

REVIEW AND SYNTHESIS

What do stakeholders understand of the links between diet and terrestrial biodiversity loss? A systematic review of the literature

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Abstract

1. The topics of biodiversity loss and dietary impact have received extensive individual scrutiny within the scientific community. However, there is a notable gap in understanding the level of awareness among stakeholders regarding the impact of dietary choices on biodiversity. Using a systematic review approach, this paper will identify how different stakeholders perceive and engage with the interconnected dynamics of biodiversity conservation and dietary choice.
2. Following systematic processes, 26 articles were identified as suitable for inclusion in a qualitative synthesis. Results delineated four distinct stakeholder categories: consumers, Indigenous populations, producers and policymakers, each with a unique understanding of the relationship between biodiversity and diet. This variation is more pronounced in regions where food sourcing is more closely linked to local environmental conditions and reflects cultural identities.
3. In developed countries, consumer behaviour tends to prioritise individual autonomy in dietary choices, posing significant implications for biodiversity conservation. Indigenous communities view themselves as essential elements of the environment, upholding collective culture, emphasising community, heritage and shared values in conservation efforts. Producers play a critical role in preserving terrestrial biodiversity through informed land management decisions, and policymakers lead by enacting policies aligned with conservation goals and discontinuing harmful subsidies.
4. This systematic review reveals a strong consensus among stakeholders on the critical link between biodiversity and dietary practices, highlighting the importance of traditional food systems, consumer education and policy support in promoting sustainable diets that protect biodiversity.

KEYWORDS

consumption, stakeholder understanding, systematic literature review, terrestrial biodiversity loss

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1 | INTRODUCTION

Biodiversity loss is one of the most pressing environmental challenges of our time, driven primarily by human activities such as unsustainable consumption and resource exploitation (Iyola et al., 2023). The rapid decline in global biodiversity threatens the foundations of our ecosystems and, by extension, our food systems (Pörtner et al., 2021). According to the UN's IPBES report, more than 1 million plant and animal species (25%) are threatened with extinction over the next decades as a result of human activity (IPBES, 2019).

The food–water–energy–biodiversity nexus highlights the vital interdependencies between biodiversity and food systems (Vargas et al., 2023). Biodiversity underpins food production and security through various mechanisms, including pollination, nutrient cycling and maintaining genetic diversity (Kim et al., 2024). These ecosystem services are crucial for sustaining diverse and resilient food systems that can adapt to changing environmental conditions. For instance, local biodiversity knowledge improves natural enemy conservation, enhancing crop protection (Tripathi et al., 2024). However, the relationship between food production and biodiversity is complex, creating a challenging balance between feeding a growing population and preserving biodiversity (Holt et al., 2016).

Within this nexus, dietary choices play a key role, with food consumption patterns directly impacting biodiversity and sustainability (Mattas et al., 2023). The growing awareness of this link has led to increased research on sustainable diets and their potential to mitigate environmental impacts (Yan et al., 2021).

Recent policy shifts, such as the EU Nature Restoration Law, underscore tensions between biodiversity goals and agricultural priorities (European Commission, 2025). While aimed at ecosystem recovery, the law faces opposition from farming groups concerned about reduced productivity and food security (Stoffers et al., 2024). Critics argue this could lower yields, while proponents highlight benefits such as improved soil health, drought resilience and alternative biomass production (Stoffers et al., 2024). The debate reflects the broader challenge of reconciling ecological restoration with food system demands, calling for integrated, stakeholder-driven approaches.

While there have been reviews on the concepts of diet and sustainability (Yan et al., 2021), diets and consumer perceptions (Hong et al., 2022; Tsofliou et al., 2022), understanding and acceptance of sustainable diets (Biasini et al., 2021), biodiversity and diet (Jacob et al., 2020; Medeiros et al., 2022) and indigenous knowledge towards diets and sustainability (Mbah et al., 2021; Sidiq et al., 2022), there remains a significant gap in the literature regarding the comprehensive understanding of various stakeholder groups on this topic.

To address this gap, our study aimed to answer the research question: 'What do stakeholders understand of the links between diet and terrestrial biodiversity loss?' By exploring this question, we aim to provide crucial insights that can inform policymaking, guide educational efforts and advance collaboration among different

sectors to promote sustainable food systems that protect and enhance biodiversity.

2 | METHOD

2.1 | Overview

A systematic review of the published literature was undertaken using the methodology outlined by Fobbe and Hilletoft (2021) and Linnenluecke et al. (2020), which adheres to the PRISMA framework to ensure replicability (Page et al., 2021). The review protocol was peer-reviewed by independent academics before being published on the Open Science Framework (<https://doi.org/10.17605/OSF.IO/78ZWY>) before the study began. All stages of the process are documented according to the PRISMA checklist, provided as a supplementary table (Appendix A).

2.2 | Literature search

The search strategy was based on three thematic groups of keywords related to 'diet', 'biodiversity loss' and 'understanding'. Our research team, which includes experts in nutrition, consumer experience, psychology, ecology and social science, collaboratively developed the search string to identify as many articles as possible of possible relevance to our research questions while reducing redundancy and duplication. The detailed breakdown is presented in Appendix B. Each group included relevant synonyms and related terms. Boolean operators 'AND' and 'OR' were used to construct a comprehensive search string that captured the intersection of these themes.

Three databases were searched, based on reputation and capacity to offer advanced search functionality (Wang et al., 2023): 'SCOPUS', 'MEDLINE' and 'GreenFile'. The choice of these three databases ensures that the review covers the multidisciplinary nature of the topic; SCOPUS provides broad scientific coverage, MEDLINE brings in-depth biomedical and nutritional perspectives, and GreenFile ensures coverage of environmental and sustainability issues. Search terms were searched for in 'title', 'abstract' and 'keyword' fields, overall years of records.

To reduce results that were unlikely to be directly relevant to our research question, we applied filters based on predefined inclusion criteria. Specifically, the search was restricted to subject areas of Environmental Science, Business, Psychology, Decision Science and Social Science. Additionally, only articles written in English and published papers were considered. The initial search, which took place on 26 May 2023, produced 16,947 articles.

After removing duplicates, 14,889 papers were independently screened by two researchers (HH and AV) based on their titles, abstracts and keywords to determine their relevance to the research question. To streamline this process, the researchers used a point system: One point was assigned if the article addressed 'stakeholders', one for 'diet/consumption' and one for 'biodiversity'. Articles

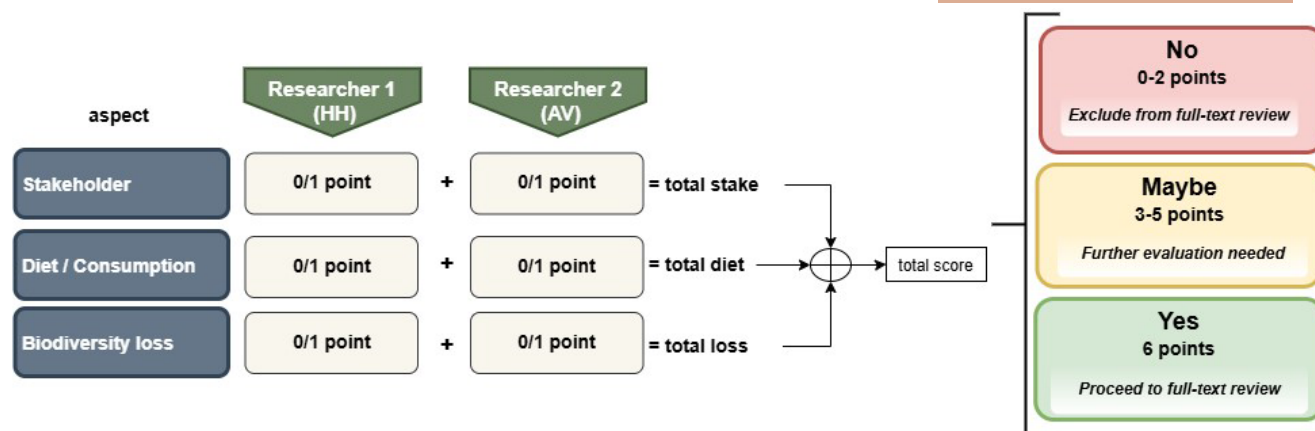


FIGURE 1 Streamline point system process.

that scored six points in total (three points from each researcher) were classified as suitable: 'yes, include', and were included in the full-text review directly. Those with scores between 3 and 5 points were labelled as 'maybe' suitable and considered further. Articles scoring 2 points and below were classified as 'no, not suitable' and were excluded from full-text review. The process is presented in Figure 1.

The papers judged as 'maybe' suitable underwent a thorough two-step review process. First, the two researchers (HH and AV) met to confirm those that met the three-point criterion. In the second step, the researchers held a meeting with the full research team, where they explained the point system and discussed all papers that had received between 3 and 5 points from both researchers. Through group consensus, a final selection of 39 articles was agreed upon, which were then included in a database for full-text analysis.

2.3 | Data extraction

To examine stakeholder understanding of the links between terrestrial biodiversity loss and diet, we collected information based on a series of variables presented in Appendices C and D. This comprehensive set of variables ensures that we extract all information relevant to 'diet', 'biodiversity', 'understanding', 'stakeholders' and the links between these, to address our research questions and provide a thorough analysis of the current state of knowledge in this field. The research team presented and further evaluated the process during a dedicated evaluation meeting. All 39 papers underwent this process and a final database with the articles that could answer the research question was created. To ensure common encoding standards, data from all included articles were extracted by one researcher (AV) and checked by a second researcher (HH). The process was presented and further evaluated by the research team during a dedicated meeting. Based on this data extraction, only papers that provided a logically consistent and evidence-based understanding of how dietary choices contribute to or mitigate terrestrial biodiversity loss were included further. Importantly, papers that considered only

biodiversity loss or only diet were not included as our focus was on the links between them. As a result, 22 papers were deemed eligible for further analysis.

In addition to the database searches, the two researchers (HH and AV) conducted a citation search based on the 39 selected papers for full-text study. This process identified 13 additional articles, which were thoroughly reviewed by one researcher (AV) and verified by the second researcher (HH). The citation search was used to uncover relevant papers that may not have shown clear relevance based on their bibliographic records alone. Following all processes, four additional articles were considered suitable for inclusion in the review, alongside the 22 articles deemed eligible via the database searches, providing 26 articles in total.

A supplementary table listing all papers that were excluded during the full-text screening phase, along with the specific reasons for their exclusion, is provided in Appendix C. This ensures transparency in the selection process and allows for a clear understanding of how and why certain studies were deemed not relevant to the research.

Figure 2 presents the PRISMA diagram, which illustrates all steps taken for data collection.

2.4 | Data analysis

For this study, we define 'stakeholder' following Freeman (2010) as individuals, groups or organisations that have the potential to influence or be influenced by the decisions made regarding, in our case, diet and terrestrial biodiversity. Different stakeholders were first identified, and articles were grouped by stakeholder, with descriptive and thematic analysis undertaken. This offered valuable insights into the selected articles, including geographical areas of study (Breit & Volkmann, 2023), also allowing assessments of comparability, while reducing bias and enhancing transparency (Tranfield et al., 2003). Thematic analysis was used to synthesise the information collected, highlight the main contributions and identify key themes regarding stakeholder understanding of the links between

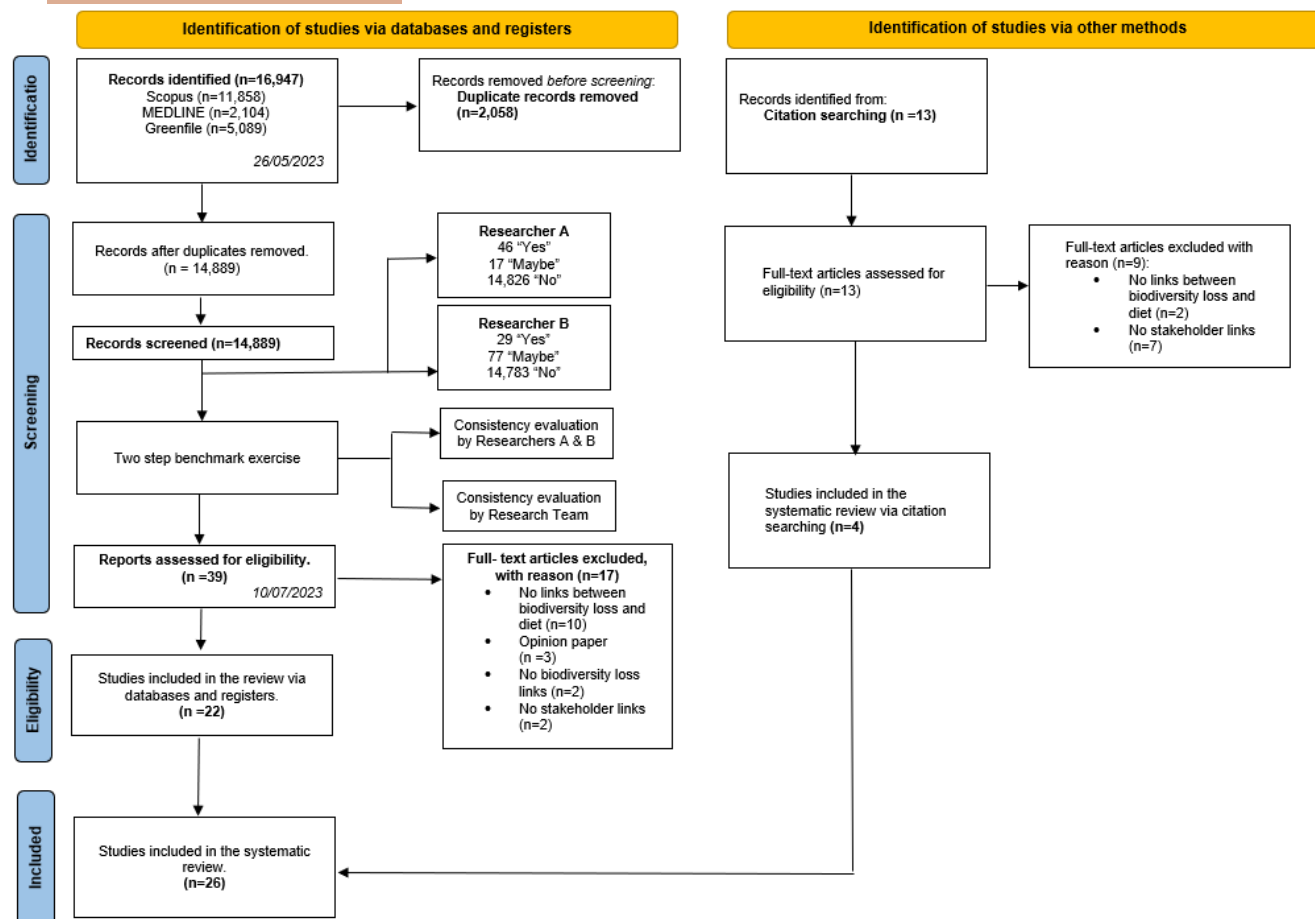


FIGURE 2 PRISMA flow diagram of study selection.

terrestrial biodiversity loss and diet (Breit & Volkmann, 2023). Stakeholder categories and thematic foci were not predefined; rather, they emerged inductively through iterative engagement with the data during the review process. This inductive approach is consistent with established practices in qualitative research, as it allows themes and classifications to be grounded in the evidence base rather than imposed a priori, thereby enhancing the transparency, credibility and contextual sensitivity of the synthesis. Stakeholder categories and emergent themes were based on the extracted data for all articles per stakeholder group, as undertaken by one researcher (AV) and checked by a second researcher (HH). A statistical synthesis was not undertaken given the nature of the data gained. Risk of bias for included articles was also not assessed considering the variety in study designs, but all articles were sourced from the peer-reviewed literature.

3 | RESULTS AND RESULTS DISCUSSION

3.1 | Descriptive results

Details of all papers included in the review are given in Table 1. These papers have been published in a diverse range of 21 scientific journals covering various research domains. This diversity is a direct

result of the teams' interdisciplinary approach, which encompasses areas such as sustainability, stakeholder understanding, consumer behaviour and dietary habits.

Analysis of the number of publications per year reveals a notable upward trend in recent years, particularly following 2012 (Figure 3) and subsequent interest in the UN Sustainable Development Goals. A specific year timeframe was not applied during the literature search; however, no articles related to stakeholder understanding of the links between biodiversity loss and diet were identified before 2006.

The final collection of 26 articles included the perspectives of four distinct groups of stakeholders: Consumers, Indigenous populations, Producers and Policymakers, with some articles overlapping between these groups (Figure 4). Rather than using predetermined categories, our analysis allowed stakeholder groups to emerge organically from the literature. It is worth noticing that some stakeholder groups are missing completely from the current literature, for example retailers.

Thirteen articles (50%) were identified that specifically explored the understanding of consumers as stakeholders. However, only Trevena et al. (2015) and Fischer et al. (2019) provide a cross-stakeholder perspective between consumers and policymakers. In addition, nine articles (35%) were identified that investigated Indigenous populations as stakeholders. Three of these papers (11%)

TABLE 1 Articles ordered by publication year (most recent–least recent).

Authors	Year	Journal	Stakeholder type	Geographical area of research	Methods
Mesías et al.	2023	New Medit: Mediterranean Journal of Economics, Agriculture and Environment	Consumers	Europe	Online focus groups (n = 6)
Whittall et al.	2023	Appetite	Consumers	Europe	Interviews (n = 21)
Arotoma-Rojas et al.	2022	Sustainability	Indig. Population	South America	Semi-structure interviews (n = 23)
Stampa & Zander	2022	Journal of Cleaner Production	Consumers	Europe	Online focus groups (n = 6)
Tittarelli et al.	2022	Sustainability	Consumers	Europe	Online survey (n = 537)
Milford et al.	2022	Journal of Agricultural and Environmental Ethics	Consumers/Producers	Europe	Semi-structured producer interviews (n = 6). Producer survey (n = 185). Online consumer survey (n = 1010)
Thant et al.	2022	Environmental and Sustainability Indicators	Policymakers	Asia	Online consultation and forum
Park et al.	2022	Sustainability	Policymakers	Worldwide	Policy documents 1994–2018 (n = 484)
Guiné et al.	2021	Sustainability	Consumers	North and South America & Europe	Survey (n = 10,067)
Vogliano et al.	2021	Food Security	Indig. Population	Oceania	Snowball sampling technique (n = 30). Focus groups (n = 86)
Hartmann et al.	2021	Appetite	Consumers	Europe	Online survey (n = 1118)
Atube et al.	2021	Agriculture & Food Security	Indig. Population/Producers	Africa	Survey (n = 395)
Ali	2021	Ethnobotany Research & Applications	Indig. Population/Producers	Asia	Survey (n = 279). Focus groups. Market survey
Sánchez-Bravo et al.	2020	Foods	Consumers	Europe, North & South America	Online survey (n = 3600)
Ruggeri et al.	2020	British Food Journal	Consumers	Europe	Survey (n = 334)
Sorgho et al.	2020	International Journal of Environmental Research and Public Health	Indig. Population/Producers	Africa	Interviews (n = 32)
Mazzocchi et al.	2019	Wine Economics and Policy	Consumers	Europe	Interviews (n = 207)
Fischer et al.	2019	Urban Forestry & Urban Greening	Consumers/Policy makers	Europe	Urban learning labs (n = 5)
Lachat et al.	2018	Proceedings of the National Academy of Sciences	Consumers	Middle- income countries of Africa, Asia & South America	Survey (n = 6226)
Negi et al.	2017	Journal of Mountain Science	Indig. Population	Asia	Reviews, survey, focus groups (n = 1080)
Hussain et al.	2016	Food Security	Indig. Population	Asia	Survey (n = 8083)
Trevena et al.	2015	Public Health Nutrition	Consumers/Policy makers	Australia	Policy paper submissions (n = 142)
Power et al.	2013	Journal for Nature Conservation	Producers	Europe	Survey (n = 38)
Sanchez et al.	2012	Climate and Development	Indig. Population	Africa	Focus groups (n = 18)
Termote et al.	2012	PloS One	Indig. Population	Africa	Surveys (n = 492)
Johns and Eyzaguirre	2006	Proceedings of the Nutrition Society	Producers/Policy makers	Africa	Case studies in Kenya, Tanzania, Uganda, and Senegal

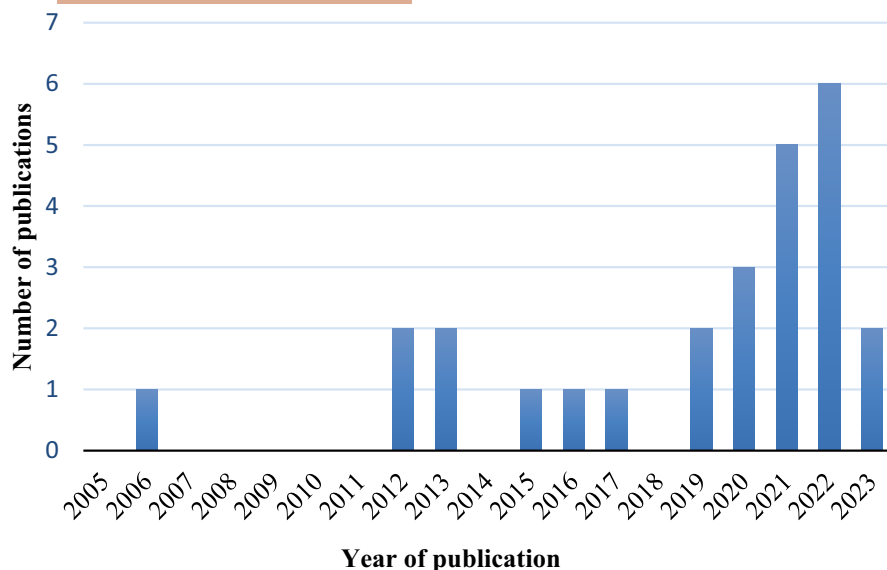


FIGURE 3 Distribution of reviewed publications by year, until May 2023. This horizontal bar chart illustrates the number of reviewed publications across different years, indicating trends in research activity over time.

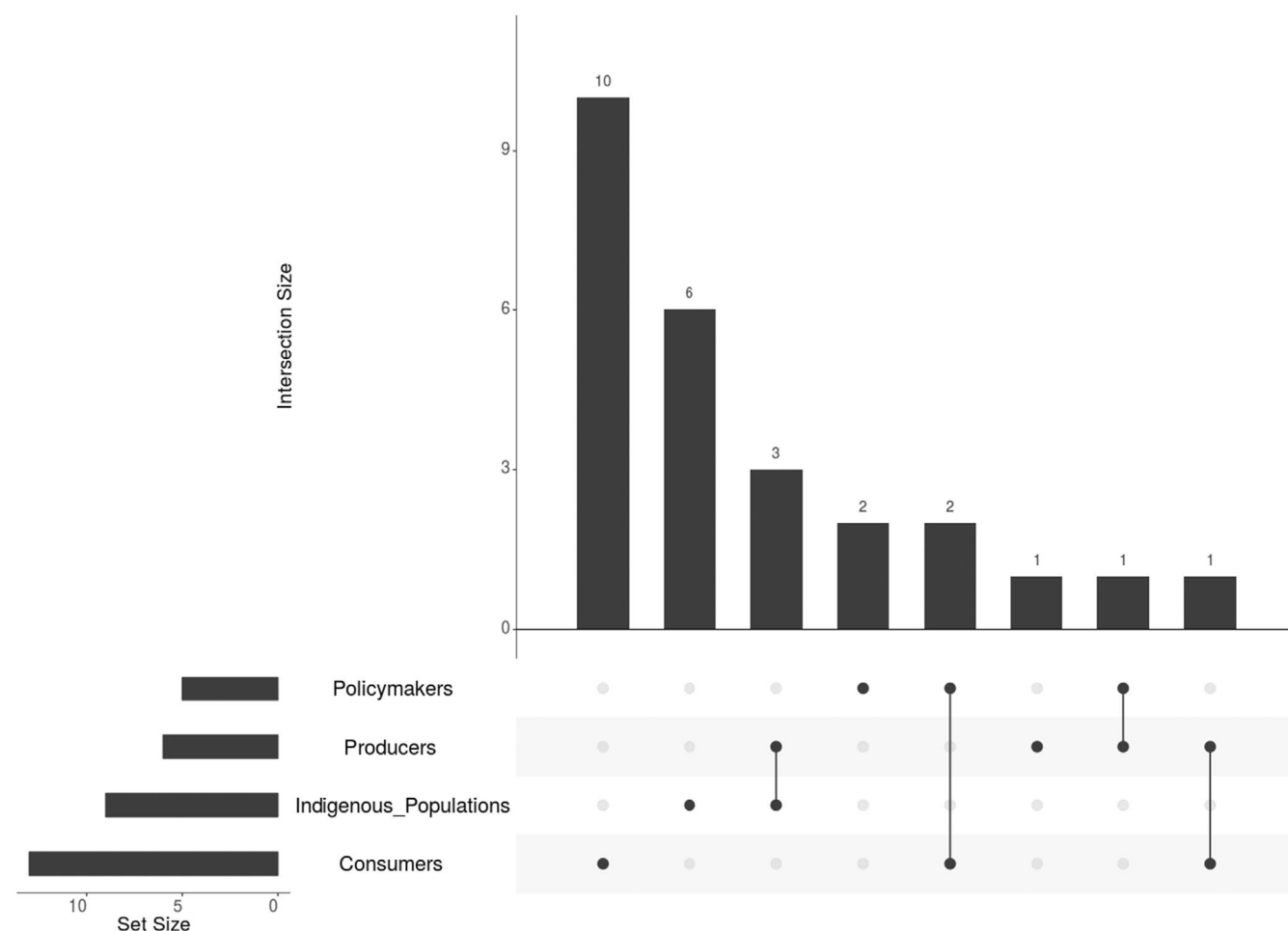


FIGURE 4 Stakeholder groups identified in reviewed articles. This UpSet diagram illustrates the distribution of stakeholder groups discussed in the reviewed literature, highlighting overlaps between Consumers, Indigenous Populations, Producers and Policymakers.

provide a cross-stakeholder relationship between Indigenous populations and producers (see Sorgho et al. (2020), Atube et al. (2021) and Sanchez et al. (2012)). The interconnection between these

stakeholder groups can be attributed to the significant presence of Indigenous populations in food production (Tonah, 2002), particularly within developing countries. Four of the papers (15%) were

based on data from Africa, three (11%) from Asia and one (4%) each from South America and Oceania. This pattern underscores the significance of Indigenous communities in less economically developed regions.

3.2 | Thematic analysis

Following the identification of key stakeholders, the analysis was conducted to uncover recurring themes that explain the perceptions, interconnections, roles and influences of each stakeholder group within the broader context of sustainable food systems. For consumers, themes centred around awareness of sustainable dietary practices and marketing techniques, and the impact of consumer choices on biodiversity. Indigenous populations identified as vital guardians of traditional knowledge, with themes reflecting their unique contributions to sustainable practices and their intimate connection to local ecosystems that impact their mental health and well-being. In contrast, producers highlighted the

importance of traditional agricultural practices, and the challenges posed by modern production methods, emphasising the need for ecological awareness. Finally, policymakers play a crucial role in shaping regulations that foster biodiversity conservation while also addressing food security and public health.

Figure 5 presents a stakeholder-level schematic highlighting the themes that have emerged.

3.2.1 | Consumers

This study defines consumers as stakeholders influencing biodiversity and diet through their purchasing decisions and consumption behaviours, reflecting preferences for sustainable products.

Impact of consumer understanding on biodiversity loss and dietary choice

Studies report how consumer understanding and awareness of biodiversity loss influences dietary choice, considering the interplay

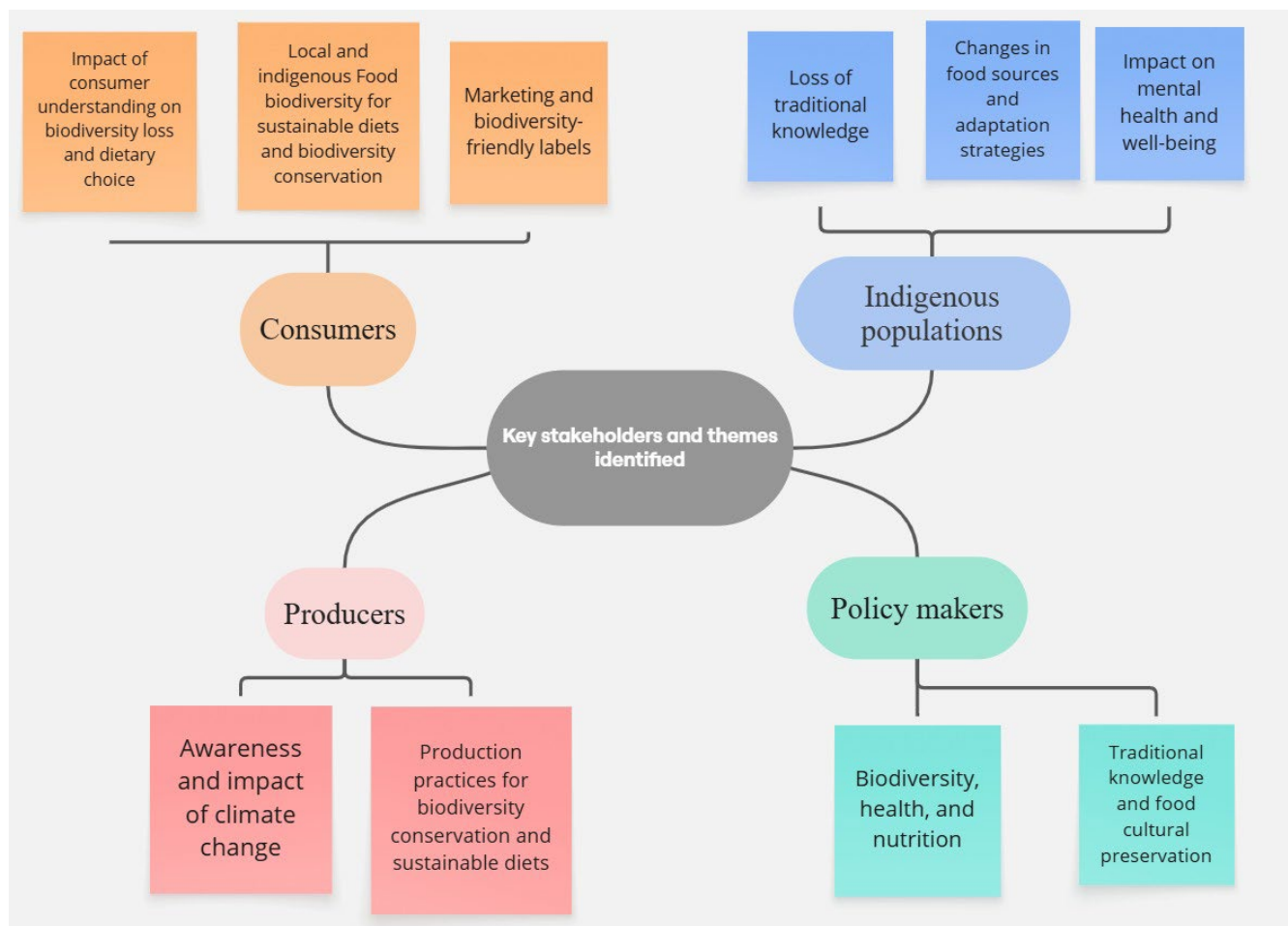


FIGURE 5 Key stakeholders and their roles in biodiversity and diet. This figure presents the four key stakeholder groups and the themes identified by this research in their understanding of the links between biodiversity conservation and sustainable food systems. Each group is represented by a coloured section with associated factors influencing their engagement in biodiversity/diet-related issues.

between health and environmental concerns. Many consumers lack knowledge about biodiversity, including species interdependence and ecosystem health (Mesías et al., 2023). Often, individuals underestimate the environmental impact of their dietary choices, favouring minor, manageable dietary adjustments over radical shifts (Whittall et al., 2023). Limited knowledge restricts sustainable behaviour adoption, with consumers largely relying on the food industry for sustainability yet recognising the need for individual responsibility (Hartmann et al., 2021; Milford et al., 2022). Tittarelli et al. (2022), identified two distinct groups of consumers, Green Attitude-oriented group and Green Attitude-not convinced group. The study found that 55.4% of consumers fell within the 'Green Attitude-oriented' group, who were deeply concerned with the sustainability of their food choices and their impact on the environment. In contrast, the other 44.6% of consumers, the 'Green Attitude-not convinced' group did not believe that their dietary choices had any significant environmental impact. Sánchez-Bravo et al. (2020) found that consumers with higher levels of academic education demonstrated greater awareness of the challenges associated with biodiversity loss within the context of dietary choice.

Addressing this knowledge gap requires targeted education about natural ecosystems and biodiversity, which can lead to more informed, environmentally responsible choices. Early hands-on experiences with nature, such as gathering wild edible plants, enhance biodiversity understanding and dietary awareness (Fischer et al., 2019).

Local and Indigenous food biodiversity for sustainable diets and biodiversity conservation

Local and Indigenous food diversity is crucial for sustainable diets and biodiversity preservation. Biodiversity loss undermines food variety, nutrition, and system stability (Sánchez-Bravo et al., 2020). Traditional and region-specific crops play a vital role, particularly in rural, middle-income areas where locally sourced foods constitute a major dietary component. In contrast, urban diets in high-income countries often rely on processed foods with a broader environmental footprint (Lachat et al., 2018). Notably, urban consumers, despite geographical separation from natural food sources, show a high awareness of the impact of biodiversity on diet, highlighting the importance of location in understanding these links (Guiné et al., 2021).

Marketing and biodiversity-friendly labels

The use of biodiversity as a marketing tool highlights the connection between consumer awareness and the willingness to pay for biodiversity-friendly products. Labels emphasising biodiversity conservation resonate more with consumers than standard organic labels, as they communicate specific environmental benefits (Ruggeri et al., 2020). Mazzocchi et al. (2019) found that biodiversity-friendly labels increase consumer willingness to pay a premium, even among those with limited biodiversity knowledge. Locally produced labels further strengthen this consumer-producer link by communicating biodiversity conservation at a community level, encouraging a sense of local environmental stewardship (Stampa & Zander, 2022).

3.2.2 | Indigenous populations

In this study, Indigenous populations are defined as culturally distinct groups with deep connections to their local environments, playing a vital role in managing and conserving terrestrial biodiversity through traditional knowledge and practices.

Loss of traditional knowledge

Biodiversity loss and changing dietary habits threaten the preservation of traditional knowledge (Arotoma-Rojas et al., 2022). Indigenous populations possess a profound understanding of shifts in biodiversity, relying on traditional signs such as the migration patterns of birds, the emergence of specific insects, and the presence of caterpillars (Sorgho et al., 2020). However, their ability to forecast growing seasons is declining (Sánchez-Bravo et al., 2020).

Traditional knowledge allows Indigenous populations to recognise environmental shifts, and coordinate communal activities such as planting, harvesting and hunting to align with seasonal weather changes throughout the year (Tume et al., 2019). Reduced male participation in hunting disrupts knowledge transmission to younger generations (Arotoma-Rojas et al., 2022). Additionally, women responsible for food gathering are losing knowledge about wild edible plants (Termote et al., 2012). Ali (2021) suggests that education, health awareness, and demand for organic products can help preserve traditional knowledge, emphasising the need for participatory adaptations and conservation strategies for future generations.

Changes in food sources and adaptation strategies

In response to climate change, deforestation, urbanisation and pollution, Indigenous communities are adapting by cultivating drought-resistant crops, using improved seeds, increasing irrigation, and mixing organic and inorganic fertilisers (Arotoma-Rojas et al., 2022; Atube et al., 2021; Hussain et al., 2016; Sanchez et al., 2012). Sorgho et al. (2020) note that during challenging times, communities may limit meal variety and prioritise essential grains. They also establish 'home-dry gardens' for fresh produce and utilise government-subsidised food options to bolster food security. Integrating these adaptation strategies with traditional knowledge into agricultural policies can enhance community livelihoods and environmental sustainability (Negi et al., 2017).

Impact on mental health and well-being

Indigenous communities view biodiversity changes as influenced by both 'human action' and 'godly action' (Sorgho et al., 2020). Human actions, such as deforestation, lead to biodiversity loss and food scarcity, while divine intervention is perceived as punishment for failing to live in harmony with nature.

These factors contribute to feelings of guilt, leading to 'ecological grief' (Arotoma-Rojas et al., 2022). This emotional burden manifests in concerns over species loss, erosion of traditional food knowledge, shifts in cultural practices and transformations of identity.

3.2.3 | Producers

In this study, producers as stakeholders are defined as individuals or entities engaged in the cultivation, harvesting, and processing of food and agricultural products. They play a crucial role in the food system, influencing biodiversity, dietary choices and sustainable practices through their production methods and decisions.

Two themes from the producer perspective offer insights into the concepts of climate change, biodiversity, food production and pesticide use. They are particularly illuminating in the context of small-scale farming, highlighting the significance of consumer influence and farm management in addressing issues in different geographical regions.

Awareness and impact of climate change

Producers have high levels of awareness and knowledge of the changes in the climate and biodiversity (Sorgho et al., 2020). Notwithstanding, there is a gap between the interpretation of natural environmental indicators and scientific meteorological knowledge. To bridge this divide and empower agricultural decision-making, timely dissemination of meteorological forecasts to farmers and producers is advocated to improve food production, where participatory workshops would be a good first step. Sanchez et al. (2012) noted that Indigenous producers are facing the inability to predict growing seasons effectively due to climate change. To address this critical issue and mitigate their vulnerability to climate risks, it was recommended that dissemination of local climate predictions via radio broadcasts, offering real-time updates, such as imminent rain or anticipated drought conditions, could be developed.

Production practices for biodiversity conservation and sustainable diets

Sorgho et al. (2020) documented that producers have voiced growing concerns regarding the excessive use of chemicals and the introduction of genetically modified seed varieties, expressing fears about the potential dual harm that these practices may inflict. On the one hand, the widespread use of chemicals, such as pesticides and herbicides, can have harmful effects on biodiversity by disrupting ecosystems and harming non-target species. On the other hand, the adoption of genetically modified seeds raises questions about the safety and long-term health implications for consumers. These concerns gain additional support from Milford et al. (2022), who reported that consumers exhibit a lack of trust in both producers and authorities when it comes to their efforts to avert the consequences caused by chemicals on biodiversity and public health. There is a strong emphasis placed by Johns and Eyzaguirre (2006) on the promotion of traditional agricultural practices and the preservation of wild biodiversity to unlock the nutritional and cultural benefits they offer. Furthermore, it is essential to ensure that producers have access to credit and adequate cash flow, enabling them to invest in improved production practices that have the potential to mitigate the effects of climate change, biodiversity loss and influence dietary choice (Atube et al., 2021).

Power et al. (2013) conducted a comparative analysis of production practices adopted by organic and conventional farmers. Their findings indicated that organic farms generally exhibited greater richness in plant diversity. However, they observed that this pattern was not uniform across all organic farms, underscoring the role of farm management in shaping plant diversity outcomes. Additionally, the study revealed that organic producers displayed a greater interest in developing knowledge related to environmentally friendly practices, highlighting their openness to adopting more sustainable approaches.

3.2.4 | Policymakers

Finally, policymakers as stakeholders are defined as individuals or groups responsible for developing, implementing, and regulating policies that govern food systems, agricultural practices, and environmental conservation. They play a vital role in shaping the framework within which food production, distribution and consumption lie, influencing both biodiversity and dietary outcomes.

Two themes on policymakers' understanding of the links between biodiversity loss and diet emphasise the need for a holistic approach that considers education, global cooperation, preservation of traditional knowledge and cultural practice. A notable difference was found between international and local-level policymakers when it comes to perspectives on the relationship between biodiversity conservation and dietary habits.

Biodiversity, health, and nutrition

Park et al. (2022) conducted an analysis of the decision-making processes within key international bodies, namely the Food and Agriculture Organization (FAO), the World Health Organization (WHO) and the Convention on Biological Diversity (CBD), regarding biodiversity loss and dietary choice. They highlighted the complex interplay between biodiversity, health and nutrition for human life and well-being, and underscored that investing in biodiversity represents an investment in ensuring food security. Simultaneously, they noted that in 2014, the FAO and WHO advocated the implementation of cohesive policies that encompass the entire spectrum from food production to consumption, with the aim of mitigating malnutrition and fostering the establishment of sustainable food systems. These policies revolved around enhancing food safety and regulating the use of chemicals to promote health and environmental sustainability.

At a local level, Trevena et al. (2015) identified the dynamics and conflicts between the food industry and civil society. Their findings reveal that food industry actors tend to associate sustainability with facilitating food production, while NGOs are more inclined to connect sustainable diets with affordability and nutrition, illustrating the divergence in perspectives between these two key stakeholder groups. Johns and Eyzaguirre (2006), considering policymakers, recognise the importance of fostering biodiversity within both production systems and natural ecosystems.

Traditional knowledge and food cultural preservation

Traditional knowledge within Indigenous populations has a vital significance and there is a necessity for its preservation. Consequently, it becomes imperative to craft comprehensive policies that not only safeguard this invaluable heritage but also integrate it into contemporary practices and decision-making processes.

At an international level, Park et al. (2022) highlighted that the CBD called for the equal treatment of traditional knowledge alongside other forms of knowledge. Meanwhile, the FAO advocated for the protection of traditional knowledge and intellectual property rights, covering areas such as patent requirements, medical methodologies, and source disclosure. In a similar vein, the United Nations Educational, Scientific, and Cultural Organization (UNESCO) developed regulations aimed at safeguarding traditional folklore. In this context, Johns and Eyzaguirre (2006) suggest that solutions addressing issues related to biodiversity and consumption must be tailored to the specific needs and circumstances of individual countries.

At a local level, there is a need for policy support to facilitate the integration of traditional knowledge and cultural practices into local-level management efforts. This can be achieved through capacity-building initiatives assisting farmers, and other key stakeholders within the food system, to enhance their resilience and ability to effectively adapt to challenging climatic conditions and processes (Thant et al., 2022).

4 | GENERAL DISCUSSION

The findings presented in this systematic review underscore the complex nature of the relationship between biodiversity loss and dietary choice.

The link between biodiversity preservation and food consumption was found to be better understood where the supply of food is local and connected to the environmental conditions of a region (Coffey et al., 2023). This emerges from a strong cultural identity, whereby characteristics and meanings of heritage are fundamental to social and environmental sustainability (Salameh et al., 2022). This phenomenon is further exemplified in the concept of *terroir* (Tarabashkina et al., 2024), which encompasses the interplay between culture, production practices, and natural elements. Initially observed in wine-producing regions, the principles of *terroir* could be extrapolated and broadened within ecosystem discussion to encompass the notion of 'nature's capital' and preservation of natural resources (Lichy et al., 2023). As a counter to consumers in developed countries who may see themselves as self-sufficient, self-reliant and independent individuals (Shavitt & Barnes, 2020) with autonomy in food choice, Indigenous communities perceive themselves as integral components of the environment (Pereira et al., 2020). They exhibit a shared sense of mutual responsibility and interconnectedness within their social framework and as such demonstrate a profound dedication to their society and a strong feeling of alignment with the collective heritage of their land (Shavitt & Barnes, 2020). Producers, as stakeholders, play an important role in the preservation of terrestrial biodiversity

through their land management decisions. They recognise the symbiotic relationship between biodiversity and the ecological processes that sustain equilibrium, and they place value on the complex nature of environmental custodianship (Kelemen et al., 2013).

Policymakers have a significant role in advancing sustainability by improving the implementation and enforcement of existing policies and regulations, reforming policies to align with sustainability objectives and eliminating harmful subsidies that encourage unsustainable practices (Díaz et al., 2019). They interconnect with consumers (see Trevena et al. (2015) and Fischer et al. (2019)) and producers (see Johns and Eyzaguirre (2006)). Engaging decision-makers with consumers and producers can inspire a cultural shift towards responsible and eco-friendly behaviours (European Commission, 2020). Allocating resources for innovation and research in sustainable technologies and practices is vital for long-term sustainability. Additionally, international cooperation in addressing global sustainability challenges, such as climate change and biodiversity conservation, is crucial (Zhang et al., 2022).

4.1 | Theoretical implications

The diverse nature of the issues explored in this review highlight the importance of interdisciplinary integration. Theoretical models in biodiversity conservation are traditionally based on ecological and environmental sciences, while dietary choices and health are studied in nutritional and medical fields. This review emphasises the need for integrated theoretical models that bridge these disciplinary boundaries and consider the interconnectedness of human actions, dietary habits and biodiversity.

A critical aspect is the impact of consumer understanding on biodiversity loss and dietary choice. By educating consumers about these links, we can promote more sustainable dietary practices that positively influence biodiversity. Additionally, the incorporation of traditional and indigenous knowledge into theoretical frameworks is vital, as it not only preserves cultural heritage but also enhances sustainable food systems.

These findings can be expanded through the application of a complex systems approach, where by identifying leverage points within the system, small innovations can have positive effects on overall system outcomes (Hulme et al., 2022).

Furthermore, policies should promote the preservation of traditional knowledge and its role in shaping food systems, thereby linking biodiversity conservation directly to dietary habits and public health. Future models must include cultural, ecological and sociological dimensions to effectively address the challenges of biodiversity loss and nutrition.

4.2 | Practical implications

The review highlights crucial managerial implications and policy-maker interventions that can be achieved at the local, national and

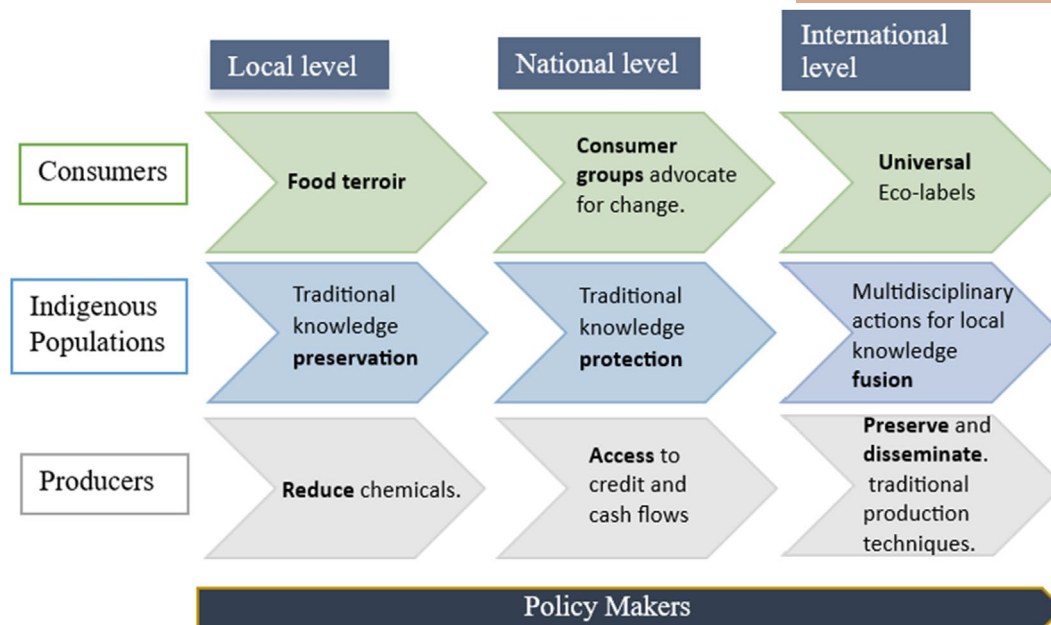


FIGURE 6 Policymaker intervention at local, national, and international level. The progression demonstrates how local initiatives can scale up to national programmes and eventually contribute to international standards and practices.

international level for strengthening the links between biodiversity, dietary choices and traditional knowledge (Figure 6).

In more detail:

- **Consumers:** Consumers play a major role in accepting sustainable dietary practices. Increasing awareness of the link between dietary choice and biodiversity loss is crucial. Initiatives like biodiversity-friendly labels on products can educate consumers about the environmental consequences of their choices (Nangia et al., 2024). Although eco-labels and certifications such as 'organic', 'fair trade' and 'Rainforest Alliance Certified' are gaining traction, unified eco-labelling systems for food are not (yet) widely available (May, 2021).
- **Indigenous Populations:** The importance of the preservation of traditional knowledge within Indigenous populations has been established. Practical policy efforts should focus on protecting this heritage through capacity-building initiatives. These initiatives can help local communities adapt to environmental challenges while maintaining traditional practices, ensuring that cultural knowledge directly contributes to sustainable food systems.
- **Producers:** Producers play a vital role as practices affect biodiversity loss. They need to enhance their environmental awareness by reducing the excessive use of chemicals and preserving traditional agricultural practices. Access to credit and cash flow is crucial to support investment in improved production practices that address the challenges posed by climate change. For producers in Indigenous communities, timely scientific meteorological forecasts, and participatory workshops, to better understand the data and take advantage of the knowledge are crucial.

- **Policymakers:** Policymakers must recognise the key role of biodiversity in ensuring food security. It is essential to support policy aimed at enhancing food safety and regulating chemical usage to promote health and environmental sustainability (MacLeod et al., 2022). This could include creating guidelines for biodiversity-friendly diets, adopting sustainable agricultural practices and encouraging collaboration between environmental and public health sectors. Tools such as biodiversity impact assessments for food policies and public awareness campaigns about the links between diet and biodiversity conservation could further bridge the gap between policy goals and practical implementation.

4.3 | Study limitations

Despite the valuable theoretical and practical implications, this study has its limitations, which might impact validity and generalisability.

A key limitation lies in the potential for bias in study selection. The use of specific databases and search terms may have inadvertently excluded relevant publications, particularly those not published in English or those from less-accessible sources, potentially skewing the findings towards a Western perspective. To reduce this bias, a citation search was employed during the full-text review, which led to the inclusion of four additional studies.

Additionally, while the number of studies included in the final analysis is not insignificant, it is small in comparison with the large volume initially identified in the database searches. This may suggest that the topic is under-researched and highlights a need for further exploration. Alternatively, the large volume of database hits may suggest a lack of precision in our search terms; most notably, the terms 'sustainable' and 'unsustainable' are very broad and will

capture many elements of the broad concept that are not directly related to biodiversity loss, for example social and cultural concerns. Broad terms were chosen for our searches to ensure no articles were missed. However, the geographically limited number of included studies may restrict the breadth and depth of the analysis, potentially reducing the representativeness of findings across different geographic and cultural contexts. This may undermine the ability to fully capture the diversity of stakeholder understanding, particularly from underrepresented groups such as smaller Indigenous communities or emerging agricultural sectors.

Finally, the thematic analysis, by its nature, carries the risk of researcher bias in the interpretation and coding of data, which may affect the reliability of the identified themes. These factors suggest that while the study provides valuable insights, its conclusions should be interpreted with caution, and further research with broader scope, more inclusive sampling and additional studies is needed to strengthen the evidence base.

4.4 | Future research

Building upon the insights gleaned from this systematic review, various avenues for future research present themselves, offering opportunities to further explain the relationships between biodiversity loss, dietary habits and stakeholder understanding.

There is a pressing need to further examine the understanding and involvement of policymakers and Indigenous populations in addressing the interconnected challenges of biodiversity loss and dietary patterns. Future research should focus on exploring the perspectives of Indigenous communities, ensuring their representation and inclusion in policymaking processes. Combining traditional knowledge with contemporary policy interventions can significantly enhance the effectiveness and relevance of biodiversity conservation efforts. Additionally, our review has highlighted a significant gap in the existing research where biodiversity loss, diet and stakeholder understanding are linked. While extensive literature exists on these topics individually, studies examining their interconnections are limited. This presents a crucial opportunity for future research to bridge these concepts and provide a more holistic understanding of their relationships.

Conducting longitudinal studies and comparative analyses across diverse geographic regions and socio-cultural contexts can provide valuable insights into the evolution of stakeholder dynamics and the effectiveness of conservation interventions over time. By tracking changes in stakeholder perceptions, behaviours, and policy outcomes, researchers can identify best practices, highlight areas for improvement, and inform evidence-based decision-making for sustainable development. Future studies should actively seek to address geographical gaps identified in the current literature, particularly focussing on underrepresented regions and stakeholder groups to provide a more comprehensive global perspective.

To address the absence of certain stakeholder groups, particularly retailers, future research should actively engage these

stakeholders through targeted surveys and interviews with retail executives and supply chain managers. Collaborating with industry partners and developing a stakeholder mapping framework could provide valuable insights into implementing biodiversity-friendly practices in food retail.

Finally, encouraging interdisciplinary collaboration and knowledge exchange between researchers, practitioners, policymakers and Indigenous communities is essential for addressing complex sustainability challenges. Future research should embrace a transdisciplinary approach, integrating diverse perspectives and methodologies to co-create solutions that are holistic, inclusive and contextually relevant.

5 | CONCLUSION

This systematic review has provided insights concerning stakeholder understanding of the links between biodiversity loss and dietary habits. The findings offer practical implications for stakeholders, namely consumers, Indigenous populations, producers and policymakers.

The implications suggest that collaborative efforts among these stakeholders are essential for fostering sustainable and resilient food systems. The theoretical implications emphasise the need for integrated, interdisciplinary, and culturally sensitive approaches to tackle the multifaceted challenges. A holistic and inclusive approach that values traditional knowledge, interdisciplinary collaboration, and informed policy decisions is essential for addressing ecosystem debate and promoting sustainability.

AUTHOR CONTRIBUTIONS

Katherine M. Appleton, Heather Hartwell and Anastasia Vayona designed the methodology for the systematic review. Anastasia Vayona led the data collection, analysis and synthesis of findings, and was responsible for drafting the manuscript. Roberta Discetti contributed to the development of the methodology and oversaw the inclusion and exclusion of studies during the full-text selection phase. Katherine M. Appleton provided supervision throughout the study and contributed to manuscript editing. Jeffery Bray assisted with the interpretation of the findings and offered feedback during the manuscript revisions. Heather Hartwell was responsible for the systematic review approach, data collection and conducted a critical revision of the manuscript. J. Robert Britton provided overall guidance on the review process and the interpretation of results. All authors contributed critically to the manuscript and gave final approval for publication.

CONFLICT OF INTEREST STATEMENT

The authors declare no conflict of interest.

DATA AVAILABILITY STATEMENT

The data supporting the findings of this systematic review come from previously published studies. The primary sources of data include 26 peer-reviewed articles identified through a systematic

review approach. Data from these studies are publicly available through the respective journals and can be accessed via DOI links or through the publisher's websites. No new datasets were created or analysed for the purposes of this review.

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

Appendix A. PRISMA 2020 Checklist.

Appendix B. Supplementary document with the test keyword string process.

Appendix C. Supplementary Table detailing the exclusion of 20 papers following the review of full-text articles for eligibility, following the removal of duplicates between studies sourced from databases and registers, and citation searching. The table outlines the rationale behind the exclusion of each paper.

Appendix D. Supplementary Table summarising the data extraction process.

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