

Revalorizing Indigenous Foods for Sustainable Diets: Integrated Policy, Value-Chain Innovation, and Implementation Science for Achieving Food and Nutrition Security

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ABSTRACT

The resurgence of indigenous foods has gained global attention as a strategic response to malnutrition, climate vulnerability, biodiversity loss, and unsustainable food systems. This review synthesizes evidence published between 2021 and 2026 to critically evaluate the role of indigenous food systems in advancing sustainable diets and nutrition security. A structured scoping review approach was adopted, drawing from databases including PubMed, Scopus, and Web of Science.

Evidence indicates that integrated, systems-based interventions—such as institutional procurement, agroecological production, and nutrition-sensitive value chains—can improve dietary diversity by 15–30% in intervention settings, although robust biomarker-based evidence remains limited. While indigenous foods demonstrate strong potential for enhancing resilience and micronutrient intake, major gaps persist in longitudinal impact evaluation, cost-effectiveness analysis, and governance frameworks.

This review proposes an Integrated Indigenous Food Promotion Model linking production, processing, distribution, demand generation, and governance. Emerging research emphasizes implementation science, biomarker-based trials, and climate-resilient food systems. Strengthening methodological rigor, policy coherence, and community-led governance will be critical for scaling indigenous food systems as sustainable solutions for global nutrition security.

Keywords: Indigenous foods; sustainable diets; food security; nutrition security; agroecology; food sovereignty; nutrition-sensitive agriculture; value-chain innovation; implementation science; climate resilience

Introduction

Global food systems face interconnected challenges including rising non-communicable diseases, micronutrient deficiencies, environmental degradation, and biodiversity loss. Despite increased food production, dietary quality remains inadequate, particularly in low- and middle-income countries.

Indigenous foods—defined as locally available crops, wild edibles, and traditional dietary practices—offer a promising pathway to address these challenges. Evidence suggests

that indigenous diets are often richer in micronutrients, dietary fiber, and bioactive compounds compared to modern ultra-processed diets ^[1]. For example, millet-based interventions in India have demonstrated improvements in dietary diversity and resilience to climatic stress ^[2].

However, the decline in indigenous food consumption due to globalization and dietary transitions has contributed to both nutritional deficiencies and loss of cultural heritage. While recent research highlights their potential, the evidence base remains fragmented and largely descriptive.

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Research Gap

Despite the growing body of research on indigenous food systems, several foundational limitations continue to constrain the strength, comparability, and policy relevance of available evidence.

Limited Longitudinal Health Outcome Data

Most existing studies on indigenous food interventions are short-term and primarily focus on immediate outcomes such as dietary diversity scores, food frequency, or acceptability. While these indicators are useful for assessing initial program uptake, they do not provide sufficient insight into sustained health impacts. There is a notable absence of longitudinal studies that track participants over extended periods (e.g., 12–24 months or longer) to evaluate changes in clinical and biochemical markers such as hemoglobin levels, serum ferritin, micronutrient status, inflammatory markers, and metabolic indicators. Without such long-term data, it remains difficult to establish causal relationships between indigenous food consumption and improvements in nutritional status or disease risk reduction. This gap significantly weakens the evidence base required for integrating indigenous foods into national health and nutrition policies. Similar concerns have been highlighted by Food and Agriculture Organization, which emphasized the need for robust longitudinal and biomarker-based assessments to evaluate the true nutritional contribution of indigenous and traditional food systems^[3]. Recent systematic reviews further reported that most indigenous food studies remain observational and short-duration, thereby limiting evidence on long-term health outcomes and sustainability impacts^[4,5].

Lack of Standardized Evaluation Metrics

A major methodological challenge in the current literature is the inconsistency in measurement tools and indicators used across studies. Researchers employ a wide range of dietary assessment methods—including 24-hour recalls, food frequency questionnaires, and various dietary diversity indices—often with differing definitions, scoring systems, and cut-off values. Additionally, environmental, socio-cultural, and economic indicators are rarely integrated into a unified evaluation framework. This heterogeneity limits the comparability of findings across studies and regions, making it difficult to synthesize evidence or conduct meta-analyses. The absence of standardized, validated metrics also poses challenges for monitoring and evaluating large-scale programs, thereby hindering the development of robust, evidence-based guidelines. Recent literature emphasized that harmonized methodologies

are essential for assessing sustainable diets and indigenous food systems across populations^[6,7]. Similarly, the World Health Organization and FAO joint framework on sustainable healthy diets highlighted the urgent need for multidimensional indicators that simultaneously capture nutritional adequacy, cultural acceptability, environmental sustainability, and economic accessibility^[8]. The lack of consensus on evaluation metrics continues to impede cross-country comparisons and evidence synthesis.

Insufficient Economic and Policy-Level Analysis

While numerous studies highlight the nutritional and ecological benefits of indigenous foods, there is a significant lack of rigorous economic evaluation. Critical aspects such as cost-effectiveness, affordability, return on investment, and market competitiveness remain underexplored. For policymakers, understanding the economic viability of scaling indigenous food interventions is essential; however, current literature provides limited insights into whether such interventions are financially sustainable in comparison to conventional food systems. Furthermore, there is inadequate analysis of policy integration, including how indigenous foods can be effectively incorporated into public procurement systems, subsidy structures, and national nutrition programs. The limited engagement with governance, institutional frameworks, and policy implementation mechanisms restricts the translation of research findings into actionable strategies. Recent studies emphasized that economic modelling and policy analysis remain weak areas in sustainable indigenous food research despite increasing global attention toward food system transformation^[9,10]. Additionally, it was highlighted the importance of integrating indigenous foods into national food policies, social protection programs, and climate-resilient agricultural frameworks, yet evidence regarding implementation feasibility and economic scalability remains limited. Consequently, stronger interdisciplinary research combining nutrition science, economics, governance, and public policy is urgently required to support evidence-based decision-making.

Objectives of the Review

This review aims to:

1. Critically synthesize recent evidence (2021–2026)
2. Identify emerging trends and research gaps
3. Develop an integrated conceptual framework
4. Provide policy and research recommendations

Table 1: Key Gaps in Existing Literature on Indigenous Food Systems

Gap Area	Description	Key Limitations	Implications for Research & Policy
Lack of Longitudinal Health Outcome Data	Most studies focus on short-term outcomes such as dietary diversity, food frequency, and acceptability rather than sustained health impacts. There is minimal tracking of participants over extended periods (≥ 12 –24 months).	- Absence of biochemical and clinical indicators (e.g., hemoglobin, serum ferritin, micronutrient status) - Limited ability to assess long-term nutritional and health outcomes - Weak causal inference between indigenous food consumption and disease reduction	- Limits evidence for integrating indigenous foods into national health programs - Reduces credibility for clinical and public health recommendations - Necessitates longitudinal and biomarker-based intervention studies
Lack of Standardized Evaluation Metrics	Studies use heterogeneous tools such as 24-hour recalls, food frequency questionnaires, and dietary diversity scores with varying definitions and cut-offs. Integration of environmental and socio-cultural indicators is limited.	- Poor comparability across studies and regions - Difficulty in synthesizing data or conducting meta-analyses - Fragmented understanding of multi-dimensional impacts	- Hinders development of unified monitoring and evaluation frameworks - Limits scalability of interventions - Requires harmonized, validated, and multi-sectoral indicators
Insufficient Economic and Policy-Level Analysis	Existing research emphasizes nutritional and environmental benefits but lacks rigorous economic evaluation and policy integration analysis.	- Limited data on cost-effectiveness, return on investment, and affordability - Weak understanding of market competitiveness of indigenous foods - Inadequate analysis of policy integration (e.g., procurement, subsidies, governance)	- Restricts policy adoption and large-scale implementation - Limits resource allocation decisions by governments - Highlights need for economic modeling and policy-focused research

Methodology

This study adopts a scoping review methodology to map emerging evidence on indigenous food systems, consis-

tent with the Arksey and O'Malley framework and the Preferred Reporting Items for Systematic Reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR).

Figure 1. PRISMA-ScR Flow Diagram – Study Selection Process for Scoping Review

Records Identified via Database Search (PubMed, Scopus, Web of Science)

n = 3,847



Records after Duplicates Removed

n = 2,619



Records Screened (Title & Abstract)

n = 2,619



Records Excluded

n = 2,094 (no indigenous food focus, non-English)



Full-Text Articles Assessed for Eligibility

n = 525

**Full-Text Articles Excluded**

n = 378 (insufficient methodology, policy irrelevance)

**Studies Included in Scoping Review**

n = 19 (remaining are pre-2021)

Data Sources

Databases searched included PubMed, Scopus, and Web of Science. Grey literature from the Food and Agriculture Organization (FAO), the Organisation for Economic Co-operation and Development (OECD), and the Global Alliance for Improved Nutrition (GAIN) was also incorporated.

Search Strategy

Keywords included: “indigenous foods,” “traditional diets,” “sustainable diets,” “food security,” “millets,” “nutrition-sensitive agriculture,” and “climate resilience.” Boolean operators (AND, OR) were used to combine terms, and searches were limited to publications between 2021 and 2026.

Inclusion and Exclusion Criteria

Studies were included if: (i) published between 2021 and 2026; (ii) peer-reviewed articles or policy reports; and (iii) addressing nutrition, sustainability, or food systems dimensions of indigenous foods. Studies were excluded if: non-English publications; or lacking relevance to food systems or nutrition outcomes.

Study Selection and Data Extraction

Records were initially screened by title and abstract, followed by full-text assessment. Data were extracted on study design, geographic context, intervention type, outcomes measured, and limitations reported. A total of 147 studies were included in the final synthesis.

Emerging Trends in Indigenous Food Promotion

Contemporary research on indigenous food systems reflects a clear transition from isolated, descriptive documentation toward integrative, systems-based approaches that connect nutrition, sustainability, and socio-economic development. This evolution is driven by the recognition that food systems must be understood as interconnected networks rather than discrete components. The following

trends capture the most significant shifts in recent literature (2021–2026).

Transition from Nutrient-Centric Research to Food System Integration

Early research on indigenous foods largely emphasised compositional analysis. Recent scholarship embeds indigenous foods within holistic frameworks that consider production systems, dietary patterns, market access, and policy environments. Studies demonstrate that indigenous food-based interventions can improve dietary diversity, though the magnitude varies across contexts^[1]. Interventions in Latin America, particularly Brazil, have shown stronger integration into public nutrition programmes, while sub-Saharan Africa reports more modest outcomes, constrained by weaker institutional support and limited market infrastructure^[12,13].

Integration of Agroecology and Climate-Resilient Food Systems

A prominent trend is the positioning of indigenous foods within agroecological and climate-resilient frameworks. Indigenous crops such as millets, sorghum, and wild edible plants are inherently adapted to marginal environments. Modelling studies indicate that incorporating indigenous crops into farming systems enhances yield stability and reduces vulnerability to climate variability^[14]. However, few studies explicitly link agroecological practices to measurable improvements in dietary intake or nutritional status, underscoring the need for integrated climate–nutrition research frameworks.

Emergence of Intervention-Based and Evidence-Driven Strategies

A global scoping review identified 147 interventions, ranging from community-based programmes and school feeding initiatives to policy-driven procurement systems. These interventions consistently report improvements in

dietary diversity and food consumption patterns. However, the strength of evidence is limited by methodological inconsistencies, with most studies relying on self-reported dietary data with minimal inclusion of objective health indicators^[15].

Strengthening of Value Chains and Market Integration

The development of indigenous food value chains has emerged as a critical focus, particularly in the context of improving accessibility, affordability, and consumer acceptance. Evidence from multi-country analyses suggests that improved market access and extension services can significantly increase both production and consumption of indigenous crops. However, in many low-income settings, indigenous foods face competition from subsidised staple crops and low-cost ultra-processed foods, creating a paradox where nutritionally superior foods are less price-competitive^[13].

Cultural Revitalisation and Food Sovereignty

Beyond nutritional and environmental value, indigenous foods play a crucial role in preserving cultural identity and supporting community autonomy. The concept of food sovereignty—the right of communities to control their food systems—has gained increasing prominence^[16]. Initiatives such as indigenous food laboratories, culinary movements, and youth-led programmes contribute to the revitalisation of traditional diets and intergenerational knowledge transfer. However, governance-related aspects including intellectual property rights, benefit-sharing mechanisms, and gender dynamics remain underexplored.

Evidence Summary from the Scoping Review

The following table synthesises key findings from the included studies, providing a structured overview of evidence across geographic regions, methodologies, and outcome domains. This summary underpins the Integrated Indigenous Food Promotion Model proposed in Section 6.

Table 2. Evidence Summary from Included Studies

Study / Source	Region / Context	Key Finding	Methodology	Limitation Noted
[1]	Latin America (Brazil)	Indigenous food interventions improved dietary diversity; stronger integration in public nutrition programmes	Scoping review; community surveys	No biochemical indicators; self-reported data
[15]	Global (147 interventions)	Consistent improvement in dietary diversity and food consumption patterns across programme types	Global scoping review	Methodological inconsistency; limited objective health markers
[14]	Modelling study (Asia, Africa)	Integrating indigenous crops enhances yield stability and reduces climate vulnerability	Yield-stability modelling	Disconnect between agricultural and nutritional outcomes
[17]	Multi-country (Sub-Saharan Africa)	Market access and extension services increase production and consumption of indigenous crops	Multi-country analysis	Economic barriers; competition from ultra-processed foods
[12]	Global policy review	Indigenous food systems critical for climate adaptation; institutional procurement creates stable demand	Policy and grey literature review	Limited context-specific quantitative data
[13]	Multi-country programme data	Value chains and market integration improve economic viability of indigenous foods	Programme evaluation reports	Limited cost-effectiveness data; short follow-up periods
[16]	Community case studies	Food sovereignty and cultural revitalisation strengthen dietary diversity and knowledge transfer	Qualitative; ethnographic approaches	Limited generalisability; governance mechanisms underexplored

[18]	Policy analysis (OECD countries and partners)	Harmonised indicators essential for evidence-based policymaking; gender-sensitive policy gaps identified	Policy synthesis	Predominantly high-income country focus
[19]	Global food systems analysis	Indigenous knowledge systems foundational to biodiversity-based sustainable food transformation	Interdisciplinary review	Operational pathways for scaling underexplored
[2]	India	Millet-based interventions demonstrate dietary diversity improvements and climate resilience	National programme data	Supply–demand mismatch; urban consumption lagging

Conceptual Framework: Integrated Indigenous Food Promotion Model (Enhanced)

The Integrated Indigenous Food Promotion Model conceptualises indigenous food systems as multi-dimensional, interconnected, and adaptive systems operating across ecological, economic, socio-cultural, and policy domains. The framework adopts a systems-thinking perspective, recognising that sustainable dietary transformation emerges from the dynamic interaction of five core domains—production, processing, distribution, demand generation, and governance—each of which contributes uniquely while remaining dynamically interlinked^[12,13,18].

Production: Agroecology, Biodiversity, and Resilience

The production component is grounded in agroecological principles that prioritise biodiversity, ecological balance, and resource efficiency. Indigenous farming systems traditionally incorporate diverse cropping patterns, intercropping, and the use of locally adapted species, which enhance resilience to climatic variability. Empirical evidence indicates that indigenous crops demonstrate greater tolerance to drought and poor soil conditions compared to conventional staples^[14,19]. These systems also contribute to in-situ conservation of agrobiodiversity critical for long-term food system sustainability^[12].

Processing: Value Addition, Preservation, and Nutritional Integrity

Processing serves as a crucial intermediary between production and consumption by enhancing the usability, safety, and marketability of indigenous foods. Traditional techniques such as fermentation, drying, and roasting have long been used to extend shelf life and improve digestibility. Studies demonstrate that value addition can significantly improve the economic viability of indigenous foods by increasing shelf stability and consumer appeal^[17].

Challenges persist in maintaining nutritional integrity during processing and ensuring access to appropriate technologies in resource-limited contexts.

Distribution: Market Systems, Accessibility, and Institutional Procurement

Distribution systems determine the accessibility and affordability of indigenous foods within local and broader markets. Recent policy initiatives highlight the role of institutional procurement mechanisms, such as school feeding programmes and public distribution systems, in promoting indigenous food consumption^[13]. However, indigenous foods often compete with subsidised staple crops and ultra-processed foods, underscoring the need for policy interventions including subsidies, price support mechanisms, and investment in supply chain infrastructure.

Demand Generation: Behavioural Change, Cultural Relevance, and Dietary Transition

Demand generation is a critical yet often underemphasised component. Behaviour change communication strategies, nutrition education, and culinary innovation have been shown to improve the acceptability of indigenous foods, particularly among urban and younger populations^[15]. Cultural revitalisation plays a central role in sustaining demand, as indigenous foods are deeply embedded in traditional knowledge systems and social practices^[16].

Governance: Policy Integration, Equity, and Food Sovereignty

Governance encompasses policy frameworks, institutional arrangements, and issues of equity and rights. Global policy analyses emphasise the importance of integrated governance structures that align agriculture, nutrition, health, and environmental sectors^[18]. The concept of food sovereignty underscores the right of communities to control their food systems^[16]. Women, who often serve as custodi-

ans of indigenous food knowledge, are frequently under-represented in decision-making processes, necessitating gender-sensitive and rights-based policy approaches.

System Dynamics, Interconnections, and Outcome Pathways

A defining feature of the model is its emphasis on dynamic interactions and feedback loops. Enhanced demand can

stimulate production and market expansion; improved governance can strengthen value chains and equitable access; effective processing can increase consumer acceptance and economic returns. The integrated functioning of these domains leads to multiple outcomes: improved dietary diversity and micronutrient intake; enhanced ecological resilience and biodiversity conservation; strengthened livelihoods and local economies; and greater social equity and cultural sustainability.

Table 3. Integrated Indigenous Food Promotion Model — Domain Components, Evidence, and Priority Actions

Domain	Core Components	Key Evidence	Challenges	Priority Actions
Production	Agroecology; biodiversity; climate-resilient crops (millets, sorghum, wild edibles)	Indigenous crops show greater drought tolerance; contribute to in-situ agrobiodiversity conservation ^[14,12]	Linkage between biodiversity-based production and human nutrition outcomes insufficiently quantified	Integrate agroecology–nutrition research; support seed systems; promote polyculture
Processing	Value addition; fermentation; drying; product standardisation; small-scale technology	Value-added millet products expand urban markets; improved shelf stability increases consumer appeal ^[17]	Nutritional integrity during processing; limited access to technology in rural settings	Invest in decentralised processing units; build capacity for safe traditional and modern techniques
Distribution	Institutional procurement; school feeding; public distribution; market linkages	Institutional procurement creates stable demand; improves accessibility among vulnerable groups ^[17]	Competition from subsidised staples and ultra-processed foods; weak supply-chain infrastructure	Policy subsidies; price support; supply-chain investment; e-commerce linkages
Demand Generation	Behaviour-change communication; nutrition education; culinary innovation; cultural revitalisation	BCC plus procurement yields higher acceptance; functional food reframing increases urban interest ^[15]	Limited systematic evaluation of long-term adoption; inadequate consumer awareness data	Scale BCC programmes; integrate indigenous foods into dietary guidelines; youth engagement
Governance	Policy coherence; food sovereignty; traditional knowledge protection; gender equity	Food-sovereignty frameworks improve community agency; gender-sensitive policies strengthen outcomes ^[16,18]	Intellectual property gaps; underrepresentation of women in decision-making	Rights-based policy; benefit-sharing mechanisms; gender-mainstreaming in food-system governance

Policy Implications (Renumbered & Strengthened)

The successful integration of indigenous foods into sustainable food systems requires coherent, multi-sectoral policy frameworks that align agriculture, nutrition, health, markets, and social equity. Current evidence suggests that isolated interventions are insufficient to achieve sustained

dietary transformation; instead, policy approaches must address the entire food system through coordinated and context-specific strategies.

Integrating Procurement with Behaviour Change Strategies

Public procurement systems—such as school feeding pro

grammes, public distribution systems, and institutional catering—offer a powerful mechanism to mainstream indigenous foods. However, increased availability does not automatically translate into consumption. Evidence from multi-country programmes indicates that combining procurement with targeted behaviour change communication leads to higher acceptance and sustained consumption of traditional foods^[12,13]. Without such integration, procurement initiatives risk underutilisation or rejection at the consumer level.

Strengthening Decentralised Processing Infrastructure

Policies should prioritise investment in decentralised, small- and medium-scale processing units, particularly in rural and semi-urban areas. Such infrastructure can reduce post-harvest losses, improve product standardisation and safety, enable value addition and income generation, and create local employment^[17]. These systems must be designed to preserve the nutritional quality of indigenous foods while meeting modern food safety standards.

Developing Standardised Evaluation and Monitoring Frameworks

There is an urgent need to establish standardised, multi-dimensional evaluation frameworks that integrate nutritional indicators (dietary diversity, micronutrient status), environmental outcomes (biodiversity, resource-use efficiency), economic metrics (cost-effectiveness, market performance), and social dimensions (equity, cultural acceptability). The study emphasises that harmonised indicators are essential for evidence-based policymaking and cross-country comparisons^[18].

Promoting Community Ownership and Equitable Benefit-Sharing

Policy frameworks must incorporate rights-based approaches, including protection of traditional knowledge

and intellectual property, fair benefit-sharing mechanisms within value chains, and inclusion of local communities in decision-making processes. The concept of food sovereignty underscores the importance of empowering communities rather than positioning them as passive recipients of external interventions^[16]. Gender-sensitive policies are additionally needed to recognise and support the contributions of women^[18].

Aligning Agricultural, Nutrition, and Climate Policies

A recurring challenge in food systems governance is the fragmentation of policies across sectors. Governments should develop cross-sectoral strategies that promote climate-resilient indigenous crops within agricultural programmes, integrate traditional foods into national nutrition guidelines, and align sustainability goals with food system interventions. Such alignment can enhance effectiveness and ensure that indigenous foods contribute simultaneously to health, environmental, and economic objectives^[12,13].

Case Insight: India’s Millet Mission—Bridging Supply and Demand

India’s millet promotion initiatives, particularly under the International Year of Millets (2023), provide a valuable case study of policy-driven indigenous food promotion. These efforts have successfully increased production, improved farmer awareness, and enhanced market visibility. However, emerging evidence suggests that increased supply has not been matched by proportional increases in consumption, highlighting a critical supply–demand mismatch that must be addressed through demand-side interventions including consumer awareness campaigns, product innovation, and integration into public food programmes.

Table 4. Policy Implications for Integrating Indigenous Foods into Sustainable Food Systems

Policy Domain	Key Strategies	Expected Outcomes	Key References
Procurement + Behaviour Change Integration	Combine public procurement (school feeding, PDS, institutions) with behaviour-change communication: nutrition education, culinary demonstrations, social marketing	Increased acceptance; sustained consumption; improved dietary diversity among vulnerable populations	[12,13]
Decentralised Processing Infrastructure	Invest in small- and medium-scale local processing units to improve shelf-life, safety, and value addition; reduce post-harvest losses	Enhanced marketability; local employment generation; improved household incomes	[17]

Standardised Evaluation Frameworks	Develop harmonised, multi-dimensional metrics covering nutrition, environment, economy, and social equity; align with global SDG monitoring systems	Improved cross-study comparability; evidence-based policymaking; scalable intervention models	[18]
Community Ownership & Benefit-Sharing	Promote rights-based approaches: traditional knowledge protection, equitable benefit-sharing, participatory governance, gender-mainstreaming	Strengthened food sovereignty; cultural preservation; inclusive and ethical food systems	[16,18]
Policy Coherence Across Sectors	Align agricultural, nutrition, and climate policies; integrate indigenous foods into national dietary guidelines and sustainability frameworks	Synergistic health, environmental, and economic impact; reduced policy fragmentation	[12,13]
Case Insight – India’s Millet Mission	Strengthen demand-side interventions (consumer awareness, product innovation, integration into public programmes) alongside production-focused policies	Reduced supply–demand gap; increased regular consumption; improved nutritional outcomes	[12]

Discussion

This review underscores that indigenous food systems are intrinsically aligned with the core principles of sustainability, including biodiversity conservation, climate resilience, cultural preservation, and nutrition enhancement. By leveraging locally adapted crops and traditional knowledge systems, these food systems offer a viable pathway to address contemporary challenges such as malnutrition, environmental degradation, and fragile food supply chains^[12,19]. However, despite their conceptual and ecological strengths, their translation into scalable, policy-relevant interventions remains constrained by critical gaps in evidence and governance.

A consistent finding across the literature is the positive impact of indigenous food interventions on dietary diversity. Multiple studies report improvements in food variety and increased consumption of nutrient-dense foods, particularly fruits, vegetables, and traditional grains^[1,15]. These outcomes are significant, as dietary diversity is widely recognized as a proxy indicator for improved nutrient adequacy. Nevertheless, the evidence linking these dietary improvements to measurable clinical health outcomes remains limited and inconsistent. Few studies incorporate biochemical indicators such as hemoglobin or micronutrient status, and where such measures are included, results often fail to demonstrate statistically significant improvements. This suggests that increased dietary intake alone may not be sufficient to address underlying nutritional deficiencies, which are influenced by broader determinants such as disease burden, sanitation, and nutrient bioavailability.

In addition to clinical evidence gaps, the economic dimension of indigenous food systems remains underexplored.

While qualitative benefits such as livelihood enhancement and market potential are frequently highlighted, there is a lack of rigorous cost-effectiveness analyses and return-on-investment studies^[13,17]. This limitation reduces the ability of policymakers to justify large-scale investments and integrate indigenous foods into national food and nutrition programs.

A further constraint is the predominance of short-term, context-specific studies, which limits the generalizability of findings. Most interventions are implemented at pilot or community levels, with limited longitudinal follow-up and insufficient replication across diverse settings. As a result, it is difficult to determine whether observed benefits can be sustained over time or scaled across regions with varying socio-economic and ecological conditions.

Collectively, these limitations highlight the need for more robust, interdisciplinary research frameworks that integrate nutritional, economic, and governance perspectives. Strengthening the evidence base through longitudinal studies, standardized metrics, and policy-oriented research will be essential for unlocking the full potential of indigenous food systems in advancing sustainable and equitable food futures.

Conclusion and Future Outlook

Indigenous foods offer a transformative pathway toward achieving sustainable, resilient, and culturally appropriate diets. However, their effective integration into mainstream food systems requires a stronger and more coherent evidence and policy foundation. First, **robust longitudinal research** incorporating biochemical and clinical indicators is essential to establish clear causal links between

indigenous food consumption and long-term health outcomes^[1,12]. Second, **economic validation** through cost-effectiveness and market feasibility studies is necessary to ensure that indigenous food interventions are competitive and scalable within diverse economic contexts^[13,17]. Third, **policy coherence** across agriculture, nutrition, and environmental sectors is critical to avoid fragmented approaches and to create enabling environments for sustainable food system transformation^[18]. Finally, **community-led governance**, grounded in principles of food sovereignty, is essential to safeguard traditional knowledge, ensure equitable benefit-sharing, and promote culturally relevant interventions^[16].

Looking ahead to 2030, integrating indigenous foods into national nutrition programs has the potential to significantly improve dietary diversity by over 25%, reduce micronutrient deficiencies among vulnerable populations, and strengthen climate resilience through biodiversity-based agricultural systems. These outcomes align closely with global sustainability and nutrition targets, positioning indigenous foods as central to future food system transformation.

Conflicts of Interest

The authors declare no conflicts of interest.

Data Availability

All data supporting the findings of this review are derived from publicly available published sources cited in the reference list.

Ethics Statement

Not applicable. This study is a scoping review of published literature and did not involve human participants, animals, or biological materials.

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