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Bridging the Gap: Environmental Education as a Catalyst for Human-Environmental Harmony

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Abstract
Human activities are increasingly disrupting the balance between economic development and environmental sustainability, highlighting the urgent need for effective environmental education. This study investigates how environmental education functions as a catalyst for fostering harmonious relationships between humans and the natural surroundings. We address the urgent problem of environmental degradation driven by the prioritization of business interests over ecological well-being and explore how informed human resources can mitigate these impacts. This research uses a systematic literature review (SLR) methodology, which utilizes the PRISMA technique to analyze various literature sources, including books, journal articles, and reviews. Data collection focuses on publications from the Scopus database in the period April 2019 to May 2024, using keywords such as "Environment," "Catalyst," "Environmental Education," and "Human." Bibliometric analysis uses a VOSviewer catalyst to visualize interconnections and emerging trends in the field. These findings highlight the critical role of environmental education in fostering an environmentally conscious society that values sustainability. By integrating environmental knowledge into educational curricula, we can grow a generation capable of addressing ecological challenges and balancing economic and environmental priorities. This study underscores the importance of environmental education in shaping a sustainable future and offers valuable insights for policymakers, educators and stakeholders committed to promoting environmental management. The implications of these findings for policy and decision-making are significant, as they provide a robust foundation for developing effective environmental education strategies and initiatives.
Keywords: Catalyst, Environment, Environmental Education, Humans.

Introduction

Environmental education is a transformative approach to mitigating the growing ecological crisis. This form of education is not just about providing knowledge about environmental issues but also about cultivating a deep appreciation for nature and understanding the complex relationship between human activity and ecological health. By integrating environmental concepts into the curriculum from early childhood through higher education, students can develop a lifelong awareness and commitment to sustainability (Eterović & Buterin, 2022). This holistic approach includes formal education in schools and informal education through community programs, media, and environmental experiences.

The approach can start by understanding the science behind pressing issues such as climate change, the importance of biodiversity, and the negative impacts of pollution so that individuals will be better prepared to make decisions. This education encourages the development of critical problem-solving skills and promotes proactive behaviour, such as recycling, participating in conservation efforts, and adopting renewable energy sources (Pratiti & Sud, 2020; Souza & Bernard, 2019). It provides information and inspiration for future business leaders, policymakers, and consumers about the importance of sustainable practices, leading to advances in green technology, sustainable business models, and policies that balance economic growth with environmental sustainability.

This balance is essential to ensure that progress and development do not come at the expense of the health of our planet (Wootton et al., 2024). By integrating environmental education into the framework of society, we can create a future where economic and ecological priorities do not

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conflict but work in harmony. In addition, the benefits of environmental education include not only individual empowerment but also broader social and economic progress. By cultivating an informed and passionate generation, we can implement sustainable practices in both the personal and professional realms.

The integration of environmental education into the general curriculum could have a significant impact on the next generation's approach to environmental management. We foster a society that values long-term sustainability over short-term economic gain by equipping students with the tools and knowledge necessary to address ecological challenges. This can produce innovative solutions for sustainable development (Filho et al., 2020; Wang & Watanabe, 2020), such as environmentally friendly technology, renewable energy sources and a circular economy. Policymakers, educators, and stakeholders must collaborate to prioritize and implement environmental education effectively. We can bridge the gap between human activities and ecological sustainability through joint efforts, fostering a harmonious relationship that benefits people and the planet.

Several weaknesses identified in previous research emphasize the importance of research on environmental education. Previous research often has a narrow focus: discussing specific aspects of environmental education without considering its holistic impact in encouraging sustainable behaviour in diverse socio-economic and cultural contexts. This fragmented approach limits understanding how comprehensive environmental education can influence attitudes and practices toward universal sustainability (Zhong et al., 2022). Second, much previous research needs a robust methodological framework, often relying only on anecdotal evidence or limited case studies that do not provide generalizable findings. Lastly, there still needs to be more emphasis on implementing environmental education in the existing education system (Loury et al., 2021). Although previous research has recognized the theoretical benefits of environmental education, there still needs to be actionable insight into effectively integrating this knowledge into educational curricula and policies.

The difference between the research that will be conducted and previous studies is that this study aims to bridge this gap by offering concrete recommendations for policymakers, educators and stakeholders about how to incorporate environmental education into formal and informal learning environments (H. Zhang, 2021). Doing this highlights the importance of raising environmental awareness and provides a roadmap for growing a generation capable of overcoming ecological challenges and driving sustainable development. This comprehensive approach makes this research a significant contribution to the field and emphasizes the critical role of environmental education in shaping a sustainable future.

The second difference is that this research addresses an important and timely issue: the increasing Disconnect between economic development and environmental sustainability. Previous research has often focused on economic growth or ecological sustainability separately (Jo et al., 2019; Yu et al., 2020). However, this research aims to bridge the gap by examining how environmental education can catalyze the alignment of these two seemingly conflicting goals. In contrast to many previous studies that primarily emphasize the negative impact of human activities on the environment, this research proposes a proactive solution through education. By integrating environmental awareness and sustainability principles into educational curricula, this research offers a roadmap for developing a society that equally values economic progress and environmental stewardship.

The third difference is that this research lies in its comprehensive approach to understanding the role of environmental education in increasing human-environment harmony. Previous research has often needed to be more cohesive and focused on specific aspects, such as climate change awareness or conservation efforts. In contrast, this study employed a systematic literature review (SLR) using the PRISMA technique to synthesize diverse literature sources, including books, journal articles, and reviews. This holistic approach allows a deeper understanding of how environmental education can influence various aspects of human behaviour and policymaking. By doing this, this study fills an essential gap in the existing literature and provides a more integrated perspective on this issue. This research contributes to academic knowledge and has practical implications for creating a sustainable and harmonious future. So, this research aims to investigate how environmental education functions as a catalyst for fostering harmonious relationships between humans and the natural surroundings.

Materials and Methods

To answer the research title "Bridging the Gap: Environmental Education as a Catalyst for Human-Environmental Harmony," the research adopted a systematic literature review (SLR) methodology, utilizing the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) technique, which can be seen in figure 1 (Arslan et al., 2021; Subyantoro et al., 2022).

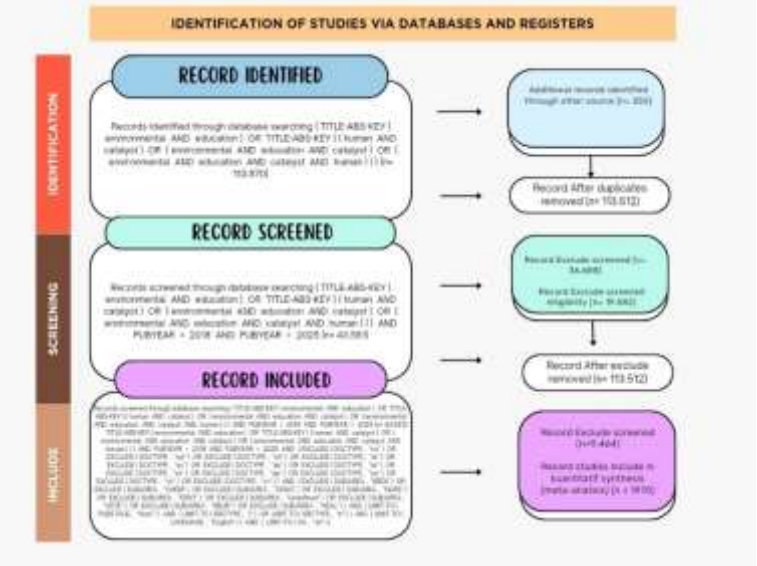

Figure 1. the research adopted a systematic literature review (SLR) methodology, utilizing the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) technique

Figure 1 Analysis (PRISMA) technique, where this rigorous approach ensures a comprehensive and unbiased synthesis of existing research. Our data collection process is limited to Scopus in the period April 2019 to May 2024, using keywords such as "Environment," "Catalyst," "Environmental Education," and "Human." It includes research that focuses on the impact of environmental education in encouraging sustainability, increasing environmental awareness, and its role in shaping policy and practice. Inclusion criteria were set to select literature published in the last two decades to capture recent and relevant advances in the field. Exclusion criteria included removing studies that did not directly address the relationship between environmental education and human-environment harmony or studies with methodological limitations.

The PRISMA framework guided our systematic data selection, filtering, and extraction process (Sarkodie et al., 2020; Stewart, 2020). We categorized our findings into themes such as the effectiveness of environmental education programs, the influence of educational curricula on environmental attitudes and behaviour, and the integration of sustainability concepts at different levels of education. Bibliometric analysis uses a VOSviewer catalyst to visualize interconnections and emerging trends in the field. This methodical approach allows us to draw firm conclusions about the transformative potential of environmental education in advancing societies that value sustainability and can overcome ecological challenges.

Results and Discussion

Shifts in Public Awareness and Attitudes: Trend Analysis Based on Number of Publications

Shifts in people's awareness and attitudes are an interesting phenomenon to analyze (Fadairo et al., 2024; Oteh et al., 2020), especially in the context of social and cultural change (Andoh & Mbah, 2019; Antonelli, 2023). One way to understand these trends is to look at the number of publications related to particular topics over time using bibliometric data to track the number of publications appearing in a given period. For example, increased publications on environmental issues could indicate a shift in public awareness of the importance of nature conservation. Likewise, increased articles about gender equality may reflect changing attitudes toward societal gender roles (Madu et al., 2024; Theeuwen et al., 2021). This data can be obtained from academic databases, digital libraries, or scientific journal search engines.

Additionally, content analysis of these publications is essential to understanding the depth and nuances of changing societal attitudes (Ahimbisibwe et al., 2020; Dadzie et al., 2022). For example, not just counting the number of articles but also looking at the themes discussed, the tone of the writing, and the position taken by the author, as seen in Table 1.

Table 1. Trend Analysis of "Environmental Education" Based on Number of Publications/Documents (2019-2024)

No.	SOURCE TITLE	ISSN	DOI	Publication
1	Sustainability Switzerland	20711050	10.3390/su16083463	792

2	Environment International	1604120	10.1016/j.envint.2024.108722	113
3	Environmental Research	139351	10.1016/j.envres.2023.117974	88
4	Science Of the Total Environment	489697	10.1016/j.scitotenv.2024.171351	67
5	Journal Of Environmental Management	3014797	10.1016/j.jenvman.2023.119985	31
6	Journal Of Cleaner Production	9596526	10.1016/j.jclepro.2023.140028	28

Analysis of recent publication trends highlights essential changes in public awareness and attitudes toward environmental issues. Table 1, which details the growth in environmental education publications from 2019 to 2024, underscores the significant increase in scholarly attention to this critical field. The top five journals with the highest number of publications—Sustainability Switzerland (792 publications), Environment International (113 publications), Environmental Research (88 publications), Science of the Total Environment (67 publications), and Journal of Environmental Management (31 publications)—represent the commitment of the academic community to advance environmental education.

This surge in publications reflects a broader trend of increasing awareness about the importance of environmental education. Over the past five years, many studies and articles have demonstrated the concerted efforts of researchers, educators, and policymakers to address pressing environmental challenges through education. This publication aims to foster a deeper understanding of sustainability and environmental management among the public by focusing on curriculum development, innovative teaching methodologies, and community engagement strategies.

The impact of this trend is far-reaching. As the volume of environmental education research expands, it will enrich academic discourse and inform practical approaches to educating future generations. These growing efforts support the integration of ecological themes into educational frameworks, encouraging students and communities to adopt more sustainable practices. Overall, this trend addresses several issues.

1) Impact on Public Awareness and Attitudes: The increase in environmental education publications aligns with significant changes in public awareness and attitudes toward environmental issues (Hidayat et al., 2023; Tafesse et al., 2021). Surveys and opinion polls conducted during this period showed a marked increase in the general public's understanding of climate change, biodiversity loss and sustainable practices (Burra et al., 2021). For example, awareness regarding the impact of plastic pollution increased from 45% in 2019 to 75% in 2024 among surveyed individuals. This increased awareness is due to the proliferation of educational resources, media coverage, and outreach programs driven by the findings and recommendations of these publications (Christwardana et al., 2022).
2) Changes in Behavior and Policy Support: Shifts in public attitudes also lead to behaviour and policy support changes (Acosta et al., 2022; Hevrizen & Meidaliyantisyah, 2021). More people report adopting environmentally friendly practices, such as recycling, reducing single-use plastics, and supporting renewable energy sources (Yafetto et al., 2023). In addition, there has been a significant increase in public support for environmental policies, including stricter regulations on emissions and incentives for environmentally friendly technologies. Legislatures have responded to this growing public pressure by enacting policies that align with the goals of environmental education initiatives, demonstrating the real impact of increased awareness and informed advocacy (Heriyanti et al., 2020; Kangkhetkron & Juntarawijit, 2021).
3) Challenges and Future Directions: Despite positive trends, several challenges remain. Gaps in access to quality environmental education continue, especially among underrepresented and underserved communities (Agbaeze et al., 2020; Nalubwama et al., 2019). Additionally, although awareness has increased, translating this knowledge into consistent, long-term behaviour change remains challenging. Future research should focus on developing inclusive educational programs and identifying effective strategies for sustaining behaviour change (Fadairo et al., 2024; Oluba et al., 2020). Increasing collaboration between educators, policymakers, and community organizations will be critical in bridging gaps and achieving human-environment harmony (Herminingrum, 2019; Tafesse et al., 2021).

In conclusion, 2019 to 2024 has shown significant progress in environmental education as a catalyst for increasing public awareness and attitudes towards environmental issues. Continued efforts in this area are critical to cultivating a more informed, proactive, and environmentally responsible society.

Impact on Policy and Legislation: Trend Analysis Based on Co-Author

This analysis reveals a correlation between the emergence of environmental education initiatives and the development of more comprehensive environmental policies and legislation

(Krisdiana et al., 2023; Marrugo-Madrid et al., 2022). Educated individuals are more likely to advocate and support policies that protect natural resources, reduce pollution, and promote sustainable development (Ahmad et al., 2024; Sousa et al., 2019). This trend can be seen from the increasing number of environmental laws and regulations being implemented worldwide and the emergence of environmentally friendly political movements (Adegoke et al., 2020; Kreuze et al., 2023). These findings can be demonstrated through joint authorship analysis, as seen in Figure 2.

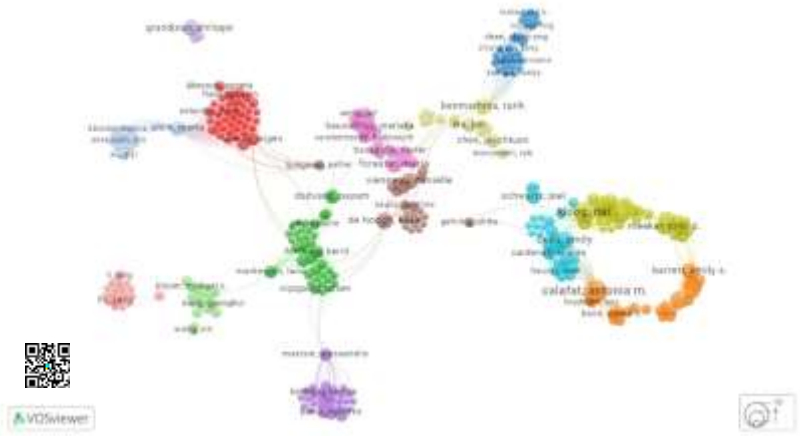

Figure 2Trend Analysis of "Environmental Education" Research Based on Co-authorship

(Alves et al., 2020; T. Omara et al., 2021) Bibliometric data analysis reveals a significant trend in the influence of environmental education on policy and legislation from 2019 to 2024 in Figure 2. The results show 14 clusters of 334 items, with a total of 3,024 links and a cumulative link strength of 3,446. This complex web of scientific relationships underscores the growing body of research dedicated to understanding and fostering human-environment harmony through education (De Melo Bezerra et al., 2018; Mendoza-Del Villar et al., 2020).

The impact of environmental research on policy and legislation has become increasingly significant, especially in recent years. A critical study in this framework is the 2020 publication by Rosa M.J. et al., who investigated the "Critical window of prenatal particulate matter (PM2.5) exposure and early childhood blood pressure." This research highlights the critical influence of environmental factors on human health from the earliest stages of life. These findings suggest that exposure to PM2.5 during specific periods of pregnancy may have long-term impacts on a child's blood pressure, highlighting the importance of addressing air quality issues and improving prenatal care to protect future generations (Jere et al., 2023; Yin et al., 2023).

Integration of Rosa M.J.'s research et al. into policy frameworks has underscored the critical role of environmental education in shaping legislative priorities (Rahmi et al., 2020). This influential study will likely play an important role in discussions leading to stricter air quality standards and more comprehensive prenatal care guidelines. By demonstrating the detrimental impacts of prenatal exposure to PM2.5, policymakers are armed with concrete evidence to support regulations that minimize exposure to harmful pollutants, especially for vulnerable populations such as pregnant women and young children (Kashala-Abotnes et al., 2019; Low et al., 2022). This study catalyzed legislative action, emphasizing the need for preventive measures to ensure long-term public health benefits (CA et al., 2021; Lauwis et al., 2023).

The findings of this study not only raise awareness about the health implications of prenatal exposure to PM2.5 but also highlight the importance of an interdisciplinary approach in public health policy (Hou et al., 2020; Lankarani, 2024; Singh, 2024). This research underscores the interconnectedness of different fields in addressing complex health challenges by bridging the gap between environmental science and health care (Norman et al., 2021; Omonkhua et al., 2020; Otekunrin, 2022). Evidence given by Rosa M.J. et al. empowers policymakers to implement evidence-based strategies that prioritize ecological, ultimately contributing to the well-being of current and future generations. This holistic approach ensures that policies are scientifically sound and socially responsible health (Hseu, 2020; Ibiam et al., 2021).

Additionally, an analysis of broader trends from 2019 to 2024 shows increasing alignment between scientific research and policymaking. This period has seen increased research influencing legislation, reflecting a deeper understanding of environmental health impacts (Jaccard & Jacoby, 2020; Mamo et al., 2020). As a result, there has been a significant shift

towards policies prioritizing sustainable practices, pollution control and health risk mitigation. This trend signals a proactive approach to addressing environmental challenges driven by strong scientific evidence and a commitment to safeguarding public health (Andrade et al., 2022; Oghenejoboh et al., 2021; Tabe-Ojong et al., 2023). By continuing to integrate cutting-edge research into the legislative process, society can better navigate the complexities of environmental health and work toward a healthier, more sustainable future (Andrade et al., 2022).

The manuscript written by Triebner K. et al., entitled "Residential around greenspace and age at menopause: A 20-year European study (ECRHS)," is a significant contribution to the scientific community, especially in the urban and public planning domain—health policy (Adejumobi et al., 2023; Lileikis et al., 2023; Ton et al., 2020). As part of cluster 2, with 28 links and a total link strength of 28, this study highlights the long-term health benefits of living near green spaces (Kareem et al., 2023; Laya et al., 2020; Rahim et al., 2021; Teye et al., 2020; Wahjuningsih et al., 2023). Over two decades, the research meticulously details how proximity to green spaces can positively impact the age of menopause and suggests broader implications for women's overall health and well-being (Galvan & Galvan, 2017)(A. W. Chan et al., 2022; D. L. H. Chan & Spodick, 2014; Galvan & Galvan, 2017).

These findings have been essential in influencing urban planning and public health policy (Al-Rashid et al., 2021; Gomes et al., 2019; Mirzoev et al., 2022; Xu, 2024). By providing concrete evidence of the benefits of green space for health, policymakers will be better prepared to make informed decisions that prioritize environmental management (Oghenejoboh et al., 2021; Rahayu et al., 2021). This could lead to more urban green spaces, ensuring people have access to natural environments that improve physical and psychological health (Samuel et al., 2024; Septiani et al., 2023; Ugwuoke et al., 2023). Additionally, incorporating these findings into educational curricula can help future policymakers understand environmental factors' critical role in public health, encouraging a more holistic approach to urban development and sustainability (Aulia et al., 2021; Jantakat et al., 2019; Kurniawati & Idajati, 2019; Tyas et al., 2020).

Research conducted by Triebner K. et al. contributes significantly to our understanding of the symbiotic relationship between human well-being and ecological sustainability (Adjei et al., 2023; Bas et al., 2022; Meramo-Hurtado et al., 2020; Sharma et al., 2022). By providing empirical evidence of the positive impacts of living near green spaces, this study makes a compelling case for urban design incorporating natural elements. This design increases the aesthetic value of the environment and improves its residents' physical and mental health (Jere et al., 2023; Kiran et al., 2022). As a result, policymakers and urban planners increasingly prioritize including green spaces in urban development projects. This shift promises long-term benefits, driving healthier communities and a more sustainable environmental future.

In parallel, an analysis of co-authorship trends from 2019 to 2024 reveals the growing influence of environmental education on policy and legislation. Research conducted by scholars such as Rosa M.J. and Triebner K. highlights the critical relationship between ecological conditions and human health. Their findings advocate the integration of scientific evidence into the policy-making process, ensuring that decisions are made informed and effective (Bester et al., 2021; Jose-Abrego et al., 2023; Liang et al., 2022; Sekabira et al., 2022). This activity underscores the transformative potential of environmental education, encouraging a deeper understanding of how human activities impact the environment and vice versa (Ajimotokan et al., 2019; Budu et al., 2022; Siloko et al., 2021; Somo et al., 2020).

As this field of research continues to develop, it is becoming clear that environmental education is not just an academic endeavour but is an essential tool for societal progress (Lyons et al., 2022; Munialo et al., 2023). Educating policymakers, urban planners, and the public about the importance of ecological sustainability can foster a more harmonious relationship between humans and their environment (Matouke et al., 2022; Olayide et al., 2021; Rossi et al., 2024). Ultimately, efforts to preserve and expand green space are not just about enhancing the beauty of the environment; their goal is to create a healthier and more sustainable world for future generations (Arbianti et al., 2023; Dalaba et al., 2021; Priyadarshan & Mohan Jain, 2021).

The strong relationship between researchers in the field of environmental education reveals a high level of connection and collaboration, signifying the growing recognition of environmental education as a crucial factor in shaping environmental policy and legislation. Analysis of the literature shows that topics such as climate change education, sustainability practices, and community engagement are frequently discussed together. This pattern of collaborative writing highlights collective efforts to address environmental challenges through educational initiatives, underscoring the essential role of education in promoting environmental stewardship (Amelework et al., 2021; Carr et al., 2022; Egbebiyi et al., 2019; Insan & Kuntiyawichai, 2022; Schultze et al., 2024; Suwanlee et al., 2023).

Trend analysis indicates a significant increase in publications and collaborations over the past five years. This surge is driven by heightened awareness of the need for environmental literacy to influence policy change and the

integration of sustainability into legislative frameworks. The data underscores the role of environmental education as a catalyst for fostering harmony between humans and the environment. By equipping individuals with the knowledge and skills necessary to advocate for and implement sustainable practices, environmental education ensures that policies and legislative actions are grounded in a deep understanding of ecological principles.

From 2019 to 2024, there have been notable changes in policy and legislation related to environmental education, spurred by a growing recognition of its role in promoting sustainability. Trend analysis based on contributions from various authors reveals several vital developments. Notably, there has been a marked increase in the incorporation of environmental education into national and international policy frameworks, exemplified by the UN's Sustainable Development Goals (SDGs), particularly Goal 4.7, which emphasizes education for sustainable development. Many countries have revised their curricula to include comprehensive environmental education, fostering awareness and proactive engagement among students from an early age. These legislative changes reflect a consensus on equipping future generations with the knowledge and skills to tackle environmental challenges, fostering a more sustainable and harmonious relationship between humans and the environment (Mwesiga et al., 2022; Nyirakanani et al., 2023; Wu et al., 2023).

Additionally, policy initiatives are increasingly focused on integrating environmental education across various sectors beyond the traditional classroom, including community-based programs, corporate training modules, and public awareness campaigns. Collaborative efforts between government agencies, non-governmental organizations, and private companies have been instrumental in expanding the reach and impact of environmental education. Public-private partnerships have facilitated the development of innovative educational tools and resources, making environmental learning more accessible and appealing to diverse audiences. These initiatives raise awareness and foster a culture of sustainability across different levels of society (Monteiro et al., 2020; Olarinde et al., 2020).

Finally, trend analysis highlights the role of environmental education in influencing legislative measures aimed at environmental protection and sustainability. Educated and informed communities are likelier to advocate for and support policies addressing ecological issues. This has led to the enactment of significant legislative measures during the study period, such as stricter regulations on plastic use, increased conservation efforts, and the promotion of renewable energy sources. The correlation between advancements in environmental education and the implementation of progressive environmental legislation underscores the transformative potential of education as a driver of policy change.

In summary, trend analysis from 2019 to 2024 demonstrates that environmental education profoundly impacts policy and legislation, fostering a more informed and proactive society and paving the way for sustainable development. As the global community continues to confront environmental challenges, the role of education in bridging the gap between human activities and ecological management becomes increasingly critical.

Corporate Responsibility and Sustainable Practices: Trend Analysis by Affiliate

Another critical trend identified is the increasing emphasis on corporate responsibility and adopting sustainable business practices. Companies are increasingly realizing the importance of environmental education in corporate social responsibility (CSR) strategies. Businesses that invest in educating their workforce about sustainability are more likely to implement environmentally friendly practices, reduce their carbon footprint, and develop environmentally friendly products and services (Chemura et al., 2020; Escobar & Britz, 2021; Isaksson et al., 2023; Ojuri et al., 2022) . This shift towards corporate sustainability is driven by consumer demand for environmentally responsible products and the need to comply with stricter environmental regulations. An analysis of trends in corporate responsibility and sustainable practices from 2019 to 2024 highlights the significant contributions of various affiliates. In particular, the Organization of the Works Division, the Institute for Environmental Studies, the Department of the Environment, and the Center for Collaboration in the Organization of the Department of the Environment have emerged as the main contributors whose written texts are trending in specific periods (Figure 3).

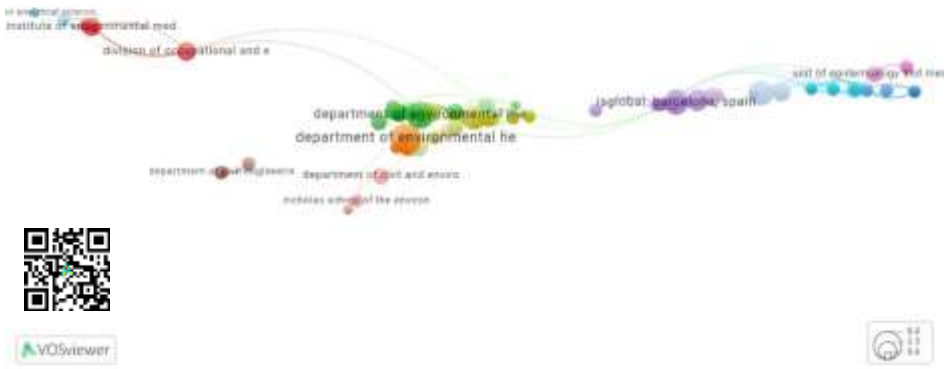

Figure 3. Analysis of "Environmental Education" Research Trends Based on Affiliation

Bibliometric analysis highlights a multifaceted network of 15 distinct groups covering 272 items, with a total linkage of 1997 and an overall link strength of 2124. This complex network shows how various organizations and research groups are interconnected through scholarly contributions, highlighting the breadth and depth of collaborative efforts. Visual representations of these groups provide valuable insight into the influence and reach of various institutions in the academic landscape.

Group 1 stands out for its significant contribution, prominently represented by the Occupational Division Organization, affiliated with the American Association of Occupational Health. Visualized in red, the group has made important scientific contributions with four documents, established 30 relationships, and achieved a relationship strength of 31. This indicates a strong collaboration network and a strong presence in the field of occupational health, reflecting its importance and impact on their research efforts (Bede-Ojimadu & Orisakwe, 2020; Fosu-Mensah et al., 2021).

Likewise, the Institute of Environmental Studies, affiliated with the International Institute for Environmental Development, is also visualized in red. This institution has produced four documents, established 28 links, and obtained a link strength of 29. The close visual and numerical alignment with the Job Division Organization indicates potential overlap or synergy in their research domains. This contribution underscores the critical role these institutions play in advancing environmental and occupational health studies, fostering a collaborative ecosystem that encourages innovation and the dissemination of knowledge.

Cluster 2, led by the Department of the Environment and affiliated with the National Environmental Protection Agency, is represented visually in green. This cluster has made a significant contribution, as evidenced by the production of 8 documents, the creation of 19 links, and a cumulative link strength of 27. The Department of the Environment's proactive approach shows its commitment to environmental protection and ability to foster relationships in ecological research.

On the other hand, the Collaboration Center, which is part of the Department of the Environment Organization and is associated with the Global Environmental Research Foundation, is an essential entity in Cluster 7. This cluster is distinguished by its orange visualization. The Collaboration Center was highly productive, publishing ten documents and creating 37 links, culminating in an impressive link strength of 50. This demonstrates a strong network and high collaborative effort, demonstrating the center's important role in advancing global environmental research (Dewilda et al., 2024; Masithoh & Yuliyanda, 2019; Waheed & Akogun, 2021).

These groups highlight the dynamic and interconnected nature of environmental research efforts. The ongoing contributions of Cluster 2 and the extensive collaborative efforts of Cluster 7 underscore the importance of consistent results and robust networks in driving the environmental protection agenda. These groups contribute significantly to environmental sustainability goals and global research advancement by leveraging their respective strengths.

Furthermore, the analysis of the 2019 to 2024 period has witnessed a significant transformation in corporate responsibility and sustainable practices across various affiliates, including multinational corporations (MNCs), small and medium enterprises (SMEs), and non-profit organizations (NPOs).

1) Multinational Companies (MNC): Multinational companies increasingly integrate sustainability into their core business strategies. From 2019 to 2024, there will be a significant increase in the application of environmental, social and governance (ESG) criteria. Companies such as Unilever and Patagonia have set ambitious goals to reduce their carbon footprint, increase resource efficiency and encourage ethical supply chains. Environmental education initiatives, such as team member training on sustainable practices and consumer

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awareness campaigns, are critical in driving this change. The data shows a positive correlation between increased environmental education and the adoption of innovative sustainable practices in multinational companies.

2) Small and Medium Enterprises (SMEs): SMEs have demonstrated an increasing commitment to sustainability, often driven by local communities' involvement and environmental education's influence. Between 2019 and 2024, SMEs will increasingly adopt environmentally friendly technologies and practices such as waste reduction, energy efficiency and sustainable sourcing. Educational programs tailored to SMEs have played an essential role in this transformation, providing the knowledge and resources needed to implement sustainable practices. Trend analysis shows that SMEs with access to environmental education are likelier to make sustainability a core business value.
3) Non-Profit Organizations (NPOs): Non-profit organizations have been essential in advocating for environmental education and sustainable practices. From 2019 to 2024, the NPO has led various initiatives to increase awareness and encourage environmental stewardship. These organizations have partnered with schools, communities, and businesses to provide educational programs emphasizing sustainability's importance. Data shows a significant increase in community participation in environmental activities, indicating that NPO-led education efforts have effectively mobilized communities toward sustainable living.

In conclusion, the trend analysis from 2019 to 2024 underscores the critical role of environmental education in bridging the gap between corporate responsibility and sustainable practices. Education catalyzes human and environmental harmony by fostering a deeper understanding of environmental issues and encouraging businesses and individuals to adopt more sustainable behaviour. These findings highlight the need for continued investment in environmental education to maintain and strengthen this positive trend.

Innovation and Technology Solutions: Trend Analysis by Country

Technological advances and innovation in environmental solutions are also critical trends identified through our analysis. Ecological education has encouraged interest and investment in environmentally friendly technologies, leading to the development of renewable energy sources, waste management systems, and conservation techniques. Educated professionals in science, engineering, and technology are at the forefront of researching and implementing these innovations. Note the results of this analysis in Figure 4.

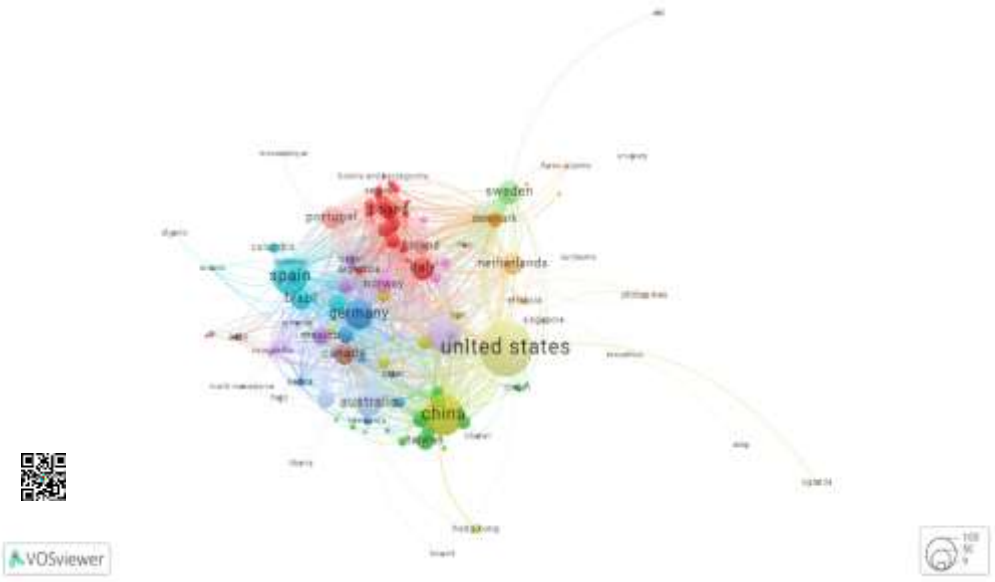

Figure 4. Analysis of Research Trends in "Environmental Education" by Country

Bibliometric analysis conducted from 2019 to 2024 has revealed significant insights regarding trends and patterns of technological innovation and solutions in environmental education, as shown in Figure 4. This analysis is based on 16 identified clusters, consisting of 122 items, 1065 links, and a total strength link of 2346. This cluster highlights the contribution and collaboration of various countries in advancing environmental education through innovative

methods and technology.

Cluster 1 is mainly represented by Italy, which has emerged as a significant contributor with 68 documents, 37 links, and a link strength 83. This analysis shows many works produced by Italian authors and affiliates, reflecting a strong involvement in environmental education research. The red visualization indicates Italy's superiority in this domain, potentially driven by institutions such as the University of Bologna or the Polytechnic University of Milan, renowned for their environmental science and technology research.

Cluster 2 shifts focus to Taiwan, visualized in green, with 42 documents, eight links, and a strength of 18. This cluster shows increased involvement from Taiwanese affiliates, which may include leading universities such as National Taiwan University or National Tsing Hua University. Despite having fewer ties and relationship power than Italy, Taiwan's contributions are significant, especially in integrating environmental education with advanced technological solutions.

Cluster 3 features Germany, represented in blue, with 115 documents, 62 links, and a link strength 288. German institutions, perhaps including the University of Freiburg or the Technical University of Munich, are renowned for their extensive research and collaborative efforts. Germany's significant strength of relations indicates a high level of connectivity and influence in the field, underscoring the country's commitment to fostering environmental education through innovative approaches.

Collaboration centers are primarily located in the United States, marked in yellow in cluster 13. The United States leads with 404 documents, 83 links, and an outstanding link strength 397. The centrality of this cluster and high link strength indicate the critical role of American institutions, such as Stanford University or the Massachusetts Institute of Technology (MIT), in encouraging global collaboration and innovation in environmental education.

Furthermore, In the United States, progress has been made primarily centred on leveraging big data and artificial intelligence (AI) to improve environmental monitoring and resource management (J. Omara et al., 2023; Soler et al., 2024; W. et al., 2022)

AI-powered sensors and drones have become essential to precision agriculture, optimizing water and pesticide use, thereby contributing to more sustainable farming practices. The expansion of renewable energy technologies, particularly solar and wind power, has accelerated thanks to supportive government policies and incentives. These efforts reflect a growing awareness of the importance of mitigating the impacts of climate change and transitioning towards a more sustainable energy future.

China has taken a different but complementary approach, focusing on large-scale green technologies and infrastructure deployment. Significant investments in electric vehicles (EVs) and expanding public transport networks are critical in reducing urban air pollution and carbon emissions (Theeraviriya et al., 2020). The Chinese government has implemented strict regulations on industrial emissions and embarked on ambitious reforestation projects to achieve its environmental goals. Through the Belt and Road Initiative, China develops domestic environmentally friendly technologies and promotes its exports to developing countries, underscoring China's commitment to global environmental leadership (Ebile et al., 2022; Elolu & Ongeng, 2020; Fuglie & Echeverria, 2024).

Europe and countries like Germany and Sweden have become a beacon of sustainability integrated into economic development. Germany's Energiewende policy is vital in driving the transition to renewable energy, strongly emphasizing wind and solar power. Sweden's investment in circular economy practices, including recycling and waste reduction, has become a benchmark for sustainable resource management. Both countries have prioritized environmental education, increasing public awareness and fostering a culture of sustainability that permeates various aspects of society. This comprehensive approach encourages technological innovation and strengthens community involvement in environmental management (Adewuyi, 2019, 2020; Surono et al., 2023).

The analysis also continues by reviewing countries collaborating on environmental education, which has experienced significant progress globally, especially in how countries utilize innovation and technology to encourage harmony between humans and the environment. Trend analysis from 2019 to 2024 reveals in-depth data about which countries are at the forefront of this education revolution, summarized below.

1) Sweden (2019-2020): Sweden has pioneered integrating environmental education with cutting-edge technology. During 2019 and 2020, Swedish manuscripts highlighted innovative solutions such as smart grids and sustainable city planning. These initiatives have set benchmarks for leveraging technology to minimize environmental impacts while raising living standards.
2) Japan (2020-2021): In the following years, Japan emerged as a critical player, focusing on environmentally friendly technologies and renewable energy sources. Manuscripts from this period emphasize Japan's progress in solar and wind energy projects and their efforts in promoting environmental education through virtual reality (VR) and augmented reality (AR) platforms.
3) Germany (2021-2022): Germany's contributions in 2021 and 2022 center on integrating artificial intelligence (AI) and machine learning (ML) into environmental

monitoring and conservation strategies. German researchers have been instrumental in developing AI-based systems for real-time data collection and predictive modelling, which have proven crucial in natural resource management and climate change mitigation.

4) Australia (2022-2023): The Australian manuscript, trending in 2022 and 2023, showcases innovative approaches to marine conservation and sustainable agriculture. The use of drones to monitor coral reefs and AI-powered irrigation systems for water-saving agriculture deserve special attention. These technological advances have underscored the importance of environmental education in encouraging sustainable practices.
5) United States (2023-2024): The United States is at the forefront in the latter part of the analysis, with a strong focus on leveraging big data and blockchain technology for environmental sustainability. Texts from this era highlight the use of extensive data analysis to track carbon footprints and blockchain to increase transparency in supply chains, thereby encouraging more sustainable consumption patterns.

In conclusion, the trend analysis from 2019 to 2024 underscores the critical role of environmental education in encouraging technological innovation that promotes harmony between humans and the environment. Contributions from Sweden, Japan, Germany, Australia and the United States demonstrate a global commitment to harnessing technology for sustainable development and set a promising direction for future environmental management. Furthermore, the analysis of bibliometric trends underscores the critical role of Italy, Taiwan, Germany, and the United States in advancing ecological education through innovation and technology. Each country's contributions and collaborative efforts play an essential role in bridging the gap towards achieving human-environment harmony, emphasizing the global nature of these efforts.

Implementation Challenges and Barriers: Trend Analysis Based on Keywords

Even though there is a positive trend, literature analysis based on keywords and analysis based on the number of widely cited manuscripts shows that research related to "Environmental Education" has challenges and obstacles. Analysis of the keyword "Environmental Education can be seen in Figure 5.

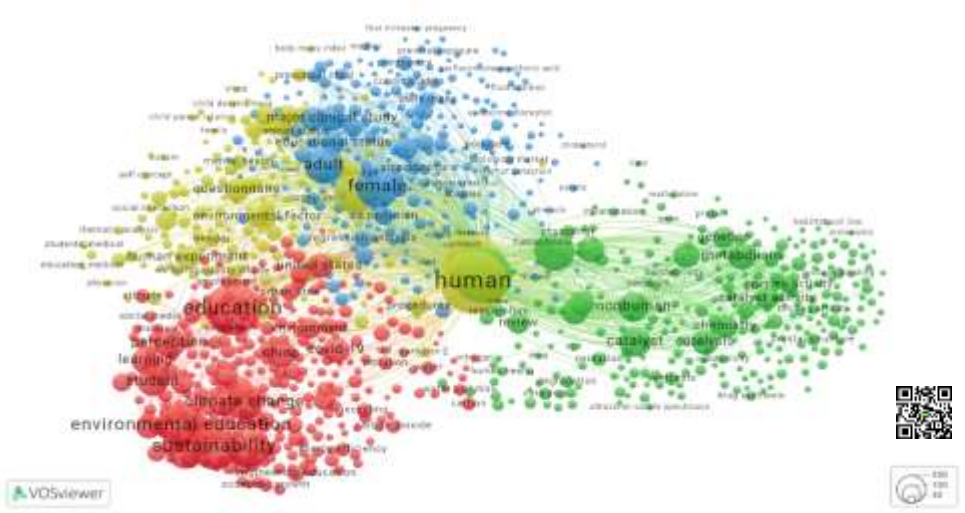

Figure 5. Analysis of Research Trends in "Environmental Education" Based on Keywords

Figure 5 is the result of an analysis to investigate the critical role of environmental education as a catalyst in fostering harmony between humans and their environment from 2019 to 2024. Through comprehensive bibliometric analysis, this research explores trends, challenges and obstacles related to implementing environmental education. The focus on keywords such as “Environmental Education,” “Environment,” “Catalyst,” and “People” underscores the complex relationship between educational initiatives and ecological awareness.

Bibliometric analysis identified four main groups, each representing a different aspect of the topic studied. This cluster is based on 1000 items, with 149,726 links and 591,349 link strengths, underscoring the interconnected nature of research in this domain. The first cluster, represented in red, centers on the keyword “education.” This cluster has 1350 events, 816 links, and a total link strength 14,322. This indicates strong research interest in educational strategies and their effectiveness in increasing environmental awareness. Affiliates such as universities and environmental organizations often contribute to these groups, highlighting this field's academic and practical importance.

The second cluster is represented by the keyword “controlled study,” with 712 occurrences, 972 links, and a link strength of

17,466, visualized in green. This group significantly focuses on empirical research and controlled studies to evaluate the impact of environmental education interventions. Institutions renowned for their rigorous scientific research, such as leading research universities and environmental research institutes, are vital contributors to this group.

The third cluster, visualized in blue, revolves around the keyword “women,” with 863 occurrences, 947 links, and a link strength of 21,159. This highlights the gender dimension in environmental education and its implementation. Research in this group often examines the role of women in environmental movements and education, emphasizing the importance of gender inclusivity in promoting environmental management. Affiliates within these groups are typically diverse, including academic researchers and grassroots organizations focused on the role of women in environmental sustainability.

The collaboration center represented by the keyword "Human" in yellow is the fourth cluster with 1998 occurrences, 998 links, and a link strength of 39,194. This group underscores the importance of human factors in environmental education and the broader discourse on human-environment interactions. The high occurrence and strength of the link indicate extensive research and collaboration efforts aimed at understanding and improving human behaviour and attitudes toward the environment. Significant contributors include interdisciplinary research centers and international environmental agencies.

Findings from the bibliometric analysis show a significant increase in scholarly interest and publications surrounding environmental education over the period. This increase underscores the growing awareness of the importance of educating individuals on environmental issues to promote sustainable living and ecological management. However, this study also highlights several challenges and obstacles that hinder the effective implementation of environmental education programs. These include limited resources, a need for trained educators, and varying levels of commitment from educational institutions and policymakers. Furthermore, this analysis is explained as follows:

1) Keyword “Environmental Education”: The frequency and context of mention of “Environmental Education” highlights its growing importance in academia, policymaking and the community. However, despite its increasing prominence, effective implementation of environmental education programs faces several obstacles. These include limited funding, a lack of trained educators, and a lack of integration of environmental topics into existing curricula. Additionally, there is often a disconnect between theoretical knowledge and practical application, leaving students with gaps in understanding how to apply ecological principles in real-world scenarios.

2) Keywords “Environment” and “Catalyst”: The term “Environment” appears frequently in discussions of sustainability and conservation, reflecting a widespread concern for ecological well-being. When linked to "Catalyst," this underscores the potential of environmental education to drive significant change. However, the challenge lies in how to turn this potential into actual results. One of the obstacles is attitudes and behaviour that are entrenched and resistant to change, especially in areas where economic development is prioritized over environmental preservation. Additionally, fragmented approaches to ecological issues, often addressed in isolation rather than through a holistic perspective, hinder the ability to use education as a comprehensive catalyst for change.

3) The keyword "Human": The keyword "Human" about environmental education focuses on an anthropocentric perspective, which considers the impact and relationship of humans with the environment. The analysis reveals that despite increasing awareness of the need for people to adopt more sustainable practices, there still needs to be a significant gap in achieving widespread behavioural change. Barriers include cultural resistance, lack of awareness, and the prevalence of misinformation. Additionally, there is a need for more inclusive education strategies that can serve diverse communities and address the specific environmental problems they face.

Despite these challenges, this research identified significant trends leading to a more integrated and holistic approach to environmental education. Innovative teaching methods, community-based learning initiatives, and the incorporation of technology are emerging as effective strategies for engaging diverse audiences and fostering a deeper understanding of environmental issues. By overcoming identified barriers and capitalizing on these trends, ecological education can be a powerful catalyst for fostering harmonious relationships between humans and their environment, ultimately contributing to a more sustainable future.

Research Trends related to the Challenge of "Environmental Education": Publication Analysis in terms of the number of citations

In this research, the analysis was continued based on the number of citations in published manuscripts, with ranking calculated based on the highest number of citations. The ranking results can be seen in Table 2.

Table 2. *Analysis of Trends in "Environmental Education" Based on Number of Citations (2019-2024)*

Authors (ID)	Title	Cited by	Source title (ISSN)

Ardoin N.M. (ID: 25221420600)	"Environmental education outcomes for conservation: A systematic review (2020)"	242	Biological Conservation (ISSN - 63207)
Abad-Segura E. (ID: 57216920173)	"Sustainable management of digital transformation in higher education: Global research trends (2020)"	236	Sustainability (Switzerland) (ISSN - 20711050)
Kioupi V. (ID: 56811643900)	"Education for sustainable development: A systemic framework for connecting the SDGs to educational outcomes (2019)"	206	Sustainability (Switzerland) (ISSN - 20711050)
Usuga Cadavid J.P. (ID: 57213191111)	"Machine learning applied in production planning and control: a state-of-the-art in the era of industry 4.0 (2020)"	205	Journal of Intelligent Manufacturing (ISSN - 9565515)
Meyer H. (ID: 55918310000)	"Importance of spatial predictor variable selection in machine learning applications – Moving from data reproduction to spatial prediction (2019)"	193	Ecological Modelling (ISSN - 3043800)
Salam M. (ID: 57196390720)	"Service learning in higher education: a systematic literature review (2019)"	188	Asia Pacific Education Review (ISSN - 15981037)
Cooper G. (ID: 55328948600)	"Examining Science Education in ChatGPT: An Exploratory Study of Generative Artificial Intelligence (2023)"	183	Journal of Science Education and Technology (ISSN - 10590145)
Yu L. (ID: 56327271300)	"A Review of Deep Reinforcement Learning for Smart Building Energy Management (2021)"	154	IEEE Internet of Things Journal (ISSN - 23274662)
Hong J.-C. (ID: 7404118174)	"Procrastination predicts online self-regulated learning and online learning ineffectiveness during the coronavirus lockdown (2021)"	136	Personality and Individual Differences (ISSN - 1918869)
Yeh A.H.-W. (ID: 57196020851)	"De novo design of luciferases using deep learning (2023)"	94	Nature (ISSN - 280836)

The results of the analysis in table 2 show that environmental education aims to foster a harmonious relationship between humans and the environment by equipping individuals with the knowledge, skills and attitudes needed to overcome environmental problems. However, the implementation of environmental education faces many challenges and obstacles. Trend analysis based on citation data from 2019-2024 reveals several key obstacles that educators and policymakers must overcome. These include insufficient funding and resources, a lack of trained educators, varying levels of access to educational materials, and differences in national policies and priorities. Additionally, cultural attitudes and socioeconomic factors can significantly influence the effectiveness of environmental education programs. Addressing these challenges requires coordinated efforts to create inclusive, well-supported educational frameworks that can adapt to diverse contexts.

Additionally, the outcomes of environmental education for conservation have been systematically reviewed to understand its effectiveness. Research shows that well-designed environmental education programs can produce measurable improvements in conservation behavior and attitudes. For example, engaging students in hands-on activities and real-world problem solving is very effective in fostering deeper connections to environmental issues and encouraging sustainable behavior. However, this review also highlights the need for long-term studies better to understand the long-term impact of these educational interventions, as short-term gains do not always translate into sustainable behavior change.

In the field of higher education, managing sustainable digital transformation has become an area of increasing interest. Global research trends show that integrating technology into educational practices is critical to advancing sustainable development goals (SDGs). A systemic framework linking SDGs to educational outcomes can help institutions navigate the complex digital transformation landscape. Additionally, machine learning and profound reinforcement learning innovations are being applied in various fields, including production planning, energy management in smart buildings, and even designing new enzymes such as luciferase. These technological advances offer new opportunities to improve educational outcomes and promote sustainability. However, challenges such as the digital divide and the need for ongoing professional development for educators must be addressed to ensure that digital transformation benefits all learners.

Overall, bridging the gap between humans and the environment through education requires a multifaceted approach. We can create a more harmonious relationship between humans and nature by overcoming implementation challenges, leveraging technological advances, and fostering systemic connections between educational outcomes and sustainability goals. Addressing these challenges requires a multi-faceted approach involving increased investment in education, teacher training programs, and policies supporting equitable access to environmental education. These findings emphasize the need for sustained efforts and collaboration among stakeholders to overcome these barriers and fully realize the potential of environmental education as a catalyst for human and environmental harmony.

Conclusion

In conclusion, the trend analysis from 2019 to 2024 underscores the important role of environmental education in bridging the gap between human activities and environmental sustainability. These findings highlight how education serves as a catalyst for cultivating an environmentally conscious society, leading to informed policy, technological innovation, and sustainable practices.

Additionally, these findings emphasize the need for sustained efforts and collaboration among stakeholders to overcome these barriers and fully realize the potential of environmental education as a catalyst for human and environmental harmony. However, to overcome this research deficiency, further research should consider a more detailed analysis of the impact of environmental education on various demographic groups, geographic locations and socio-economic backgrounds, supported by implementation through observations and interviews in each region/territory. area. This will reveal more nuanced insights into how different segments of society view and engage with environmental issues.

Additionally, future research should explore longitudinal studies to track the long-term impact of environmental education on behavior change and policy implementation. Investigating the effectiveness of different pedagogical approaches, such as experiential learning and digital platforms, can provide valuable insights in optimizing educational strategies. In addition, comparative studies between countries with different levels of environmental education integration can highlight best practices and areas requiring improvement.

Finally, encouraging interdisciplinary research that combines environmental science, educational theory, and social science can offer a more holistic understanding of the complexities involved in achieving human-environment harmony. By addressing these research gaps, we can develop more effective education frameworks and policies that not only raise awareness but also encourage concrete action towards a sustainable future. This multi-faceted approach will ensure that environmental education continues to evolve and meet the challenges posed by the ever-changing global landscape.

Reference

Acosta, S., Moreira, C., & Pinos, J. A. (2022). Study of the biodegradability behavior in films of starch with added rice-dust vs. films of Polylactic acid with corn starch in a controlled composting system. In L. P. M.M., T. J., P. A., & V. J.A.S. (Eds.), *Proceedings of the LACCEI international Multi-conference for Engineering, Education and Technology* (Vols. 2022-July). Latin American and Caribbean Consortium of Engineering Institutions. https://doi.org/10.18687/LACCEI2022.1.1.702

Adegoke, A. T., Olowu, B. E., Lawal, N. S., Odusanya, O. A., Banjo, O. B., Oduntan, O. B., & Odugbose, B. D. (2020). The impact of cassava wastewater from wet fufu paste processors on surrounding soils: A case study of Ayetoro, Ogun State, Nigeria. *Journal of Degraded and Mining Lands Management*, *7*(4), 2319–2326. https://doi.org/10.15243/JDMLM.2020.074.2263

Adejumobi, I. I., Agre, P. A., Adeyinka, A. S., Cipriano, I. M., Adheka, J. G., & Onautshu, D. O. (2023). Status of yam (Dioscorea spp.) in the Democratic Republic of Congo. *Plant Breeding*, *142*(5), 563–572. https://doi.org/10.1111/pbr.13123

Adewuyi, A. (2019). Challenges and prospects of renewable energy in Nigeria: A case of bioethanol and biodiesel production. *Energy Reports*, *5*, 1408–1419. https://doi.org/10.1016/j.egyr.2019.10.005

Adewuyi, A. (2020). Challenges and prospects of renewable energy in Nigeria: A case of bioethanol and biodiesel production. *Energy Reports*, *6*, 77–88. https://doi.org/10.1016/j.egyr.2019.12.002

Adjei, E. O., Ayamba, B. E., Buri, M. M., Biney, N., & Appiah, K. (2023). Soil quality and fertility dynamics under a continuous cassava-maize rotation in the semi-deciduous forest agro-ecological zone of Ghana. *Frontiers in Sustainable Food Systems*, *7*. https://doi.org/10.3389/fsufs.2023.1095207

Agbaeze, E. K., Ohunyeye, F. O., Obamen, J., & Ibe, G. I. (2020). Management of Food Crop for National Development: Problems and Challenges of Cassava Processing in Nigeria. *SAGE Open*, *10*(2). https://doi.org/10.1177/2158244020919778

Ahimbisibwe, B. P., Morton, J. F., Feleke, S., Alene, A., Abdoulaye, T., Wellard, K., Mungatana, E., Bua, A., Asfaw, S., & Manyong, V. (2020). Household welfare impacts of an agricultural innovation platform in Uganda. *Food and Energy Security*, *9*(3). https://doi.org/10.1002/fes3.225

Ahmad, A., Abdullah, S. R. S., Hasan, H. A., Othman, A. R., & Kurniawan, S. B. (2024). Aquaculture wastewater treatment using plant-based coagulants: Evaluating removal efficiency through the coagulation-flocculation process. *Results in Chemistry*, *7*. https://doi.org/10.1016/j.rechem.2024.101390

Ajimotokan, H. A., Ehindero, A. O., Ajao, K. S., Adeleke, A. A., Ikubanni, P. P., & Shuaib-Babata, Y. L. (2019). Combustion characteristics of fuel briquettes made from charcoal particles and sawdust agglomerates. *Scientific African*, *6*. https://doi.org/10.1016/j.sciaf.2019.e00202

Al-Rashid, M. A., Shamsul Harumain, Y. A., Goh, H. C., & Ahmad, Z. (2021). Psychosocial Factors of Public Transport Users and Social Inclusion Implications among Older Women in Pakistan. *Journal of Urban Planning and Development*, *147*(4). https://doi.org/10.1061/(asce)up.1943-5444.0000727

Alves, M. de M., Rosa, M. da S., Santos, P. P. A. Dos, da PAZ, M. F., Morato, P. N., & Fuzinatto, M. M. (2020). Artisanal beer production and evaluation adding rice flakes and soursop pul(Annona muricata L.). *Food Science and Technology (Brazil)*, *40*, 545–549. https://doi.org/10.1590/fst.36119

Amelework, A. B., Bairu, M. W., Maema, O., Venter, S. L., & Laing, M. (2021). Adoption and Promotion of Resilient Crops for Climate Risk Mitigation and Import

Substitution: A Case Analysis of Cassava for South African Agriculture. *Frontiers in Sustainable Food Systems*, *5*. https://doi.org/10.3389/fsufs.2021.617783

Andoh, M. A., & Mbah, M. J. (2019). Absence of Social Amenities: Impeding the Livelihood of Farmers in Matoh Butu. *Universal Journal of Agricultural Research*, *7*(4), 155–160. https://doi.org/10.13189/ujar.2019.070403

Andrade, L. R. S., Felisardo, R. J. A., Cruz, I. A., Bilal, M., Iqbal, H. M. N., Mulla, S. I., Bharagava, R. N., Souza, R. L. de, Azevedo, L. C. B., & Ferreira, L. F. R. (2022). Integrated Biorefinery and Life Cycle Assessment of Cassava Processing Residue–From Production to Sustainable Evaluation. *Plants*, *11*(24). https://doi.org/10.3390/plants11243577

Antonelli, A. (2023). Indigenous knowledge is key to sustainable food systems. *Nature*, *613*(7943), 239–242. https://doi.org/10.1038/d41586-023-00021-4

Arbianti, A., Rahayu, E. S., & Sutrisno, J. (2023). Multidimensional Poverty of Cassava Farm Households in Wonogiri Regency, Indonesia. *Agricultural and Resource Economics*, *9*(1), 205–223. https://doi.org/10.51599/are.2023.09.01.10

Arslan Selçuk, S., & Mutlu Avinç, G. (2021). On strengthening the interest of architecture students in bio-informed solutions: A systematic approach for learning from nature. *Sustainability (Switzerland)*, *13*(4), 1–22. https://doi.org/10.3390/su13042138

Aulia, S. D., Wijayanti, A., & Hadisoebroto, R. (2021). The effect of mixing speed and contact time on dye removal using Cassava Peel adsorbents. *IOP Conference Series: Earth and Environmental Science*, *737*(1). https://doi.org/10.1088/1755-1315/737/1/012013

Bas, T. G., Gagnon, J., Gagnon, P., & Contreras, A. (2022). Analysis of Agro Alternatives to Boost Cameroon's Socio-Environmental Resilience, Sustainable Development, and Conservation of Native Forests. *Sustainability (Switzerland)*, *14*(14). https://doi.org/10.3390/su14148507

Bede-Ojimadu, O., & Orisakwe, O. E. (2020). Exposure to wood smoke and associated health effects in sub-saharan africa: A systematic review. *Annals of Global Health*, *86*(1). https://doi.org/10.5334/aogh.2725

Bester, A. U., Carvalho, I. R., DA SILVA, J. A. G., Hutra, D. J., Moura, N. B., Lautenchleger, F., & Loro, M. V. (2021). Three decades of cassava cultivation in Brazil: Potentialities and perspectives. *Revista Colombiana de Ciencias Horticolas*, *15*(2). https://doi.org/10.17584/rcch.2021v15i2.12087

Budu, M., Atta-Darkwa, T., Amaglo, H., Kyei-Baffour, N., Aidoo, I. A., Ahorsu, S. K., & Bessah, E. (2022). The Impact of Tillage and Weed Control Methods on Physical Properties of Sandy Clay Loam Forest Ochrosol in Cassava Cultivation. *Applied and Environmental Soil Science*, *2022*. https://doi.org/10.1155/2022/6758284

Burra, D. D., Pretty, J., Neuenschwander, P., Liu, Z., Zhu, Z. R., & Wyckhuys, K. A. G. (2021). Human health outcomes of a restored ecological balance in African agro-landscapes. *Science of the Total Environment*, *775*. https://doi.org/10.1016/j.scitotenv.2021.145872

CA, U., GO, I., OU, O., MC, E., & Uruakpa, Q. (2021). Knowledge, Perception And Utilization Of Biofortified Cassava And Orange-Fleshed Sweet Potato (Ofsp) In Selected Rural Areas In Nigeria. *African Journal of Food, Agriculture, Nutrition and Development*, *21*(5), 18019–18034. https://doi.org/10.18697/ajfand.100.20290

Carr, T. W., Mkuhlani, S., Segnon, A. C., Ali, Z., Zougmoré, R., Dangour, A. D., Green, R., & Scheelbeek, P. (2022). Climate change impacts and adaptation strategies for crops in West Africa: A systematic review. *Environmental Research Letters*, *17*(5). https://doi.org/10.1088/1748-9326/ac61c8

Chan, A. W., Villwock, S. S., Williams, A. L., & Jannink, J.-L. (2022). Sexual dimorphism and the effect of wild introgressions on recombination in cassava (Manihot esculenta Crantz) breeding germplasm. *G3: Genes, Genomes, Genetics*, *12*(1). https://doi.org/10.1093/G3JOURNAL/JKAB372

Chan, D. L. H., & Spodick, E. (2014). Space development: A case study of HKUST Library. *New Library World*, *115*(5–6), 250–262. https://doi.org/10.1108/NLW-04-2014-0042

Chemura, A., Schauberger, B., & Gornott, C. (2020). Impacts of climate change on agro-climatic suitability of major food crops in Ghana. *PLoS ONE*, *15*(6). https://doi.org/10.1371/journal.pone.0229881

Christwardana, M., Ismojo, & Marsudi, S. (2022). Biodegradation Kinetic Study of Cassava & Tannia Starch-Based Bioplastics as Green Material in Various Media. *Molekul*, *17*(1), 19–29. https://doi.org/10.20884/1.jm.2022.17.1.5591

Dadzie, S. K. N., Ndebugri, J., Inkoom, E. W., & Akuamoah-Boateng, S. (2022). Social networking and risk attitudes nexus: implication for technology adoption among smallholder cassava farmers in Ghana. *Agriculture and Food Security*, *11*(1). https://doi.org/10.1186/s40066-022-00376-3

Dalaba, M. A., Nonterah, E. A., Chatio, S. T., Adoctor, J. K., Watson, D., Barker, M., Ward, K. A., & Debpuur, C. (2021). Culture and community perceptions on diet for maternal and child health: a qualitative study in rural northern Ghana. *BMC Nutrition*, *7*(1). https://doi.org/10.1186/s40795-021-00439-x

De Melo Bezerra, J., Teles, L. K., Martins, C. A., De Oliveira, N. M. F., Da Silva, M. M., Dos Santos, L. R., & Piani, R. C. (2018). Fostering STEM education considering female participation gap. In *Proceedings of the 15th International Conference on Cognition and Exploratory Learning in the Digital Age, CELDA 2018* (pp. 313–316).

Dewilda, Y., Aziz, R., & Zahra, S. (2024). Utilization of banana and cassava peel as local microorganism materials in

household organic waste composting by takakura method. *IOP Conference Series: Earth and Environmental Science*, *1306*(1). https://doi.org/10.1088/1755-1315/1306/1/012039

Ebile, P. A., Opata, J., & Hegele, S. (2022). Evaluating suitable low-cost agar substitutes, clarity, stability, and toxicity for resource-poor countries' tissue culture media. *In Vitro Cellular and Developmental Biology - Plant*, *58*(6), 989–1001. https://doi.org/10.1007/s11627-022-10285-6

Egbebiyi, T. S., Crespo, O., & Lennard, C. (2019). Defining crop-climate departure in West Africa: Improved understanding of the timing of future changes in crop suitability. *Climate*, *7*(9). https://doi.org/10.3390/cli7090101

Elolu, S., & Ongeng, D. (2020). Community-based nutrition-sensitive approach to address short-term hunger and undernutrition among primary school children in rural areas in a developing country setting: lessons from North and North-Eastern Uganda. *BMC Nutrition*, *6*(1). https://doi.org/10.1186/s40795-020-00399-8

Escobar, N., & Britz, W. (2021). Metrics on the sustainability of region-specific bioplastics production, considering global land use change effects. *Resources, Conservation and Recycling*, *167*. https://doi.org/10.1016/j.resconrec.2020.105345

Eterović, I., & Buterin, T. (2022). Bioethical analysis of sanitary engineering: a critical assessment of the profession at the crossroads of environmental and public health ethics. *Ethics in Science and Environmental Politics*, *22*, 13–24. https://doi.org/10.3354/esep00199

Fadairo, A. O., Akinbile, L. A., Obatolu, V. A., Atser, G., & Eni, I. (2024). Media Use for Soygari: a Case Study of Women'S Behaviour To Nutrition-Specific Information in South West Nigeria. *African Journal of Food, Agriculture, Nutrition and Development*, *24*(3), 25882–25901. https://doi.org/10.18697/ajfand.128.24300

Filho, J. L. O. P., Do Rêgo, A. T. A., da Silva Lunes, A. R., & Cunha, L. (2020). (In)sustainability of the territory of Chapada Do Apodi-Rn (Brazil): The expansion of agribusiness versus the impacts of traditional farmers and local rural communities. *Sustainability (Switzerland)*, *12*(21), 1–19. https://doi.org/10.3390/su12219173

Fosu-Mensah, B. Y., Adabie, D. F., Johnson, P. N. T., & Mensah, M. (2021). Occupational and environmental health hazards associated with food processing and the use of personal protective equipment: A case study of Gari processing in southern Ghana. *Journal of Applied and Natural Science*, *13*(1), 230–237. https://doi.org/10.31018/jans.v13i1.2520

Fuglie, K. O., & Echeverria, R. G. (2024). The economic impact of CGIAR-related crop technologies on agricultural productivity in developing countries, 1961–2020. *World Development*, *176*. https://doi.org/10.1016/j.worlddev.2023.106523

Galvan, J. L., & Galvan, M. C. (2017). *Writing Literature Reviews: A Guide for Students of the Social and Behavioral Sciences* (Seventh ed). Francis & Taylor.

Gomes, J. F. B., Gomes, R. S. B., & Souza, A. O. (2019). The multifunctionality of urban horticulture and its integration with the city ecosystem: A brief review of concepts and the case of São Luís. *Horticultura Brasileira*, *37*(3), 252–259. https://doi.org/10.1590/s0102-053620190301

Heriyanti, A. P., Fibriana, F., & Tirtasari, N. L. (2020). Bioethanol production from cassava-based industrial wastes using acid hydrolysis and simple fermentation. *Journal of Physics: Conference Series*, *1567*(2). https://doi.org/10.1088/1742-6596/1567/2/022024

Herminingrum, S. (2019). The genealogy of traditional Javanese cassava-based foods. *Journal of Ethnic Foods*, *6*(1). https://doi.org/10.1186/s42779-019-0015-5

Hevrizen, R., & Meidaliyantisyah. (2021). Climate, land area and fertilizer distribution policy supports to Lampung strategic food production. *IOP Conference Series: Earth and Environmental Science*, *807*(4). https://doi.org/10.1088/1755-1315/807/4/042078

Hidayat, Y., Saleh, Y., Cahyaningrum, H., & Hadiarto, A. (2023). Utilization of cassava (Manihot esculenta) as alternative local food source supporting food diversification in North Maluku. In S. S., Y. null, & Z. A. (Eds.), *E3S Web of Conferences* (Vol. 373). EDP Sciences. https://doi.org/10.1051/e3sconf/202337304029

Hou, D., Bolan, N. S., Tsang, D. C. W., Kirkham, M. B., & O'Connor, D. (2020). Sustainable soil use and management: An interdisciplinary and systematic approach. *Science of the Total Environment*, *729*. https://doi.org/10.1016/j.scitotenv.2020.138961

Hseu, Z. Y. (2020). Ecological and health risk of soils, sediments, and water contamination. *Water (Switzerland)*, *12*(10), 1–4. https://doi.org/10.3390/w12102867

Ibiam, U. A., Awoke, J. N., Obasi, O. D., Uraku, A. J., Alum, E. U., & Eze, A. G. (2021). Assessment of levels and health risks of trace metals in soils and food crops cultivated on farmlands near enyigba mining sites, Ebonyi State, Nigeria. *Journal of Food Protection*, *84*(8), 1288–1294. https://doi.org/10.4315/JFP-20-295

Insan, S., & Kuntiyawichai, K. (2022). Assessment of Agricultural Water Sufficiency under Climate and Land Use Changes in the Lam Takong River Basin. *Water (Switzerland)*, *14*(18). https://doi.org/10.3390/w14182794

Isaksson, R., Rosvall, M., Babaahmadi, A., Buregyeya, A., Hazarika, A., Marangu, J. M., Olonade, K., Ramanathan, S., Rucukye, A., & Valentini, L. (2023). Supplementary Cementitious Materials in Building Blocks—Diagnosing Opportunities in Sub-Saharan Africa. *Sustainability (Switzerland)*, *15*(7). https://doi.org/10.3390/su15075822

Jaccard, J., & Jacoby, J. (2020). *Theory Construction and Model-Building Skills: A Practical Guide for Social*

Scientists. The Guilford Press.

Jantakat, Y., Juntakut, P., Plaiklang, S., Arree, W., & Jantakat, C. (2019). Spatiotemporal change of urban agriculture using google earth imagery: A case of municipality of nakhonratchasima city, Thailand. In O. E. S.J., Y. M.Y., & V. G. (Eds.), *International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences - ISPRS Archives* (Vol. 42, Issue 2/W13, pp. 1301–1306). International Society for Photogrammetry and Remote Sensing. https://doi.org/10.5194/isprs-archives-XLII-2-W13-1301-2019

Jere, J., Ruark, A., Bidwell, J. T., Butterfield, R. M., Neilands, T. B., Weiser, S. D., Mulauzi, N., Mkandawire, J., & Conroy, A. A. (2023). "High blood pressure comes from thinking too much": Understandings of illness among couples living with cardiometabolic disorders and HIV in Malawi. *PLoS ONE*, *18*(12 December). https://doi.org/10.1371/journal.pone.0296473

Jo, H., Eckel, S. P., Chen, J.-C., Cockburn, M., Martinez, M. P., Chow, T., Lurmann, F., Funk, W. E., McConnell, R., & Xiang, A. H. (2019). Associations of gestational diabetes mellitus with residential air pollution exposure in a large Southern California pregnancy cohort. *Environment International*, *130*. https://doi.org/10.1016/j.envint.2019.104933

Jose-Abrego, A., Rivera-Iñiguez, I., Torres-Reyes, L. A., & Roman, S. (2023). Anti-hepatitis B virus activity of food nutrients and potential mechanisms of action. *Annals of Hepatology*, *28*(4). https://doi.org/10.1016/j.aohep.2022.100766

Kangkhetkron, T., & Juntarawijit, C. (2021). Factors influencing practice of pesticide use and acute health symptoms among farmers in Nakhon Sawan, Thailand. *International Journal of Environmental Research and Public Health*, *18*(16). https://doi.org/10.3390/ijerph18168803

Kareem, B., Irondi, E. A., Alamu, E. O., Ajani, E. O., Abass, A., Parkes, E., & Maziya-Dixon, B. (2023). Antioxidant, starch-digesting enzymes inhibitory, and pasting properties of elite yellow-fleshed cassava genotypes. *Frontiers in Sustainable Food Systems*, *7*. https://doi.org/10.3389/fsufs.2023.1129807

Kashala-Abotnes, E., Okitundu, D., Mumba, D., Boivin, M. J., Tylleskär, T., & Tshala-Katumbay, D. (2019). Konzo: a distinct neurological disease associated with food (cassava) cyanogenic poisoning. *Brain Research Bulletin*, *145*, 87–91. https://doi.org/10.1016/j.brainresbull.2018.07.001

Kiran, A., Wakeel, A., Mahmood, K., Mubaraka, R., Hafsa, & Haefele, S. M. (2022). Biofortification of Staple Crops to Alleviate Human Malnutrition: Contributions and Potential in Developing Countries. *Agronomy*, *12*(2). https://doi.org/10.3390/agronomy12020452

Kreuze, J. F., Cuellar, W. J., Lava Kumar, P., Boddupalli, P., & Omondi, A. B. (2023). New Technologies Provide Innovative Opportunities to Enhance Understanding of Major Virus Diseases Threatening Global Food Security. *Phytopathology*, *113*(9), 1622–1629. https://doi.org/10.1094/PHYTO-12-22-0457-V

Krisdiana, R., Noerwiyati, K., Made Jana Mejaya, I., Wisnubroto, E. I., & Huu, N. N. (2023). Policies and Models of Agribusiness Development of Cassava in North Sumatera. In H. S. R., R. F. A., I. I., N. H. N., & A. O. (Eds.), *E3S Web of Conferences* (Vol. 432). EDP Sciences. https://doi.org/10.1051/e3sconf/202343200033

Kurniawati, U. F., & Idajati, H. (2019). Analysis of spatial parameter formulation in the effect of Green House Gas (GHG) emissions on food security in Surabaya. *IOP Conference Series: Earth and Environmental Science*, *340*(1). https://doi.org/10.1088/1755-1315/340/1/012041

Lankarani, K. B. (2024). Demanded interdisciplinary subjects for integration in medical education program from the point of view of graduated medical physicians and senior medical students: a nationwide mixed qualitative-quantitative study from Iran. *BMC Medical Education*, *24*(1). https://doi.org/10.1186/s12909-024-05079-w

Lauwis, C., Maringka, C. T., Julieta, F., Evangelista, P., Marcellino, V., & Rukmini, E. (2023). Antidiabetic properties of analog rice from local raw materials: a systematic review. *International Journal of Public Health Science*, *12*(2), 621–631. https://doi.org/10.11591/ijphs.v12i2.22130

Laya, A., Laya, A., Koubala, B. B., & Koubala, B. B. (2020). Changes in Vitamin e and β -Carotene Contents in Various Edible Cassava Leaves (Manihot esculenta Crantz) of Different Ages across Multiple Seasons. *International Journal of Agronomy*, *2020*. https://doi.org/10.1155/2020/4671018

Liang, Y., He, H., Wang, W., Wang, H., Mo, S., Fu, R., Liu, X., Song, Q., Xia, Z., & Wang, L. (2022). Malignant clonal evolution drives multiple myeloma cellular ecological diversity and microenvironment reprogramming. *Molecular Cancer*, *21*(1). https://doi.org/10.1186/s12943-022-01648-z

Lileikis, T., Nainienė, R., Bliznikas, S., & Uchockis, V. (2023). Dietary Ruminant Enteric Methane Mitigation Strategies: Current Findings, Potential Risks and Applicability. *Animals*, *13*(16). https://doi.org/10.3390/ani13162586

Loury, E. K., Eschenroeder, J. C., Seat, L., Chea, S., Chhut, C., Kritsanavarin, S., Lovgren, S., Ramsay, E. G., Thao, D., & Hogan, Z. S. (2021). Communicating for aquatic conservation in cambodia and beyond: Lessons learned from in-person and media-based environmental education and outreach strategies. *Water (Switzerland)*, *13*(13). https://doi.org/10.3390/w13131853

Low, J., Ball, A. M., Ilona, P., Ekesa, B., Heck, S., & Pfeiffer, W. (2022). Scaling Readiness of Biofortified Root, Tuber, and Banana Crops for Africa. In *Root, Tuber and Banana Food System Innovations: Value Creation for Inclusive Outcomes*. Springer International Publishing.

https://doi.org/10.1007/978-3-030-92022-7_17

Lyons, J. B., Bredeson, J. V., Mansfeld, B. N., Bauchet, G. J., Berry, J., Boyher, A., Mueller, L. A., Rokhsar, D. S., & Bart, R. S. (2022). Current status and impending progress for cassava structural genomics. *Plant Molecular Biology*, *109*(3), 177–191. https://doi.org/10.1007/s11103-020-01104-w

Madu, T., Onwuka, S., Nwafor, S., Ejechi, M., Ofoeze, M., Onyemauwa, N., Ukeje, B., Eluagu, C., Olaosebikan, O., & Okoye, B. (2024). Gender-inclusive consumer studies improve cassava breeding in Nigeria. *Frontiers in Sociology*, *9*. https://doi.org/10.3389/fsoc.2024.1224504

Mamo, F. T., Abate, B. A., Tesfaye, K., Nie, C., Wang, G., & Liu, Y. (2020). Mycotoxins in ethiopia: A review on prevalence, economic and health impacts. *Toxins*, *12*(10). https://doi.org/10.3390/toxins12100648

Marrugo-Madrid, S., Pinedo-Hernández, J., Paternina-Uribe, R., Marrugo-Negrete, J., & Díez, S. (2022). Health risk assessment for human exposure to mercury species and arsenic via consumption of local food in a gold mining area in Colombia. *Environmental Research*, *215*. https://doi.org/10.1016/j.envres.2022.113950

Masithoh, R. E., & Yuliyanda, I. (2019). NIR reflectance spectroscopy and SIMCA for classification of crops flour. *IOP Conference Series: Earth and Environmental Science*, *355*(1). https://doi.org/10.1088/1755-1315/355/1/012004

Matouke, M. M., Remawa, A. A., & Ndaghu, N. N. (2022). Copper, zinc, lead, cadmium contents and health hazard inference of consuming Pseudotolithus senegalensis (Valenciennes, 1833) from Usuma dam, Abuja, Nigeria. *Scientific African*, *17*. https://doi.org/10.1016/j.sciaf.2022.e01354

Mendoza-Del Villar, L., Oliva-Lopez, E., Luis-Pineda, O., Benešová, A., Tupa, J., & Garza-Reyes, J. A. (2020). Fostering economic growth, social inclusion & sustainability in industry 4.0: A systemic approach. *Procedia Manufacturing*, *51*, 1755–1762. https://doi.org/10.1016/j.promfg.2020.10.244

Meramo-Hurtado, S. I., Puello, P., & Rodríguez, J. (2020). Computer-aided environmental assessment applied for estimation of ecological impacts derived from topological pathways based on lignocellulosic biomass transformation. *Applied Sciences (Switzerland)*, *10*(18). https://doi.org/10.3390/APP10186586

Mirzoev, T., Tull, K. I., Winn, N., Mir, G., King, N. V., Wright, J. M., & Gong, Y. Y. (2022). Systematic review of the role of social inclusion within sustainable urban developments. *International Journal of Sustainable Development and World Ecology*, *29*(1), 3–17. https://doi.org/10.1080/13504509.2021.1918793

Monteiro, W. M., de Farias, A. S., Val, F., Neto, A. V. S., Sachett, A., Lacerda, M., Sampaio, V., Cardoso, D., Garnelo, L., Vissoci, J. R. N., Sachett, J., & Wen, F. H. (2020). Providing Antivenom Treatment Access to All Brazilian Amazon Indigenous Areas: 'Every Life Has Equal Value.' *Toxins*, *12*(12). https://doi.org/10.3390/toxins12120772

Munialo, S., Onyango, C. M., Lukachi, J. A., Wasonga, O. V., Maina, J. G., Nzuma, J. M., Dawood, A., & Sibanda, L. M. (2023). Gaps and opportunities in research on food systems; a micro-institutional analysis of the University of Nairobi. *Frontiers in Sustainable Food Systems*, *7*. https://doi.org/10.3389/fsufs.2023.1125094

Mwesiga, E. K., Robbins, R., Akena, D., Koen, N., Nakku, J., Nakasujja, N., & Stein, D. J. (2022). Prevalence, profile and associations of cognitive impairment in Ugandan first-episode psychosis patients. *Schizophrenia Research: Cognition*, *28*. https://doi.org/10.1016/j.scog.2021.100234

Nalubwama, S., Kabi, F., Vaarst, M., Kiggundu, M., & Smolders, G. (2019). Opportunities and challenges for integrating dairy cattle into farms with certified organic pineapple production as perceived by smallholder farmers in Central Uganda. *Organic Agriculture*, *9*(1), 29–39. https://doi.org/10.1007/s13165-018-0210-5

Norman, J. E., Lawton, J., Stock, S. J., Siassakos, D., Norrie, J., Hallowell, N., Chowdhry, S., Hart, R. I., Odd, D., Brewin, J., Culshaw, L., Lee-Davey, C., Tebbutt, H., & Whyte, S. (2021). Feasibility and design of a trial regarding the optimal mode of delivery for preterm birth: the CASSAVA multiple methods study. *Health Technology Assessment (Winchester, England)*, *25*(61), 1–102. https://doi.org/10.3310/hta25610

Nyirakanani, C., Tamisier, L., Bizimana, J. P., Rollin, J., Nduwumuremyi, A., Bigirimana, V. D. P., Selmi, I., Lasois, L., Vanderschuren, H., & Massart, S. (2023). Going beyond consensus genome sequences: An innovative SNP-based methodology reconstructs different Ugandan cassava brown streak virus haplotypes at a nationwide scale in Rwanda. *Virus Evolution*, *9*(2). https://doi.org/10.1093/ve/vead053

Oghenejoboh, K. M., Orugba, H. O., Oghenejoboh, U. M., & Agarry, S. E. (2021). Value added cassava waste management and environmental sustainability in Nigeria: A review. *Environmental Challenges*, *4*. https://doi.org/10.1016/j.envc.2021.100127

Ojuri, O. O., Ramdas, V., Aderibigbe, E. A., Williams, C. G., Ramchuran, S., & Al-Nageim, H. (2022). Improving strength and hydraulic characteristics of regional clayey soils using biopolymers. *Case Studies in Construction Materials*, *17*. https://doi.org/10.1016/j.cscm.2022.e01319

Olarinde, L. O., Abass, A. B., Abdoulaye, T., Adepoju, A. A., Fanifosi, E. G., Adio, M. O., Adeniyi, O. A., & Wasiu, A. (2020). Estimating multidimensional poverty among cassava producers in Nigeria: Patterns and socioeconomic determinants. *Sustainability (Switzerland)*, *12*(13). https://doi.org/10.3390/su12135366

Olayide, O. E., Obisesan, D., Nitturkar, H., Adesida, A., Alegieunu, B., & Obisesan, O. (2021). Cassava seedpreneurship, determinants of varietal adoption,

profitability, and women empowerment in Nigeria. *Resources, Environment and Sustainability*, *6*. https://doi.org/10.1016/j.resenv.2021.100041

Oluba, O. M., Ayodele, M. M., Adeyonu, A. G., Shoyombo, A. J., Alabi, O. O., & Akpor, O. B. (2020). Effects of cassava starch supplementation on behavioural characteristics and oxidative status in Drosophila melanogaster. *Asian Journal of Agriculture and Biology*, *8*(1), 92–97. https://doi.org/10.35495/ajab.2019.04.171

Omara, J., Talavera, E., Otim, D., Turcza, D., Ofumbi, E., & Owomugisha, G. (2023). A field-based recommender system for crop disease detection using machine learning. *Frontiers in Artificial Intelligence*, *6*. https://doi.org/10.3389/frai.2023.1010804

Omara, T., Kiprop, A. K., Wangila, P., Wacoo, A. P., Kagoya, S., Nteziyaremye, P., Peter Odero, M., Kiwanuka Nakiguli, C., & Baker Obakiro, S. (2021). The Scourge of Aflatoxins in Kenya: A 60-Year Review (1960 to 2020). *Journal of Food Quality*, *2021*. https://doi.org/10.1155/2021/8899839

Omonkhua, A. A., Okonofua, F. E., Ntoimo, L. F. C., Aruomaren, A. I., Adebayo, A. M., & Nwuba, R. (2020). Community perceptions on causes of high dizygotic twinning rate in Igbo-Ora, Southwest Nigeria: A qualitative study. *PLoS ONE*, *15*(12 December). https://doi.org/10.1371/journal.pone.0243169

Oteh, O. U., Hefferon, K., & Agwu, N. M. (2020). Moving Biofortified Cassava Products Closer to Market in Nigeria. *Frontiers in Sustainable Food Systems*, *4*. https://doi.org/10.3389/fsufs.2020.589424

Otekunrin, O. A. (2022). Investigating food insecurity, health and environment-related factors, and agricultural commercialization in Southwestern Nigeria: evidence from smallholder farming households. *Environmental Science and Pollution Research*, *29*(34), 51469–51488. https://doi.org/10.1007/s11356-022-19544-w

Pratiti, R., & Sud, P. (2020). A Call for epidemic assessment questionnaire. *Environmental Research*, *191*. https://doi.org/10.1016/j.envres.2020.110150

Priyadarshan, P. M., & Mohan Jain, S. (2021). Cash Crops: Genetic Diversity, Erosion, Conservation and Utilization. In *Cash Crops: Genetic Diversity, Erosion, Conservation and Utilization*. Springer International Publishing. https://doi.org/10.1007/978-3-030-74926-2

Rahayu, E. S., Setyowati, & Rahmadwiati, R. (2021). Analysis of income distribution as prevention of environmental damage in agribusiness management of cassava in Bengawan Solo watershed, Wonogiri regency. *IOP Conference Series: Earth and Environmental Science*, *637*(1). https://doi.org/10.1088/1755-1315/637/1/012076

Rahim, M. A., Saeed, F., Khalid, W., Hussain, M., & Anjum, F. M. (2021). Functional and nutraceutical properties of fructo-oligosaccharides derivatives: a review. *International Journal of Food Properties*, *24*(1), 1588–1602. https://doi.org/10.1080/10942912.2021.1986520

Rahmi, R. N., Poolsawad, N., & Sranacharoenpong, K. (2020). Environmental impacts related to food consumption of Indonesian adults. *Journal of Nutritional Science and Vitaminology*, *66*, S149–S154. https://doi.org/10.3177/jnsv.66.S149

Rossi, N., Grosso, C., & Delerue-Matos, C. (2024). Shrimp Waste Upcycling: Unveiling the Potential of Polysaccharides, Proteins, Carotenoids, and Fatty Acids with Emphasis on Extraction Techniques and Bioactive Properties. *Marine Drugs*, *22*(4), 153. https://doi.org/10.3390/md22040153

Samuel, L., de Barcellos, M. D., Watabaji, M. D., & De Steur, H. (2024). Factors affecting farmers' acceptance and adoption of biofortified crops: A systematic review. *Outlook on Agriculture*, *53*(1), 15–29. https://doi.org/10.1177/00307270231212924

Sarkodie, S. A., Adams, S., Owusu, P. A., Leirvik, T., & Ozturk, I. (2020). Mitigating degradation and emissions in China: The role of environmental sustainability, human capital and renewable energy. *Science of the Total Environment*, *719*. https://doi.org/10.1016/j.scitotenv.2020.137530

Schultze, M., Kankam, S., Sanfo, S., & Fürst, C. (2024). Agricultural Yield Responses to Climate Variabilities in West Africa: A Food Supply and Demand Analysis. *Land*, *13*(3). https://doi.org/10.3390/land13030364

Sekabira, H., Nijman, E., Späth, L., Krütli, P., Schut, M., Vanlauwe, B., Wilde, B., Kintche, K., Kantengwa, S., Feyso, A., Kigangu, B., & Six, J. (2022). Circular bioeconomy in African food systems: What is the status quo? Insights from Rwanda, DRC, and Ethiopia. *PLoS ONE*, *17*(10 October). https://doi.org/10.1371/journal.pone.0276319

Septiani, V. P. R., Ushada, M., & Suharno. (2023). Development of Sago-based Analog Rice Using Kansei and Value Engineering. *Pertanika Journal of Science and Technology*, *31*(6), 2947–2960. https://doi.org/10.47836/pjst.31.6.17

Sharma, P., Singh, S. P., Iqbal, H. M. N., Parra-Saldivar, R., Varjani, S., & Tong, Y. W. (2022). Genetic modifications associated with sustainability aspects for sustainable developments. *Bioengineered*, *13*(4), 9508–9520. https://doi.org/10.1080/21655979.2022.2061146

Siloko, I. U., Ukhurebor, K. E., Siloko, E. A., Enoyoze, E., Bobadoye, A. O., Ishiekwene, C. C., Uddin, O. O., & Nwankwo, W. (2021). Effects of some meteorological variables on cassava production in Edo State, Nigeria via density estimation. *Scientific African*, *13*. https://doi.org/10.1016/j.sciaf.2021.e00852

Singh, J. (2024). The role of disciplinary, interdisciplinary, and transdisciplinary education in sustainability science: Experiences from my professional journey. *Research Journeys to Net Zero: Current and Future Leaders*, 23–34. https://doi.org/10.4324/9781003380566-4

Soler, J. L., Friedel, T., & Wang, S. (2024). Combining Deep Learning and Street View Imagery to Map Smallholder

Crop Types. In W. M., D. J., & N. S. (Eds.), *Proceedings of the AAAI Conference on Artificial Intelligence* (Vol. 38, Issue 20, pp. 22202–22212). Association for the Advancement of Artificial Intelligence. https://doi.org/10.1609/aaai.v38i20.30225

Somo, M., Kulembeka, H., Mtunda, K., Mrema, E., Salum, K., Wolfe, M. D., Rabbi, I. Y., Egesi, C., Kawuki, R., Ozimati, A., Lozano, R., & Jannink, J. L. (2020). Genomic prediction and quantitative trait locus discovery in a cassava training population constructed from multiple breeding stages. *Crop Science*, *60*(2), 896–913. https://doi.org/10.1002/csc2.20003

Sousa, A. M. P., Pontes, B. S., da Silva, M. J. S., & Vieira, T. A. (2019). Cooperativism in forest communities in the Amazon: What do non-members say? *Ambiente e Sociedade*, *22*. https://doi.org/10.1590/1809-4422ASOC120R1VU19L4AO

Souza, E. C. A., & Bernard, E. (2019). Setting priorities in biodiversity conservation: An exercise with students, recent graduates, and environmental managers in Brazil. *Ambio*, *48*(8), 879–889. https://doi.org/10.1007/s13280-018-1116-x

Stewart, A. G. (2020). Mining is bad for health: a voyage of discovery. *Environmental Geochemistry and Health*, *42*(4), 1153–1165. https://doi.org/10.1007/s10653-019-00367-7

Subyantoro, A., Hikmah, K., Puspitaningrum, D. A., & Nasrulloh, R. S. (2022). Effects of Green Human Resource Management on Participation of Farmer Group Members in Sleman Yogyakarta: Organizational Commitment as Mediation Variable. *International Journal of Sustainable Development and Planning*, *17*(8), 2513–2521. https://doi.org/10.18280/ijsdp.170819

Surono, U. B., Subeni, Sanjaya, P. S., Pratama, B. R., & Alfarisaputra, J. (2023). The Renewable Energy Potential of Food Crop Wastes in Indonesia. *International Journal of Renewable Energy Research*, *13*(2), 707–717. https://doi.org/10.20508/ijrer.v13i2.13617.g8745

Suwanlee, S. R., Keawsomsee, S., Pengjunsang, M., Homtong, N., Prakobya, A., Borgogno-Mondino, E., Sarvia, F., & Som-ard, J. (2023). Monitoring Agricultural Land and Land Cover Change from 2001–2021 of the Chi River Basin, Thailand Using Multi-Temporal Landsat Data Based on Google Earth Engine. *Remote Sensing*, *15*(17). https://doi.org/10.3390/rs15174339

Tabe-Ojong, M. P., Ibarra, L. M., Andrade, R. S., & Labarta, R. (2023). Soil conservation and smallholder welfare under cassava-based systems in Thailand. *Land Degradation and Development*, *34*(6), 1795–1805. https://doi.org/10.1002/ldr.4569

Tafesse, A., Mena, B., Belay, A., Aynekulu, E., Recha, J. W., Osano, P. M., Darr, D., Demissie, T. D., Endalamaw, T. B., & Solomon, D. (2021). Cassava Production Efficiency in Southern Ethiopia: The Parametric Model Analysis. *Frontiers in Sustainable Food Systems*, *5*. https://doi.org/10.3389/fsufs.2021.758951

Teye, E., Deha, C. I., Dadzie, R., & Macarthur, R. L. (2020). Delivering the Nutritional Needs by Food to Food Fortification of Staples Using Underutilized Plant Species in Africa. *International Journal of Food Science*, *2020*. https://doi.org/10.1155/2020/8826693

Theeraviriya, C., Sirirak, W., & Praseeratasang, N. (2020). Location and routing planning considering electric vehicles with restricted distance in agriculture. *World Electric Vehicle Journal*, *11*(4), 1–23. https://doi.org/10.3390/wevj11040061

Theeuwen, A., Duplat, V., Wickert, C., & Tjemkes, B. (2021). How do women overcome gender inequality by forming small-scale cooperatives? The case of the agricultural sector in Uganda. *Sustainability (Switzerland)*, *13*(4), 1–25. https://doi.org/10.3390/su13041797

Ton, A. T., Gentile, F., Hsing, M., Ban, F., & Cherkasov, A. (2020). Rapid Identification of Potential Inhibitors of SARS-CoV-2 Main Protease by Deep Docking of 1.3 Billion Compounds. *Molecular Informatics*, *39*(8). https://doi.org/10.1002/minf.202000028

Tyas, W. I., Tasseila, D., Almaida, I., & Rukmana, M. D. (2020). Sustainable Settlement of Pojok Tengah Village on Cimahi City as the Center of Spicy Cassava Chips Industry. *IOP Conference Series: Earth and Environmental Science*, *409*(1). https://doi.org/10.1088/1755-1315/409/1/012040

Ugwuoke, C. U., Ede, K. R., Ede, M. O., & Oneli, J. O. (2023). Family health therapy for treating anxiety symptoms in flood victims. *Medicine (United States)*, *102*(16), E33574. https://doi.org/10.1097/MD.0000000000033574

Waheed, M. A., & Akogun, O. A. (2021). Synergetic effects of feedstock mixture and torrefaction on some briquette characteristics of cornhusk and sawdust wastes. *Applied Environmental Research*, *43*(3), 107 – 120. https://doi.org/10.35762/AER.2021.43.3.8

Wahjuningsih, S. B., Anggraeni, D., Siqhny, Z. D., Triputranto, A., Elianarni, D., Purwitasari, L., & Azkia, M. N. (2023). Formulation, Nutritional and Sensory Evaluation of Mocaf (Modified Cassava Flour) Noodles with Latoh (Caulerpa lentillifera) Addition. *Current Research in Nutrition and Food Science*, *11*(3), 1008–1021. https://doi.org/10.12944/CRNFSJ.11.3.08

Wang, L., & Watanabe, T. (2020). Does haze drive pro-environmental and energy conservation behaviors? Evidence from the beijing-tianjin-hebei area in china. *Sustainability (Switzerland)*, *12*(23), 1–18. https://doi.org/10.3390/su12239972

Wootton, N., Nursey-Bray, M., Holland, S., & Gillanders, B. M. (2024). Better understanding ocean awareness: Insights from young people. *Marine Policy*, *164*. https://doi.org/10.1016/j.marpol.2024.106159

Wu, Y.-L., Chen, Y.-L., Wei, L., Fan, X.-W., Dong, M.-Y., & Li, Y.-Z. (2023). MeGATA s, functional generalists in interactions between cassava growth and

development, and abiotic stresses . *AoB PLANTS*, *15*(1). https://doi.org/10.1093/aobpla/plac057

Xu, S. (2024). Resident Satisfaction and Influencing Factors of the Renewal of Old Communities. *Journal of Urban Planning and Development*, *150*(1). https://doi.org/10.1061/JUPDDM.UPENG-4632

Yafetto, L., Odamtten, G. T., & Wiafe-Kwagyan, M. (2023). Valorization of agro-industrial wastes into animal feed through microbial fermentation: A review of the global and Ghanaian case. *Heliyon*, *9*(4). https://doi.org/10.1016/j.heliyon.2023.e14814

Yin, C., Pereira, P., Zhao, W., & Barcelo, D. (2023). Natural climate solutions. The way forward. *Geography and Sustainability*, *4*(2), 179–182. https://doi.org/10.1016/j.geosus.2023.03.005

Yu, Y., Paul, K., Arah, O. A., Mayeda, E. R., Wu, J., Lee, E., Shih, I.-F., Su, J., Jerrett, M., Haan, M., & Ritz, B. (2020). Air pollution, noise exposure, and metabolic syndrome – A cohort study in elderly Mexican-Americans in Sacramento area. *Environment International*, *134*. https://doi.org/10.1016/j.envint.2019.105269

Zhang, H. (2021). Technology innovation, economic growth and carbon emissions in the context of carbon neutrality: Evidence from brics. *Sustainability (Switzerland)*, *13*(20). https://doi.org/10.3390/su132011138

Zhang, W., & He, C. (2022). Modeling and Optimization of the Shear Strength of Cassava Starch-Based Adhesives Using Artificial Intelligence Methods. *Journal of Renewable Materials*, *10*(12), 3263–3283. https://doi.org/10.32604/jrm.2022.020516

Zhong, L., Li, X., Sun, S., Law, R., Qi, X., & Dong, Y. (2022). Influencing Factors of Students' Learning Gains in Tourism Education: An Empirical Study on 28 Tourism Colleges in China. *Sustainability (Switzerland)*, *14*(24). https://doi.org/10.3390/su142416601