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RETRACTED: Sustainability: A Concept in Flux? The Role of Multidisciplinary Insights in Shaping Sustainable Futures

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Abstract: This study explores the multifaceted concept of sustainability through a multidisciplinary lens, integrating perspectives from natural sciences, social sciences, humanities, economics, engineering, technology, psychology, and health. Drawing on a systematic review of the literature and empirical data from the Sustainable African futures Sustainability School, this research integrates disciplinary insights and aligns them with the United Nations' Sustainable Development Goals (SDGs). The findings reveal significant variations in how different disciplines define, prioritise, and approach sustainability, highlighting the need for transdisciplinary approaches to develop holistic and actionable solutions. This study identifies limitations in multidisciplinary methods, such as potential biases and siloed discussions, and advocates for research that fosters dynamic exchanges across various disciplines. Practical recommendations are provided for corporate sustainability initiatives and governmental policies that align with the SDGs, offering pathways to address the interconnected global challenges of sustainable development. By advancing collaborative transdisciplinary approaches, this study contributes to the shaping of sustainable futures through integrated and inclusive strategies.

Keywords: sustainability; multidisciplinary; transdisciplinary; sustainable development; interdisciplinary collaboration



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1. Introduction

The concept of sustainability has evolved significantly since its early roots in environmentalism, which initially focused on preserving natural resources and maintaining ecological balance [1]. A pivotal moment in this evolution was the publication of the Brundtland Report in 1987, officially titled *Our Common Future*. This report introduced the widely cited definition of sustainable development as “development that meets the needs of the present without compromising the ability of future generations to meet their own needs” [2]. This broadened the understanding of sustainability to include social and economic dimensions alongside environmental concerns, reflecting the interconnected nature of global challenges [3].

Over the decades, sustainability has been subject to diverse interpretations and applications, often tailored to suit varying agendas and contexts [4]. As Farley and Smith (2020) [5] aptly highlight, “if sustainability is everything, then it risks being nothing”, underscoring the challenge of crafting a concept that is both inclusive and actionable. This complexity calls for definitions that balance inclusivity with practical applicability, ensuring that sustainability can effectively guide policies and actions.

The 17 Sustainable Development Goals (SDGs), adopted by the United Nations in 2015, provide a globally recognised framework for addressing sustainability. These goals

encompass a wide range of issues, from poverty and inequality to climate change and environmental degradation, and reflect the multidimensional scope of sustainability [6]. While the SDGs have galvanised global efforts, their implementation varies significantly across regions and sectors, highlighting the need for a deeper understanding of sustainability's diverse interpretations [7–10].

This study explores sustainability's multifaceted nature through a multidisciplinary lens. By examining perspectives from natural sciences, social sciences, economics, health, and engineering, we aim to uncover the assumptions and values that underpin these diverse interpretations of sustainability. This approach aligns with previous studies that advocate for the integration of disciplinary insights to address sustainability's complexities [3,4,11].

Three fundamental questions drive this investigation: What is sustainability? On whose agenda? On whose terms? These questions critically examine the varied definitions and applications of sustainability across disciplines, the power dynamics influencing its discourse, and the frameworks that shape its implementation. Addressing these questions is essential for advancing sustainability in a way that is equitable, inclusive, and effective. By shedding light on these contested perspectives, this study contributes to a comprehensive understanding of sustainability and seeks to pave the way for a transdisciplinary approach that transcends disciplinary silos [1,3,12]. To address these complex challenges, this study integrates both theoretical insights and empirical data collected from the Sustainable African futures Sustainability School, a collaborative initiative involving participants from over ten African countries. The empirical data from the sustainability school offer a unique perspective on regional sustainability priorities and the practical challenges of implementing transdisciplinary approaches.

Aligned with the SDGs, this study integrates multidisciplinary insights to explore contested understandings of sustainability. It aims to advance holistic, actionable solutions to global challenges by fostering collaboration and transcending siloed approaches.

2. Literature Review

2.1. What Is Sustainability? From Environmentalism to Sustainable Development

The concept of sustainability has undergone significant transformation from its early focus on environmental conservation to a comprehensive framework that incorporates both economic and social dimensions. Initially, sustainability efforts were primarily concerned with protecting natural ecosystems from the adverse effects of industrial activities. This early form of environmentalism was poignantly highlighted by Rachel Carson's seminal work, "Silent Spring" (1962), which exposed the detrimental impacts of pesticides on wildlife and sparked widespread environmental awareness and activism [13]. Carson's work catalysed the modern environmental movement, emphasising the need for regulatory measures to safeguard ecological health.

The concept of sustainable development gained prominence with its formalisation in the late 20th century as an approach that balances economic growth, social equity, and environmental protection. Building upon earlier work such as *The Limits to Growth* [14], which highlighted the risks of resource overexploitation, the 1987 definition by the World Commission on Environment and Development (WCED) [2] framed sustainable development as a pathway to meet current needs without jeopardising the ability of future generations to do the same. These foundational contributions emphasised the need for systemic, integrated strategies to address the complex interplay of environmental, social, and economic factors.

Over time, major international milestones further advanced this integrated perspective. The 1992 Rio Earth Summit resulted in Agenda 21, a comprehensive global plan of action for sustainability [15]. Successive global summits, including the Johannesburg Summit in

2002 and Rio + 20 in 2012, expanded on these ideas by refining strategies and fostering a greater international commitment to sustainable development [16]. These initiatives illustrate the progressive evolution of sustainability discourse, ultimately culminating in comprehensive frameworks aimed at addressing interconnected global challenges.

The adoption of the SDGs in 2015 represents a significant milestone in global sustainability efforts, expanding the scope of sustainable development to address contemporary challenges. The 17 SDGs encompass a wide range of objectives, from eradicating poverty and hunger to promoting clean energy and combating climate change [6]. Unlike earlier initiatives, the SDGs explicitly integrate social, economic, and environmental dimensions, acknowledging the multifaceted and interconnected nature of global challenges. Moreover, the SDGs emphasise inclusivity and participatory governance, recognising the critical role of governments, businesses, civil societies, and marginalised communities in achieving sustainable development [17]. While ambitious, the SDGs also face critiques regarding their feasibility and effectiveness in fostering sustainable outcomes [7,9,10].

These historical milestones underscore the dynamic and contested nature of sustainability. The continued evolution of sustainability frameworks reflects ongoing efforts to align global priorities with actionable strategies. By integrating insights from multiple disciplines and stakeholders, sustainability can be pursued as both a shared aspiration and a practical roadmap to address interconnected challenges.

The literature continues to build on these foundational ideas, emphasising the need for transformative changes in how societies and economies operate. For instance, Elkington's concept of the triple bottom line, which evaluates corporate performance based on social, environmental, and economic criteria, has gained traction as a way to promote corporate responsibility and sustainable business practises [18]. The 3BL concept aligns closely with the United Nations' five dimensions of sustainable development—people, planet, prosperity, peace, and partnership (the 5Ps)—which underpin the Sustainable Development Goals (SDGs). The 5Ps build on the 3BL framework by broadening its scope to include aspects of global peace and partnerships, emphasising the interconnected nature of sustainability efforts. Furthermore, the notion of planetary boundaries proposed by Rockström et al. (2009) [19] has provided a scientific basis for understanding the limits within which humanity can safely operate, reinforcing the urgency of sustainable practises to avoid crossing ecological thresholds that could lead to irreversible environmental damage. These evolving concepts underscore the dynamic nature of sustainability and the continuous efforts to refine and expand its application in response to emerging challenges.

Historical vs. Contemporary Perspectives

Historically, sustainability was primarily concerned with environmental protection and resource management. Influential figures like John Muir and Gifford Pinchot advocated for preserving natural landscapes, leading to the establishment of national parks [20]. Their efforts were rooted in the belief that natural beauty and wilderness have intrinsic values that warranted protection from industrial exploitation. This early focus on conservation and preservation laid the groundwork for modern environmental policies and institutions.

Contemporary perspectives, however, embrace a broader view that includes social justice, economic equity, and community resilience. This shift is exemplified by the concept of “just sustainabilities”, which seeks to ensure that sustainability efforts do not exacerbate social inequalities but rather promote fairness and inclusivity [21]. This holistic approach acknowledges the interconnectedness of ecological, social, and economic systems, emphasising the need for a balanced and inclusive development strategy. For instance, the notion of sustainable development has evolved to encompass goals such as poverty eradication,

gender equality, and access to clean water and education, as highlighted by the United Nations' Sustainable Development Goals (SDGs) [6].

The transition from a narrow focus on environmental conservation to a more integrated framework reflects a deeper understanding of sustainability's complexities and trade-offs. Contemporary approaches recognise that environmental degradation and social inequities are often intertwined, necessitating integrated solutions that address multiple dimensions of sustainability simultaneously. This integrated perspective is evident in the growing emphasis on resilience and adaptive capacity in the face of climate change, where community well-being and environmental health are seen as mutually reinforcing goals [22]. Additionally, the incorporation of economic sustainability into the broader discourse highlights the importance of creating economic systems that support long-term environmental stewardship and social welfare, moving beyond mere resource management to fostering sustainable livelihoods and economic opportunities for all [23].

2.2. Whose View on Sustainability Is Appropriate? An Overview of the Existing Literature on Sustainability from Various Disciplines

The concept of sustainability has been explored and interpreted through the lenses of various academic disciplines, each contributing unique perspectives and insights. Natural sciences often emphasise the ecological and environmental dimensions of sustainability, focusing on biodiversity conservation, ecosystem services, and climate change mitigation [24,25]. These perspectives underscore the importance of maintaining an ecological balance and protecting natural resources to ensure long-term environmental health. In contrast, social sciences explore the social implications of sustainability, such as equity, justice, and community resilience, highlighting the interconnectedness of human and ecological systems [21,22]. This approach stresses the need for inclusive and equitable solutions that address the needs of diverse communities.

Economic perspectives examine the viability of sustainable development practises within market economies, addressing the balance between economic growth and environmental preservation [26]. These studies often focus on the integration of sustainability into economic policies and practises, seeking ways to promote green growth and sustainable business models. However, the debate on economic growth versus environmental sustainability remains contentious. The Club of Rome's seminal work [14] raised concerns about the ecological consequences of unrestrained economic expansion, advocating for a re-evaluation of growth-centric paradigms. This tension persists in contemporary discussions, particularly around SDG 8, which seeks to promote sustained economic growth alongside full employment and decent work. Critics argue that SDG 8 opens a "Pandora's box" as its growth-focused goals may conflict with the ecological imperatives of other SDGs, highlighting the complexities of balancing development objectives within planetary boundaries [27,28].

In contrast, the degrowth movement proposes an alternative vision that prioritises well-being and ecological balance over economic expansion, challenging traditional notions of prosperity. Engineering and technological disciplines contribute to these debates by developing sustainable technologies and infrastructure solutions that minimise environmental impact while supporting societal needs [29]. Innovations in renewable energy, sustainable building materials, and efficient waste management systems exemplify how these fields support sustainability goals while navigating the challenges of reconciling economic growth with environmental preservation.

Health sciences integrate sustainability by addressing the impacts of environmental degradation on public health and promoting sustainable health practises [30]. This includes studying the effects of pollution on health, advocating for cleaner environments, and promoting practises that enhance both human health and environmental sustainabil-

ity. An emerging example is the use of carbon balance sheets in healthcare systems to measure and mitigate the carbon footprint of medical facilities and their operations. By quantifying emissions from energy usage, medical waste, and supply chains, these tools enable healthcare providers to implement strategies to reduce their environmental impact while maintaining high standards of care [31]. This multidisciplinary approach underscores the complexity of sustainability, necessitating collaborative efforts across various fields to develop comprehensive and effective solutions. Figure 1 summarises key authors and their contributions to the sustainability discourse from various disciplinary perspectives.

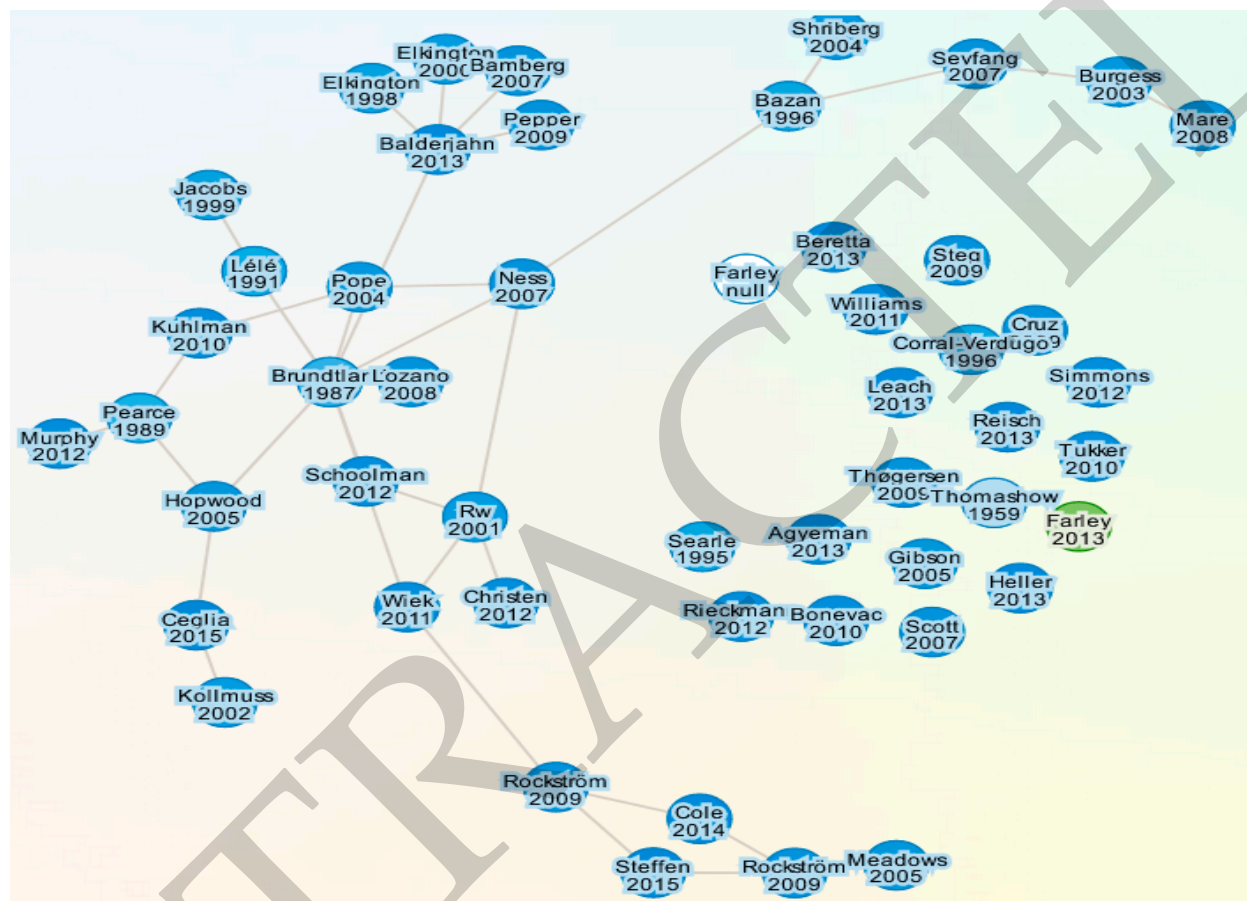


Figure 1. Literature mapping on various aspects of sustainability.

2.2.1. Natural Sciences Perspectives

Natural sciences have been instrumental in advancing sustainability research, focusing on critical issues such as climate change, biodiversity loss, and resource depletion. The concept of planetary boundaries [19] underscores the importance of maintaining an ecological balance by identifying critical thresholds that should not be crossed to ensure Earth's stability. These boundaries include critical processes such as climate regulation, biosphere integrity, land-system change, and freshwater use, which are essential for maintaining Earth's resilience.

Studies continue to highlight the necessity of sustainable resource management and conservation efforts to protect ecological integrity. For instance, Steffen et al. (2015) [32] expanded on the planetary boundaries' framework, emphasising that humanity has already transgressed several of these thresholds, including those related to biodiversity loss and nitrogen cycles, which pose significant risks to global environmental stability. Advances in climate science, as documented by the Intergovernmental Panel on Climate Change [33], provide robust evidence of the accelerating impacts of climate change, urging

immediate and comprehensive actions to reduce greenhouse gas emissions and enhance carbon sequestration.

Moreover, contemporary research in natural sciences has increasingly integrated technological innovations and interdisciplinary approaches to address complex sustainability challenges. For instance, the use of satellite remote sensing and geographic information systems (GIS) has significantly improved the monitoring and management of natural resources [34]. These technologies enable more precise tracking of deforestation rates, water usage, and habitat changes, thereby facilitating more effective conservation strategies.

In addition, the field of ecological economics has long provided valuable insights into the economic implications of environmental degradation and the benefits of ecosystem services [35,36]. While this perspective is not new and has always been integral to sustainability discourse, its relevance continues to grow in light of emerging challenges such as biodiversity loss, climate change, and resource scarcity. What is novel in recent discussions is the application of ecological economic principles in innovative frameworks like natural capital accounting and ecosystem-based valuation models, which provide measurable ways to integrate ecosystem services into national accounting systems [37]. These advancements not only bridge the gap between ecological sustainability and economic development but also advocate for policies that promote environmental health and economic prosperity in a more quantifiable manner. Overall, the contributions from natural sciences and ecological economics remain vital in shaping a comprehensive understanding of sustainability, emphasising the need for maintaining ecological integrity to support long-term human well-being.

2.2.2. Social Sciences and Humanities Perspectives

Social sciences and humanities explore the human dimensions of sustainability, including social equity, community resilience, and behavioural change. Research in this field emphasises the importance of addressing the needs and rights of marginalised communities in sustainability practises [38]. This perspective underscores that sustainable development cannot be achieved without considering social justice and the equitable distribution of resources. Studies have shown that marginalised communities often bear the brunt of environmental degradation and the impacts of climate change, necessitating inclusive policies that prioritise their well-being and involvement [39]. Recent studies continue to explore these dynamics, highlighting the critical role of intersectionality in understanding and addressing the diverse impacts of environmental policies [40].

The field also examines cultural values, social norms, and power dynamics that shape sustainability outcomes. Understanding these factors is crucial for fostering behavioural changes and developing effective sustainability interventions. For instance, Bamberg and Möser (2007) [41] found that a combination of personal attitudes, social norms, and perceived behavioural control influences pro-environmental behaviours. This highlights the need for community engagement and participatory approaches in sustainability initiatives. Engaging local communities in decision-making processes ensures that their knowledge, values, and needs are incorporated, leading to more sustainable and accepted outcomes [22].

Additionally, recent research has focused on the role of social capital and networks in enhancing community resilience. Studies have demonstrated that communities with strong social capital are better equipped to cope with and recover from disasters, emphasising the importance of fostering robust social networks [42]. This multidisciplinary approach within the social sciences provides a comprehensive understanding of how human behaviour, social structures, and cultural contexts interact with sustainability goals, underscoring the complexity and interdependence of these interactions in achieving sustainable development.

2.2.3. Economic Perspectives

Economic perspectives on sustainability focus on integrating environmental and social considerations into economic systems. This integration is evident in various sub-fields, such as corporate social responsibility, sustainable supply chain management, green finance, and sustainable marketing. Sustainable supply chain management emphasises reducing environmental impacts across the entire supply chain, from raw material extraction to product disposal. It involves practises like sourcing from environmentally responsible suppliers, minimising waste, reverse logistics, and optimising logistics to reduce carbon footprints [43,44]. By adopting these practises, companies not only contribute to environmental sustainability but also achieve cost savings and improved efficiency.

Green finance is another critical sub-field, focusing on directing financial flows towards sustainable projects and initiatives. This includes investments in renewable energy, energy efficiency projects, and green bonds that fund environmentally beneficial activities [45]. Green finance aims to mobilise capital for sustainable development, creating financial products that reward environmentally responsible behaviour. The rise in green finance is driven by the increasing recognition that sustainable investments can yield competitive financial returns while addressing pressing environmental challenges.

Sustainable marketing involves promoting products and services based on their environmental and social benefits. This approach not only meets consumer demand for sustainable products but also encourages companies to innovate and adopt sustainable practises [23]. Companies engaged in sustainable marketing highlight their commitment to sustainability through transparency, ethical sourcing, and eco-friendly products, thereby building trust and loyalty among environmentally conscious consumers. These economic perspectives underscore the need for systemic changes to achieve long-term sustainability. They highlight the role of economic incentives and market-based solutions in driving the transition towards sustainable development. By aligning economic activities with environmental and social goals, these sub-fields contribute to a more holistic understanding of sustainability, fostering innovation and collaboration across various sectors.

2.2.4. Health Perspectives

Health perspectives highlight the links between human health and sustainability, emphasising the need for healthy ecosystems to support well-being. Research in this area underscores the impacts of environmental degradation on public health and advocates for sustainable healthcare practises and policies [46]. Sustainable development goals related to health focus on ensuring access to clean water, sanitation, and healthy living conditions, which are crucial for overall well-being [6]. Addressing the question of “whose sustainability?” involves recognising that marginalised and vulnerable populations often face the brunt of environmental health risks. These groups are disproportionately affected by pollution, inadequate access to healthcare, and poor living conditions, making it essential to prioritise their needs in sustainability agendas. Recent studies emphasise the importance of integrating health equity into sustainability frameworks to ensure that all communities benefit from sustainable development initiatives [47,48].

2.2.5. Engineering and Technological Perspectives

Engineering and technological innovations play a crucial role in advancing sustainability by developing solutions that reduce environmental impact and support economic and social goals. Sustainable infrastructure, renewable energy technologies, and efficient resource management systems are key areas of focus [3]. Innovations in green building design, sustainable transportation, and waste management demonstrate the significant contributions of engineering to sustainability [49]. When considering “whose sustainabil-

ity?” and “whose agenda?”, it is critical to ensure that technological advancements are accessible and beneficial to all societal segments. Inclusive engineering practises involve designing technologies that address the needs of underserved communities, promoting equitable access to sustainable solutions. For instance, developing affordable renewable energy systems for low-income households can enhance energy equity and contribute to broader sustainability goals [50,51].

2.2.6. Other Perspectives—Law, Policy, Psychology, and Ethics

Other disciplines, such as law, policy, psychology, and ethics, also contribute significantly to the sustainability discourse. Legal scholars examine the regulatory frameworks necessary for enforcing sustainable practises, while ethicists explore the moral dimensions of sustainability, including intergenerational equity and environmental justice [1]. Psychological issues, particularly mental health concerns, have been found to significantly impact sustainable actions. Mental health can influence an individual’s capacity to engage in and prioritise sustainable behaviours. Stress, anxiety, and other mental health challenges can reduce one’s motivation and ability to make environmentally conscious choices [52], highlighting the need to integrate mental well-being into sustainability initiatives. Policy research focuses on the implementation and effectiveness of sustainability policies at various governance levels, highlighting the importance of coherent and integrated policy approaches [6].

Additionally, perspectives from arts and culture, a field often subordinated to others, are increasingly recognised for their valuable contributions to sustainability [53,54]. Ethical considerations emphasise fairness and justice in resource distribution and the impacts of sustainability policies on different populations [55]. Considering “whose sustainability?” in this context means ensuring that legal, policy, and ethical frameworks are inclusive and address the needs of all stakeholders, particularly marginalised groups. Policies should be designed to promote participatory governance, where diverse voices are heard and considered in decision-making processes, thereby fostering a more just and equitable approach to sustainability [56,57].

2.3. A Call for a Multidisciplinary Approach

Despite the extensive literature on sustainability, significant gaps remain. Many studies are siloed within specific disciplines, leading to fragmented solutions that fail to address the interconnected nature of sustainability challenges [5]. A multidisciplinary approach is essential to overcome these gaps, allowing for a holistic understanding of sustainability. Integrating insights from various disciplines helps us comprehend the complexities and trade-offs involved in achieving sustainable outcomes. Recognising diverse values and incorporating multiple perspectives allow us to navigate contested pathways to sustainability.

Recent research underscores the importance of transdisciplinary collaboration in addressing complex global challenges, advocating for frameworks that bridge disciplinary divides and foster innovative solutions [58,59]. Establishing a research core and a framework for sustainability bridges these divides and fosters collaborative solutions [60]. Moreover, advancements in sustainability emphasise the need for inclusive and participatory approaches, ensuring that all stakeholders, including marginalised communities, are involved in the decision-making process [61]. This comprehensive approach is crucial for developing resilient and adaptive strategies that can effectively respond to the dynamic and multifaceted nature of sustainability issues.

3. Methodology

This study adopted a multidisciplinary approach to comprehensively explore the complex concept of sustainability. By integrating perspectives from various academic fields, we aimed to provide a holistic understanding of sustainability and its implications across different sectors. The methodology involved a systematic review of the existing literature and empirical data collection from the Wits-Edinburgh African Sustainable Futures (WESAF) Sustainability School, which was held from April to May 2024. The participants of the WESAF Sustainability School consisted of 50 individuals, representing multiple African countries, including South Africa, Ghana, Rwanda, Namibia, Kenya, Nigeria, Mauritius, Uganda, and Zimbabwe. Participants were selected based on their expertise in various fields, including natural sciences, social sciences, economics, engineering, health, and psychology. The group included academics, practitioners, and postgraduate students, ensuring a blend of theoretical and practical perspectives. While the participants' geographic origin predominantly focused on African contexts, this enriched the discussions with insights into sustainability challenges and opportunities unique to the Global South. The sustainability school used the SDGs as a unifying framework for multidisciplinary cluster discussions, aligning themes and challenges with specific SDG targets. This approach grounded the findings in a globally recognised framework, enhancing their relevance and applicability.

The systematic review of the literature involved an extensive search and analysis of studies on sustainability from various disciplines, including natural sciences, social sciences, economics, engineering, technology, health, law, policy, and ethics. This review aimed to identify key themes, perspectives, and gaps in the current understanding of sustainability, providing the foundational knowledge necessary for framing the empirical research.

To conduct a systematic review of the literature, this study utilised databases including Scopus and Web of Science, chosen due to their extensive coverage of multidisciplinary research. Search strings combined keywords such as “sustainability”, “transdisciplinary approaches”, “multidisciplinary perspectives”, and “sustainable development”. Boolean operators (AND and OR) were employed to refine the search. The inclusion criteria focused on peer-reviewed articles published between 2000 and 2024, written in English, which addressed sustainability from at least one disciplinary perspective. Exclusion criteria included grey literature, editorials, and articles that lacked empirical or theoretical contributions.

The initial search identified 1200 articles, which were screened for relevance using their titles and abstracts. After applying the inclusion/exclusion criteria, 180 articles underwent full-text screening. The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) framework guided the selection process, ensuring transparency and replicability [62]. The final sample with 67 studies was categorised by discipline to extract themes, research gaps, and emerging trends.

Empirical data were collected from the WESAF Sustainability School, a programme designed to promote academic and social integration among participants from over ten African countries. The programme facilitated structured academic support, skill development, and interdisciplinary collaboration among 50 participants. During the sustainability school, participants were divided into six multidisciplinary clusters, each focusing on different aspects of sustainability:

- Economies, Policies, and Inequalities;
- Education, Culture, and Youth;
- Energy, Technology, and Green Infrastructure;
- Health;
- Land, Food, and Natural Resources;
- Education and Psychology.

Data collection involved participatory focus group discussions within these clusters. Each group discussed critical questions related to sustainability, including defining what sustainability means to their cluster, identifying key issues and whose interests are prioritised in sustainability agendas, determining critical research questions, and discussing methods to address these questions. This participatory approach ensured that diverse perspectives and experiences were captured, providing rich qualitative data for analysis.

The qualitative data collected from the WESAF Sustainability School were analysed using thematic analysis, a method well-suited for identifying, analysing, and reporting patterns within data [63]. Focus group discussion notes and participant reflections were manually coded using a deductive–inductive approach. Initial codes were guided by the study’s research questions, while iterative refinements from multiple readings of the data allowed for the emergence of nuanced themes.

Photographs of the cluster discussion notes provided additional layers of insight. These visual data points were used to complement the transcripts, with key terms and phrases extracted and subjected to basic word-mapping techniques. This approach highlighted variations and overlaps in themes across clusters. Prominent themes included “equity and inclusivity”, “disciplinary dominance”, and “collaborative innovation”. These themes informed the synthesis of disciplinary perspectives and highlighted the nuances in sustainability discourse across clusters.

This thematic analysis provided insights into the interdisciplinary nature of sustainability research, underscoring the importance of collaborative efforts across various fields to develop comprehensive and effective solutions. Manual coding was employed to ensure contextual accuracy and immersion in the data. To capture the nuances of interdisciplinary dialogue, thematic derivation prioritised both recurring patterns and unique insights. For example, themes such as “equity and inclusivity”, “interdisciplinary challenges”, and “mental health in sustainability” were identified, reflecting the diversity of perspectives within the clusters.

4. Findings and Discussion

This section presents the findings from our study, guided by the key questions and objectives stated in the introduction: What is sustainability? Whose interests are prioritised? How do different disciplines define, prioritise, and approach sustainability? By analysing and synthesising the perspectives from various disciplines, we gain a comprehensive understanding of sustainability’s multifaceted nature. Guided by the SDGs, the Education, Culture, and Youth cluster highlighted SDG 4 (Quality Education) and SDG 5 (Gender Equality) as critical priorities, emphasising the role of inclusive curricula in fostering sustainable mindsets. Similarly, the Energy, Technology, and Green Infrastructure cluster focused on SDG 7 (Affordable and Clean Energy) and SDG 9 (Industry, Innovation, and Infrastructure), proposing innovative solutions to accelerate renewable energy adoption in underserved communities.

4.1. Disciplinary Perspectives on Sustainability

The data collected from the WESAF Sustainability School provide insights into how different disciplines approach sustainability. The six multidisciplinary clusters formed during the programme—Economies, Policies, and Inequalities; Education, Culture, and Youth; Energy, Technology, and Green Infrastructure; Health; and Land, Food, and Natural Resources—each had distinct yet overlapping perspectives on sustainability.

The findings from this study highlight distinct disciplinary variations in defining and prioritising sustainability. For instance, while natural sciences emphasise ecological thresholds and biodiversity conservation [19,32], social sciences focus on inclusivity and

community resilience [21,38]. This divergence underscores the need for a transdisciplinary approach, as highlighted by Farley and Smith (2020) [5], to bridge these perspectives and develop actionable solutions. Similarly, the Psychology cluster revealed emerging themes related to mental health and its intersection with sustainability, aligning with recent insights on environmental psychology and human well-being [53,55,60]. These findings underscore the importance of recognising diverse disciplinary contributions while addressing shared global challenges.

4.1.1. Economies, Policies, and Inequalities

This cluster emphasised the role of economic systems and policies in achieving sustainability. Key focus areas included the green economy, sustainable supply chain management, green finance, and social equity. The participants highlighted the need for economic models that integrate environmental and social considerations, advocating for policy interventions and financial incentives to promote sustainable practises. The research questions focused on identifying effective policy frameworks and market mechanisms that balanced economic growth with environmental preservation. The methods used included policy analysis and economic modelling. This aligns with the existing literature that emphasises the need for systemic changes to achieve long-term sustainability [17,23].

4.1.2. Education, Culture, and Youth

The Education, Culture, and Youth cluster explored the role of education and cultural values in promoting sustainability. The discussions emphasised the importance of integrating sustainability into educational curricula and fostering a culture of environmental stewardship among youth. Key focus areas included sustainability education, cultural influences on behaviour, and youth engagement. Key research questions included how educational programmes can effectively instil sustainable practises and how cultural values influence sustainability behaviours. The methods used involved qualitative research, including interviews and surveys with educators and students. This perspective resonates with the findings of Agyeman and Agyeman (2013) [21], who highlighted the interconnectedness of cultural values and sustainability outcomes.

4.1.3. Energy, Technology, and Green Infrastructure

This cluster focused on technological innovations and infrastructure developments that support sustainability. Key areas included renewable energy technologies, green building designs, sustainable transportation systems, and smart cities. Participants stressed the importance of technological advancements in reducing environmental impact and supporting sustainable economic growth. The research questions centred on the development and implementation of sustainable technologies and the policies needed to support these innovations. The methods included case studies, technical assessments, and field experiments. The emphasis on technological solutions is consistent with the works of Graedel and Allenby (2003) [49] and Pröpper (2017) [3], which underscore the critical role of engineering in sustainability.

4.1.4. Health Cluster

The Health cluster highlighted the connections between human health and environmental sustainability. The discussions emphasised the impact of environmental degradation on public health and the need for sustainable healthcare practises. Key focus areas included access to clean water, sanitation, sustainable healthcare systems, and the impact of pollution on health. The research questions explored the health implications of environmental policies and the integration of sustainability into healthcare systems. The methods used included epidemiological studies, health impact assessments, and community health sur-

veys. The findings align with past studies that emphasise the public health dimension of sustainability [30,46].

4.1.5. Land, Food, and Natural Resources

This cluster examined the sustainable management of natural resources, with a focus on land use, agriculture, and food security. Key issues included sustainable agricultural practises, the conservation of biodiversity, equitable resource distribution, and the impact of climate change on agriculture. The research questions addressed methods to achieve food security while preserving natural ecosystems and promoting social equity. The methods included field studies, participatory research, ecological assessments, and geospatial analysis. The focus on sustainable agriculture and biodiversity conservation is supported by both historical perspectives [25,64] and contemporary studies [32,65,66].

4.1.6. Psychology Cluster

The Psychology cluster focused on the interplay between mental health and sustainable behaviours, exploring how psychological factors influence individual and collective actions towards sustainability. The key issues included the impact of mental health on environmental engagement, the role of psychological well-being in promoting sustainable lifestyles, and strategies to enhance environmental awareness and pro-environmental behaviour. Research questions addressed how mental health challenges affect sustainable actions and what psychological interventions can foster environmental stewardship. The methods included surveys, interviews, psychological assessments, and experimental studies, among others.

Recent studies underscore the critical role of mental health in shaping sustainable behaviours. For instance, mental health issues such as stress and anxiety have been shown to reduce an individual's capacity to engage in sustainable practises [67]. Conversely, psychological well-being can enhance environmental engagement by fostering a sense of connection to nature and a commitment to sustainability [68]. These findings highlight the importance of integrating mental health support into sustainability initiatives to promote more effective and sustained environmental actions. By addressing both psychological and environmental factors, this cluster aims to develop holistic approaches that support both mental well-being and sustainability.

To provide a detailed overview of this study's multidisciplinary approach, Table 1 summarises the key focus areas, research questions, and methods that emerged from each cluster's discussions, highlighting the diverse perspectives. Table 1 provides a concise overview of the key focus areas, research questions, and methodologies emerging from the cluster discussions. It highlights the thematic diversity and the areas of convergence that underscore the value of multidisciplinary engagement in addressing sustainability challenges. Additionally, a visual documentation of the cluster discussions, captured in the word map from the discussion notes, further illustrates the depth and variety of the insights gathered during these sessions (see Figure 2).

Figure 2 presents a word map derived from cluster discussion notes, visually representing the frequency and thematic prominence of key terms. This visualisation underscores the overlaps and distinctions between clusters, emphasising the interconnected nature of sustainability challenges.

Table 1. Summary of key focus areas, research questions, and methods for each cluster.

Cluster	Sample Key Focus Areas	Sample Key Research Questions	Methods
Economies, Policies, and Inequalities	Green economy, sustainable supply chains, green finance, and social equity	1. What policy frameworks and market mechanisms balance growth and preservation? 2. How can green finance initiatives be scaled? 3. What are the impacts of sustainable supply chains on economic inequalities?	Policy analysis and economic modelling
Education, Culture, and Youth	Sustainability in education, societal functionality, economic progression, cultural influences, youth engagement, cultural heritage, knowledge production and retainment, and social justice (education as an “equaliser”).	1. How can education effectively instil sustainable practises? 2. How do cultural values influence sustainability behaviours? 3. What strategies increase youth engagement in sustainability initiatives?	Interviews, surveys with educators/students, ethnography, and archival data analysis
Energy, Technology, and Green Infrastructure	Renewable energy, green buildings, sustainable transport, and smart cities	1. What technologies and policies support sustainable infrastructure? 2. How can smart cities contribute to sustainability goals? 3. What are the barriers to the adoption of renewable energy technologies?	Case studies, technical assessments, and field experiments
Health	Clean water, sanitation, sustainable healthcare, and pollution impacts	1. What are the health implications of environmental policies? 2. How can sustainability be integrated into healthcare systems? 3. What is the impact of pollution on public health?	Epidemiological studies, health impact assessments, and community health surveys
Land, Food, and Natural Resources	Sustainable agriculture, biodiversity conservation, and climate change	1. How can food security be achieved while preserving ecosystems? 2. What are the effects of climate change on agricultural practises? 3. How can biodiversity be conserved while promoting social equity?	Field studies, participatory research, ecological assessments, and geospatial analysis

equity considerations from social sciences and economic viability considerations from economic perspectives. The multidisciplinary approach adopted in this study underscores the need for collaboration across fields to address the complex and interconnected nature of sustainability. However, it also highlights the limitations of such an approach, including potential conflicts in priorities and methods.

4.3. Limitations of a Multidisciplinary Approach

While the multidisciplinary approach enriches our understanding of sustainability, it also presents significant challenges. Each discipline has its own methodologies, terminologies, and priorities, which can lead to fragmented efforts and siloed thinking. For instance, while economists might prioritise market-based solutions, social scientists may focus more on participatory and community-based approaches. These differing priorities can hinder the development of integrated strategies that effectively address sustainability's multifaceted nature [17].

Furthermore, the empirical data from the WESAF Sustainability School indicate that working in multidisciplinary teams requires strong communication and collaboration skills, as well as a willingness to understand and respect different disciplinary perspectives. The participatory focus group discussions revealed that while participants valued the diverse insights, they also experienced difficulties in reconciling conflicting viewpoints and integrating them into a unified framework. This finding is consistent with the challenges noted by Schoolman et al. (2012) [30] in achieving interdisciplinary integration in sustainability research.

The geographical context of the participants naturally influenced the perspectives discussed, emphasising issues such as equitable resource distribution, socio-economic inequalities, and the impacts of climate change on vulnerable populations. These regional considerations were noted as part of the study's scope, acknowledging their significance in shaping the sustainability discourse. However, the study's findings maintain relevance in broader global contexts as many of the challenges and solutions discussed are universally applicable.

5. Conclusions and Recommendations

The findings from this study underscore the necessity of adopting a transdisciplinary approach to sustainability, one that transcends disciplinary boundaries and fosters genuine collaboration among the different fields. The multidisciplinary exploration findings revealed the rich yet often fragmented insights each discipline brings to the sustainability discourse. Integrating these diverse perspectives and methodologies is essential to develop more comprehensive and effective strategies to achieve sustainability.

5.1. Key Insights and Reflections

One of the key insights from this study is the recognition that sustainability is inherently multifaceted, encompassing ecological, social, economic, and technological dimensions. The ecological perspective emphasises the critical importance of maintaining planetary boundaries, while social sciences highlight the need for equity and justice [38]. Economic perspectives bring attention to market mechanisms and policy interventions necessary for sustainable development [23], and engineering disciplines offer practical solutions through sustainable technologies and infrastructure [49].

However, this study also revealed significant challenges in achieving genuine interdisciplinary integration. Different disciplines often prioritise conflicting objectives and employ varied methodologies, leading to potential tensions and fragmented efforts. The empirical data from the WESAF Sustainability School highlighted the need for strong

communication and collaboration skills, as well as a willingness to understand and respect diverse disciplinary perspectives.

5.2. The Argument for a Transdisciplinary Approach

This study advocates for a transdisciplinary approach to sustainability, which goes beyond merely combining different disciplinary insights. Instead, it calls for the creation of new frameworks that integrate these perspectives into a cohesive strategy. Recent studies support this view, emphasising the importance of breaking down silos to address complex global challenges effectively [69,70]. A transdisciplinary approach fosters innovation by encouraging the cross-pollination of ideas and methodologies, ultimately leading to more robust and holistic solutions.

The findings of this study indicate that transdisciplinary collaboration can address the limitations of a multidisciplinary approach by fostering a deeper understanding of sustainability's interconnected dimensions. This approach not only enhances the efficacy of sustainability initiatives but also ensures that these initiatives are inclusive and equitable, addressing the needs and rights of marginalised communities.

Recent case studies demonstrate the transformative potential of transdisciplinary approaches in addressing complex sustainability challenges. For instance, collaborative frameworks integrating public health, engineering, and social sciences have been pivotal in advancing equitable access to renewable energy in marginalised communities [11]. Similarly, a recent study on biodiversity conservation underscores how transdisciplinary research fosters stakeholder engagement and policy coherence, ensuring sustainable outcomes in diverse ecological contexts [71]. These examples highlight the resolution of sustainability issues through innovative frameworks that transcend traditional disciplinary boundaries. By pooling knowledge and methodologies from various fields, transdisciplinary research can uncover synergies that lead to more robust and inclusive sustainability solutions.

Advancements in transdisciplinary sustainability efforts from 2023 to 2024 further reinforce the need for collaborative frameworks. Studies have shown that integrating circular economy principles with social justice paradigms has significantly improved urban waste management systems, reducing environmental impacts while promoting social equity [72]. Additionally, global initiatives such as the UN's Integrated Policy Framework on Sustainability emphasise the critical role of transdisciplinary approaches in achieving the Sustainable Development Goals [73]. These developments underscore the urgency of moving beyond isolated disciplinary interventions to embrace integrated solutions that address the interconnected nature of sustainability challenges.

This study demonstrates how aligning multidisciplinary research with the SDGs can provide a cohesive framework for addressing sustainability challenges. By integrating insights from diverse fields, our research advances our understanding of the complexities and trade-offs inherent in sustainable development. Our findings emphasise the need for policy frameworks and academic efforts that prioritise transdisciplinary collaboration, ensuring that sustainability initiatives are both inclusive and impactful.

5.3. Recommendations and Practical Implications

To effectively implement a transdisciplinary approach for sustainability, the following recommendations are provided for both corporate sustainability initiatives and governmental policies and regulations.

5.3.1. Corporate Sustainability Initiatives

Corporations should embed sustainability into their core business strategies, ensuring that all operations, from supply chain management to product development, align with sustainable practises. This can be achieved through the adoption of the circular economy

model, which emphasises resource efficiency and waste reduction [70,74]. Companies should enhance their corporate social responsibility (CSR) initiatives to include comprehensive sustainability goals that address environmental, social, and economic impacts. This includes investing in renewable energy, reducing carbon footprints, and ensuring fair labour practises throughout the supply chain [25]. Additionally, corporations should collaborate with academic institutions, non-profits, and governmental bodies to innovate and implement sustainable technologies and practises. Such partnerships can drive advancements in areas like green infrastructure, sustainable agriculture, and clean energy.

5.3.2. Governmental Policies and Regulations

Governments should develop integrated policy frameworks that address the multi-faceted nature of sustainability. This includes policies that simultaneously target environmental protection, social equity, and economic development. The creation of cross-sectoral committees can facilitate the integration of different policy areas [73,75]. Policymakers should provide financial incentives, such as tax breaks and subsidies, to encourage businesses and individuals to adopt sustainable practises. This can accelerate the transition to renewable energy sources, sustainable agriculture, and green technologies [17]. Moreover, governments must strengthen regulatory standards to ensure that all sectors comply with sustainability principles. This includes stricter environmental regulations, labour rights protections, and standards for sustainable production and consumption.

6. Study Limitations and Future Directions in Sustainability

While this study provides significant insights into the necessity and implementation of a transdisciplinary approach to sustainability, it is not without its limitations. One primary limitation is the reliance on qualitative data collected through the WESAF Sustainability School, which, while rich in detail, may not fully capture the breadth of perspectives across different contexts and regions. The focus groups and discussions, although diverse, were limited to participants from over ten African countries, potentially excluding important perspectives from other parts of the world. Future studies should aim to include a more globally representative sample to enhance the generalizability of the findings.

Another limitation is the potential bias introduced by the multidisciplinary clusters. While the clustering method facilitated in-depth exploration of specific themes, it may have siloed discussions and allowed some participants to dominate. To address this, future research should employ methods that encourage more fluid exchanges between disciplines. Additionally, the focus on qualitative data means that quantitative measures of transdisciplinary impacts were not fully explored. Future research should use mixed-method approaches to quantify these benefits and challenges, potentially through longitudinal studies that track transdisciplinary project outcomes over time.

Despite these limitations, this study opens several avenues for future research. There is a need for further exploration into the mechanisms that facilitate effective transdisciplinary collaboration. This includes understanding the role of institutional support, funding mechanisms, and educational programmes in fostering a culture of interdisciplinarity. Additionally, future research should examine the specific barriers to transdisciplinary work, such as disciplinary silos, differing terminologies, and methodological conflicts, and propose strategies to overcome these challenges.

Another promising direction for future research is the development of frameworks and tools that can operationalise transdisciplinary approaches in practical settings. This includes creating guidelines for integrating diverse perspectives in policy-making, developing assessment tools to measure the impact of transdisciplinary projects, and designing educational curricula that prepare future leaders to work across disciplines.

Finally, there is a critical need to explore the ethical implications of transdisciplinary sustainability efforts. This includes examining methods to ensure that all voices, particularly those from marginalised communities, are included in sustainability dialogues and decision-making processes. Ethical considerations must also address issues of equity and justice, ensuring that sustainability initiatives do not disproportionately benefit certain groups while disadvantaging others.

Overall, while this study has highlighted the potential of a transdisciplinary approach to sustainability, it also underscores the complexity and challenges of such efforts. By addressing these limitations and pursuing the suggested future research directions, scholars and practitioners can further advance our understanding and improve the implementation of effective, inclusive, and impactful sustainability strategies. This study advocates for continued innovation and collaboration across disciplines, driving us towards a more sustainable and equitable future.

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