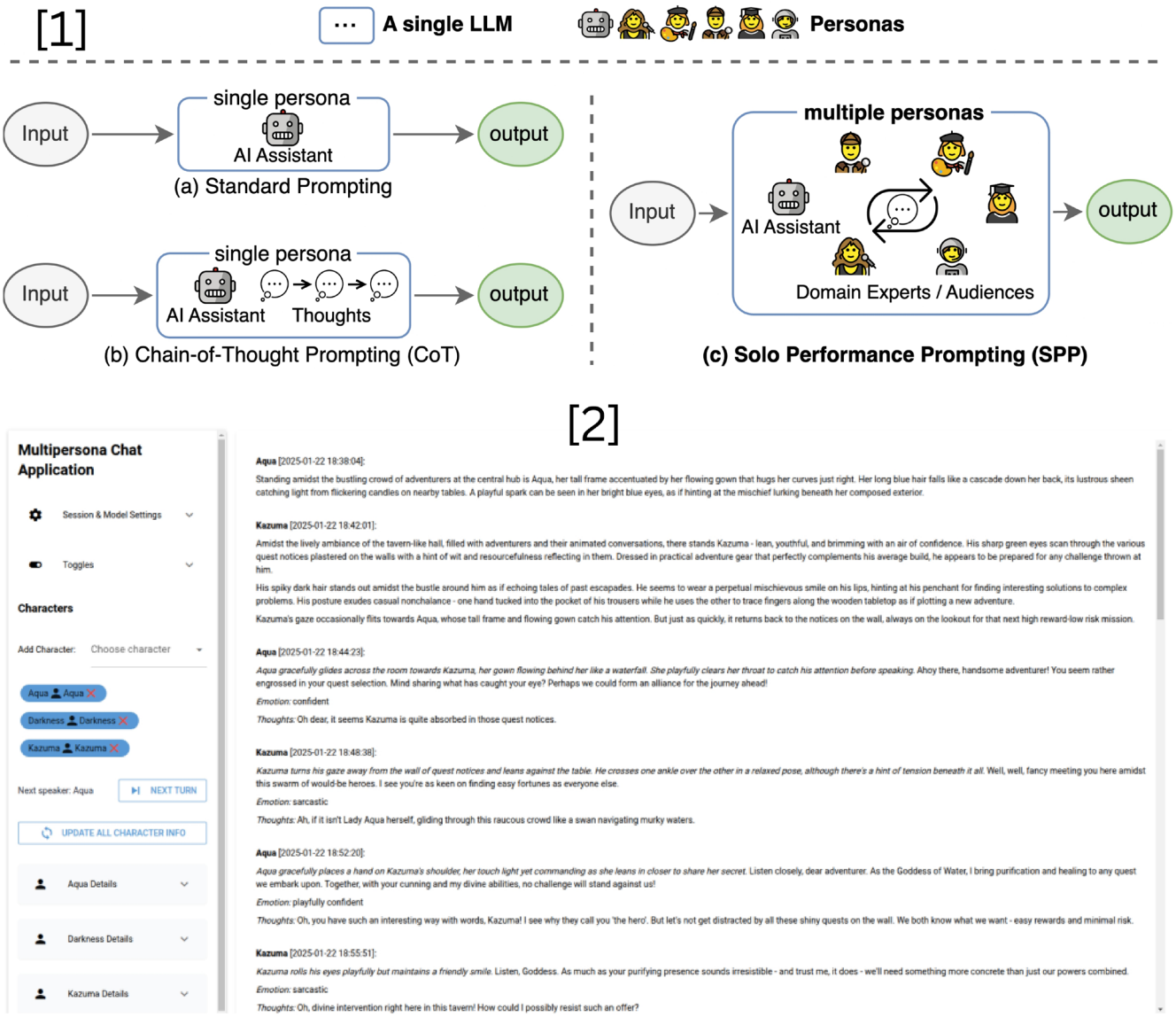

FIGURE 11 | (1) Schematic illustration of solo performance prompting and chain-of-thought prompting, (Wang et al. 2023). (2) Chat application interface (bottom) demonstrates a multipersona conversation application (Smeets 2025).

leverages technology to address these gaps. Figure 11 illustrates how conversational AI systems could integrate multiple personas representing stakeholders from both the Global South and the Global North, while providing graphical interfaces that enable direct communication with personas representing differing stakeholder views on environmental sustainability challenges.

4.3 | Limitations and Future Directions

4.3.1 | Limitations

The first limitation is that, despite the review's aim to be comprehensive, which includes evidence from 36 studies, it is likely that relevant studies were left out due to search methodology, database selection, and keyword search strategy. Using predetermined search strings, the search was restricted to three academic databases (Web of Science, IEEE Xplore, and ACM Digital Library). This selection of databases may have left out relevant research that was published in other databases. Although this is offset by the inclusion of new studies from the supplementary search, it remains impossible to ignore the potential for relevant studies that have not yet been identified. While non-English publications were included and translated using Google Translate, machine translation may have introduced minor inaccuracies in the interpretation of nuanced methodological details. However, the publications examined and the supporting data in this study are representative of the primary body of work in the field of persona research in environmental sustainability contexts. Therefore, the analysis is less likely to be significantly impacted by the inclusion of any potential excluded studies.

Second, we have omitted records published in other forums, such as practitioner reports, industry publications, or grey literature, and have only included articles published in peer-reviewed conferences and journals, assuming that they represent the frontier of research. There may be interesting studies that highlight new developments in the field, especially with reference to

actual implementation experiences in corporate environments. But because of methodological decisions, they are not included. To increase the scope of research in this area, we suggest that future studies incorporate this evidence.

Finally, the review grouped study contexts using the Global North and Global South classification. However, countries and areas covered in each classification varied greatly in terms of economic growth, cultural values, and sustainability concerns. This wide classification could obscure significant differences in the creation and use of personas in various national or regional contexts. Therefore, in order to better understand contextual differences in persona research on environmental sustainability, we advise future studies to employ more precise regional or cultural classifications.

4.3.2 | Future Research

Methodological innovations would help create personas that can dynamically represent changing user behaviors, preferences, and environmental conditions over time. In order to create adaptive persona systems that are appropriate for the complex and dynamic nature of environmental sustainability concerns, future research should investigate longitudinal data gathering frameworks combined with a graphical interface (see Figure 11), along with AI-driven data analytics. This includes looking into how personas can evolve in real-time as climate conditions change, policies shift, and social movements emerge.

An area of study is expanding persona approaches beyond anthropocentric models to incorporate non-human actors, such as ecosystems, wildlife, and natural resources. In order to provide representations of nature's voice (which are also significant non-human stakeholders in environmental sustainability), future research should promote interdisciplinary partnerships among ecological modelers, environmental scientists, and indigenous knowledge holders. The potential of having a non-human voice (as shown in Figure 10) to promote fruitful communication between human stakeholders and environmental viewpoints should be investigated in future research.

Future research should address the mismatch between personas' focus on individual users and the need for collective solutions in environmental sustainability. Personas are effective tools for representing distinct user segments, but this focus on individuals can obscure how climate change and environmental degradation arise from the interplay of government policies, corporate practices, and community actions. Future studies should examine how personas can be redesigned to address collective environmental sustainability challenges rather than individual user preferences alone.

In order to reflect environmental justice through persona development, future research must purposefully close existing gaps presented in this study. For personas to support environmental sustainability transitions rather than just technological optimization, critical frameworks that deal with power dynamics, equity, and decolonial perspectives must be embedded. Future research should look into how personas might represent environmental injustices.

5 | Conclusion

A systematic review of 36 studies shows how persona research operates across environmental sustainability contexts, from energy and climate applications to policy-making interventions. The analysis shows that persona research in environmental sustainability focuses on 10 of the 17 SDGs, with 7 absent from the reviewed literature. This includes concentration on consumption and production (SDG 12, 19.62%), climate action (SDG 13, 17.75%), clean energy (SDG 7, 11.21%), and innovation (SDG 9, 12.14%), while water systems and marine environments (SDGs 6, 14) are not represented and terrestrial ecosystems (SDG 15, 1.86%) receive minimal attention. The dominance of research in Global North contexts may limit knowledge diversity, though recent years show increased Global South representation. Most personas represent individual end users rather than organizational actors or ecosystem stakeholders. Implementation barriers, such as technical issues, are prevalent in persona research on environmental sustainability. However, current solutions emphasize methodological adaptations rather than targeted responses to specific types of barriers. This suggests a misalignment between the identified barriers and the proposed solutions. Overall, these findings suggest that personas hold significant potential for environmental sustainability research, yet realizing this potential would benefit from fundamental shifts. Future research should move beyond developing static persona approaches, incorporating diverse theoretical frameworks, and addressing validation methods appropriate for different cultural contexts. The findings point to opportunities for methodological innovations to support understanding of how the benefits and burdens of climate action, resource management, and consumption shifts are distributed across different groups. Only by addressing these systemic limitations can persona research contribute meaningfully to inclusive and transformative environmental sustainability initiatives.

Author Contributions

Rajat Patil: conceptualization (equal); writing – original draft (lead); formal analysis (lead); methodology (lead); data curation (lead). **Joni Salminen:** supervision, conceptualization (equal); writing – review and editing (equal). **Waleed Akhtar:** writing – review and editing (equal); Data curation (supporting). **Shah Rukh Shakeel:** writing – review and editing (equal). **Bernard J. Jansen:** writing – review and editing (equal).

Endnotes

[1] Supporting Information: coding data available via OSF repository: https://osf.io/f42tb/?view_only=5f97725d1fa149dcbfd5d61c91d90810.

[2] Supporting Information: coding data available via OSF repository: https://osf.io/f42tb/?view_only=5f97725d1fa149dcbfd5d61c91d90810.

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[4] Supporting Information: coding data available via OSF repository: https://osf.io/f42tb/?view_only=5f97725d1fa149dcbfd5d61c91d90810.

[5] Supporting Information: coding data available via OSF repository: https://osf.io/f42tb/?view_only=5f97725d1fa149dcbfd5d61c91d90810.

[6] Supporting Information: coding data available via OSF repository: https://osf.io/f42tb/?view_only=5f97725d1fa149dcbfd5d61c91d90810.

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Supporting Information

Additional supporting information can be found online in the Supporting Information section. **Table S1:** Overview of reviewed articles with publication details and associated SDGs.