

Indigenous Foods and Biodiversity for Sustainable Food Systems: A Review of Nutritional, Ecological and Socio-Cultural Perspectives

Manjusha Rai¹, Arundhati Rai^{2*}

¹Assistant Professor, Home Science, Km. Mayawati Govt. Girls P.G. College, Badalpur, Gautam Buddha Nagar, UP, India

²Assistant Professor, Home Science, Pt. D.D.U. Govt. P.G. College, Palahipatti, Varanasi, UP, India

Corresponding Author Email ID: arundhatirai@gmail.com

Received: 14/08/2026

Accepted: 28/08/2026

Published: 30/09/2026

Abstract

Indigenous foods and food biodiversity have considerable potential to contribute to more diverse, resilient, and sustainable food systems. Their importance extends beyond nutrient supply, as they are closely associated with ecological resources, traditional knowledge, cultural identity, and local livelihoods. Evidence reviewed in this paper indicates that indigenous and underutilized foods can improve dietary diversity and provide important nutrients, although their nutritional contribution depends on food composition, processing practices, antinutrient content, and nutrient bioavailability. Greater food and agrobiodiversity can also support resource conservation, ecological resilience, and adaptation to changing environmental conditions by diversifying local food and production systems. At the same time, the sustainability of these food systems is threatened by biodiversity loss, land and resource pressures, changing dietary preferences, weakening transmission of traditional knowledge, limited documentation, food safety concerns, and inadequate institutional recognition. Commercialization and value addition may create livelihood opportunities and improve the availability of indigenous foods, but inappropriate commercialization may also weaken cultural and ecological linkages if community interests and resource sustainability are not adequately considered. Overall, the evidence suggests that strengthening indigenous food systems requires an integrated approach that connects biodiversity conservation with nutrition, traditional knowledge, sustainable livelihoods, and supportive food-system policies. Recognizing and appropriately integrating indigenous foods and associated knowledge into sustainable food-system planning can contribute to dietary diversity, ecological resilience, cultural continuity, and more locally adapted and sustainable food systems.

Keywords: Indigenous foods; food biodiversity; agrobiodiversity; sustainable food systems; dietary diversity.

Journal of Applied Pharmaceutical Sciences and Research, (2026);

DOI: 10.31069/japsr.v9i3.05

Introduction

Food systems are increasingly expected to deliver adequate nutrition while reducing environmental pressures, supporting livelihoods and maintaining the ecological resources on which food production depends. Sustainable diet frameworks explicitly connect nutrition, environmental integrity, cultural acceptability and the responsible use of natural resources.^[1] At the same time, global assessments of biodiversity for food and agriculture show that diversity at genetic, species and ecosystem levels contributes to the functioning of production systems, livelihoods, food security and ecosystem services.^[2] These perspectives create an important rationale for examining foods that remain closely connected with local environments and community knowledge, including their links with nutrition and biodiversity conservation.^[3]

Indigenous foods occupy this space because food acquisition, production, processing and consumption in many Indigenous and traditional communities are linked with local ecosystems and culturally transmitted knowledge.

FAO and the Alliance of Bioversity International and CIAT have documented food systems in diverse regions in which wild and cultivated foods, livestock, fisheries, forests and local management practices collectively contribute to food, nutrition and livelihoods.^[4] Indigenous food systems are therefore not simply collections of traditional recipes; they are dynamic socio-ecological systems shaped by land, water, biodiversity, seasonality, institutions, markets and knowledge.

The nutritional dimension is particularly relevant. The review by Kapoor et al.^[5] documented 508 indigenous foods consumed by Indigenous communities across 15 Indian states and one Union Territory and reported substantial variation in nutrient composition across food groups. Such evidence illustrates the potential contribution of underused foods to dietary diversity, while also demonstrating the need for reliable food-composition data.

Recent literature has expanded this discussion toward biocultural diversity, resilient food systems and planetary

health. Argumedo et al.^[6] emphasized the role of food-related biocultural diversity in nutrition, resilience and adaptive capacity. Wang et al.^[7] similarly argued that interactions between Indigenous knowledge and science-based approaches can support more sustainable food-system development. However, recent publications also show that the field is becoming more specialized: Marak et al.^[8] examined sustainable diets and Indigenous food systems through a Meghalaya-focused case study, while Barwant et al.^[9] systematically reviewed endangered foods and their contribution to food security. The present review addresses a broader integrative question by connecting indigenous foods, biodiversity, nutrition, ecology, livelihoods and socio-cultural continuity without restricting the discussion to a single region or to endangered foods.

Conceptual Linkages Between Indigenous Foods, Biodiversity and Sustainability

Indigenous Foods and Indigenous Food Systems

The term indigenous foods are used here in a broad functional sense for foods that are native to, long-established within, or traditionally accessed from particular local environments and that are incorporated into community food practices. This includes wild edible plants, traditional crop varieties, locally adapted livestock, fish and other animal foods, fungi, fruits, tubers, seeds and fermented or otherwise processed products. Such foods may be obtained through cultivation, gathering, hunting, fishing, pastoralism or local exchange. The foundational work by FAO and the Centre for Indigenous Peoples' Nutrition and Environment (CINE) emphasized the links among food, culture, environment, diversity and health.^[10]

Food Biodiversity and Agrobiodiversity

Food biodiversity refers to diversity within and among foods used by people, including differences among species, varieties, breeds, and wild or underutilized foods. Charrondière et al.^[11] demonstrated the importance of recording foods below the species level because nutrient composition can differ substantially among varieties and cultivars. Agrobiodiversity extends beyond the diversity of crops to include genetic resources, associated organisms, and the ecological settings that support agricultural production [2]. Assessment of food biodiversity should also consider the diversity of foods actually consumed, rather than relying only on the availability or production of different species.^[12]

Sustainable Food Systems

A sustainable food system must be considered across production, processing, distribution, consumption and waste, while accounting for environmental, economic, health and socio-cultural outcomes. Sustainable diets are not defined only by nutrient adequacy; FAO^[1] also emphasizes low environmental impact, cultural acceptability, accessibility, fairness and protection of biodiversity. Consequently,

indigenous foods are relevant not because they are inherently sustainable, but because they may provide context-specific pathways for diversification and resilience when harvested or produced within ecological limits.

Nutritional Contributions of Indigenous Foods and Food Biodiversity

Dietary Diversity and Nutrient Adequacy

Dietary diversity is influenced by the range of foods that are available, affordable, acceptable and actually consumed. Food biodiversity can expand this range by adding locally available vegetables, fruits, pulses, grains, nuts, seeds and animal-source foods. Reviews of agricultural biodiversity and sustainable diets identify important connections between production diversity, food availability and dietary quality, although these relationships are context-dependent.^[13] Ruel et al.^[14] likewise found that agriculture can improve access to nutritious foods, but effects depend on food environments, markets, behaviour, gender relations and other contextual factors.

Micronutrient Diversity

The contribution of indigenous foods may be particularly relevant for micronutrients because different species and varieties can contain distinct nutrient profiles. Kapoor et al.^[5] reported that many documented Indian indigenous foods were important sources of iron, calcium and protein, while also noting the presence of antinutritional factors in a subset of foods. Such findings support the inclusion of indigenous foods in nutrition research, but they do not justify assuming that every indigenous food is nutritionally superior to conventional foods.

Processing, Antinutrients and Bioavailability

Nutritional value depends not only on composition but also on preparation and bioavailability. Traditional processing methods such as soaking, fermentation, germination, cooking and drying can alter nutrient availability and reduce some antinutritional components, although the magnitude and direction of effects vary with food and processing conditions. Therefore, food-composition databases and dietary assessments should, where possible, document the food form and preparation method rather than treating raw and prepared foods as nutritionally equivalent.^[5]

Availability Does Not Equal Consumption

An important limitation in biodiversity–nutrition discussions is the assumption that the presence of many edible species automatically produces dietary diversity. Communities may know and recognize many indigenous foods without consuming them frequently. Market access, seasonality, labour requirements, taste preferences, food safety, social norms and dietary transition can determine actual use. Evidence from food-biodiversity research highlights the importance of considering both food availability and actual

consumption patterns when assessing the contribution of biodiversity to dietary diversity.^[12]

Ecological Sustainability and Climate Resilience

Local Adaptation and Resource Efficiency

Locally adapted crops and foods may possess characteristics suited to particular climates, soils and management conditions. Neglected and underutilized species have received attention because their diversity can broaden the resource base available to farmers and consumers and can contribute to more resilient food systems when appropriately integrated.^[15] However, the ecological performance of any species depends on the production system, resource requirements, management practices and landscape context.

Diversification and System Resilience

Diversification can function as a risk-management strategy because reliance on a narrow range of crops or food sources may increase vulnerability to pests, climatic shocks and market disruptions. Argumedo et al. [6] connect food-related biocultural diversity with resilience and adaptive capacity, while FAO & Alliance of Bioversity International and CIAT^[4] document Indigenous food systems in which multiple ecological resources are combined across landscapes. Diversity should therefore be understood as a system property rather than simply a count of food species.

Conservation of Biological Resources

Food use and biodiversity conservation can reinforce one another when harvesting and production remain within ecological limits. FAO^[2] identifies biodiversity for food and agriculture as fundamental to production-system functions and ecosystem services. Conservation strategies may include on-farm management, community seed systems, protection of wild food habitats and maintenance of traditional varieties. These approaches are particularly relevant where conservation is linked with continued culturally meaningful use.

Climate Change and Resilience

Climate change can simultaneously alter species distributions, seasonal availability, water resources and food security. Food-system diversification may provide additional options for adaptation, but resilience should not be assumed solely from traditional status. Local evidence is needed to determine whether particular foods remain available under changing climatic conditions and whether increased demand could create new ecological pressures.

Traditional Knowledge, Food Culture and Socio-Cultural Sustainability

Traditional Ecological Knowledge

Knowledge about edible species, harvesting seasons, seed selection, cultivation, storage, processing and preparation is a major component of food-system biodiversity. FAO's

work with Indigenous food systems shows that traditional knowledge is connected with natural-resource management, governance, language and food practices.^[4] Such knowledge should be treated as a living knowledge system rather than as a static collection of heritage practices.

Culinary Knowledge and Food Preparation

Culinary practices can determine whether biodiversity is converted into usable nutrition. Processing and preservation allow seasonal foods to be stored and consumed beyond their period of availability. Fermentation, drying, cooking and other local methods may also influence sensory characteristics and nutritional properties. Documentation should therefore record recipes, preparation methods and food contexts alongside botanical or taxonomic information.

Cultural Identity and Food Heritage

Food practices can contribute to cultural identity and continuity. The loss of traditional foods may therefore involve more than a reduction in species diversity; it can also weaken associated languages, skills, ceremonies and intergenerational knowledge. Indigenous Peoples' food-system literature has repeatedly emphasized the cultural and environmental dimensions of food rather than treating nutrition as an isolated outcome.^[4,10]

Equity and Knowledge Co-Creation

Research and policy initiatives should recognize Indigenous Peoples as knowledge holders and rights-bearing partners. Brock et al.^[16] argue that more equitable food-system transformation requires broader approaches to knowledge production and exchange. Similarly, Wang et al.^[7] emphasize interaction between Indigenous and science-based knowledge rather than replacement of one by the other. Community participation, appropriate attribution, benefit sharing and respect for local decision-making are therefore important components of responsible research.

Livelihoods, Markets and Value Chains

Indigenous Foods as Livelihood Resources

Indigenous foods can contribute to livelihoods through subsistence, local trade, small-scale processing and seasonal income. FAO & Alliance of Bioversity International and CIAT^[4] document the multiple functions of Indigenous food systems, including food provision, livelihoods and ecosystem management. These functions are often interconnected, so interventions that focus only on commercial value may overlook household nutrition and cultural roles.

Commercialization: Opportunities and Risks

Commercialization can create incentives for conservation when local foods receive fair value and producers retain control over their resources. At the same time, demand growth may encourage overharvesting, replacement of diverse varieties with standardized forms, or unequal distribution of economic benefits. Sustainable value chains

should therefore consider ecological harvesting limits, traceability, producer participation, food safety and equitable benefit sharing.

Local Markets and Institutional Demand

Local markets, schools, community programmes and public procurement can potentially create stable demand for culturally appropriate foods. Nutrition-sensitive agriculture research indicates that improving production alone does not guarantee improved nutrition; market access, consumer behaviour and complementary nutrition actions influence outcomes.^[14,17] This lesson is applicable to indigenous foods: market development should be connected with nutrition education, affordability and sustainable production.

Women and Intergenerational Transmission

Women and older community members frequently play important roles in food collection, processing and culinary transmission, although roles vary across communities. Programmes that document or commercialize indigenous foods should avoid assuming a uniform gender pattern and should instead examine local responsibilities, decision-making and benefit distribution. Intergenerational learning is particularly important where dietary transition and migration are reducing opportunities to practice traditional food skills.

Challenges to the Sustainability of Indigenous Food Systems

Land, Habitat and Resource Pressures

Habitat conversion, land-use change, declining access to traditional territories and pressure on natural resources can reduce the availability of wild and cultivated indigenous foods. Global assessments identify land-use change and other drivers as major pressures on biodiversity for food and agriculture.^[2]

Agricultural Homogenization and Dietary Transition

Agricultural specialization and dietary transition can reduce both production diversity and demand for local foods. Declining consumption of biodiverse and traditional foods may, in turn, affect their local availability and the continued use of associated food knowledge. Evidence from food-biodiversity research indicates that local availability, food consumption and agricultural biodiversity are closely interconnected, although these relationships can vary across food systems and contexts.^[12]

Documentation and Data Gaps

Many indigenous foods remain poorly represented in national food-composition databases. Charrondière et al.^[11] showed the value of biodiversity-oriented food-composition databases that capture varieties, breeds and wild foods. Without reliable compositional, consumption and ecological data, the contribution of indigenous foods to nutrition and sustainability can be underestimated or described using unsupported generalizations.

Food Safety and Standardization

Traditional status does not automatically guarantee safety. Wild foods may require correct identification, appropriate processing and careful handling. Commercialization may also require standardized information on contaminants, allergens, microbial safety and preparation. Research should therefore combine respect for traditional practices with scientifically appropriate safety assessment.

Policy and Institutional Recognition

Food biodiversity often falls between agricultural, nutrition, biodiversity and cultural policies. Martin et al.^[18] showed strong interconnections among food, water and biodiversity in the Indian context, illustrating why sector-specific governance can overlook important linkages. More integrated planning is needed to connect conservation, nutrition, livelihoods and local governance.

Pathways for Integrating Indigenous Foods into Sustainable Food Systems

Conservation Through Sustainable Use

Conservation strategies should combine in situ and on-farm approaches with sustainable use. Community seed systems, traditional-variety cultivation, habitat protection and responsible harvesting can maintain diversity while keeping foods connected to everyday diets. Argumedo et al.^[6] emphasize conservation, use and celebration of food-related biocultural diversity as complementary pathways.

Nutrition-Sensitive Food-System Planning

Indigenous foods can be incorporated into nutrition-sensitive planning when their availability, affordability, nutrient composition, preparation and cultural acceptability are established. Programmes should avoid replacing local diets with a single standardized intervention and should instead evaluate how locally appropriate foods can complement existing nutrition strategies.^[14]

Community-Based Documentation

Documentation should combine ethnobotanical, nutritional, ecological and socio-cultural information. Community members should participate in identifying foods, describing seasonal availability, recording preparation methods and deciding how knowledge is shared. Digital databases can improve visibility, but data governance and community consent are essential.

Sustainable Value Addition

Value addition may include hygienic drying, milling, fermentation, minimally processed products and culturally appropriate packaged foods. However, processing should not erase food identity or create excessive standardization. Economic analysis should consider production costs, ecological limits, producer returns and consumer affordability rather than focusing only on product price.

Policy Integration

Policies can connect biodiversity conservation, nutrition, agriculture, local enterprise and cultural heritage. Public procurement, community seed systems, support for local processing, food-composition databases and recognition of Indigenous knowledge can form complementary policy components. Such integration is consistent with the broader food-system approach advocated in international assessments.^[19,20]

Integrating Indigenous and Scientific Knowledge

Knowledge integration should be based on mutual respect rather than a hierarchy in which local knowledge is accepted only after being translated into scientific categories. Wang et al.^[7] identify opportunities for combining experience-based knowledge with contemporary science in food production and processing. Brock et al. [16] further highlight the need for knowledge democratization and more inclusive food-system decision-making.

Conclusion

Indigenous foods and food biodiversity represent an important dimension of sustainable food-system thinking because they connect nutrition with ecological resources, local adaptation, livelihoods and cultural knowledge. Available evidence supports their potential contribution to dietary diversity and resilience, but it also shows that these benefits are context-dependent. Indigenous foods should therefore not be treated as inherently superior or automatically sustainable. Their contribution depends on ecological availability, sustainable harvesting or production, nutritional quality, food preparation, affordability, consumption patterns, safety and equitable governance.

A practical pathway is to conserve biodiversity through sustainable use while strengthening community-led documentation, nutrition-sensitive planning, responsible value addition, reliable food-composition data and equitable knowledge partnerships. Such an approach can help position indigenous foods not as remnants of traditional food systems but as living resources within future-oriented strategies for nutritious, resilient and culturally grounded food systems.

References

- Food and Agriculture Organization of the United Nations. Sustainable diets and biodiversity: directions and solutions for policy, research and action. Rome: FAO; 2012.
- Food and Agriculture Organization of the United Nations. The state of the world's biodiversity for food and agriculture. Rome: FAO; 2019.
- Heywood VH. Ethnopharmacology, food production, nutrition and biodiversity conservation: towards a sustainable future for indigenous peoples. *J Ethnopharmacol.* 2011;137(1):1-15. doi:10.1016/j.jep.2011.05.027.
- Food and Agriculture Organization of the United Nations, Alliance of Bioversity International and CIAT. Indigenous peoples' food systems: insights on sustainability and resilience from the front line of climate change. Rome: FAO; 2021. doi:10.4060/cb5131en.
- Kapoor R, Sabharwal M, Ghosh-Jerath S. Indigenous foods of India: a comprehensive narrative review of nutritive values, antinutrient content and mineral bioavailability of traditional foods consumed by indigenous communities of India. *Front Sustain Food Syst.* 2022;6:696228. doi:10.3389/fsufs.2022.696228.
- Argumedo A, Song Y, Khoury CK, Hunter D, Dempewolf H, Guarino L, et al. Biocultural diversity for food system transformation under global environmental change. *Front Sustain Food Syst.* 2021;5:685299. doi:10.3389/fsufs.2021.685299.
- Wang H, Fu Y, Zhao Q, Hou D, Yang X, Bai S, et al. Towards resilient food systems: interactions with indigenous knowledge. *Trends Food Sci Technol.* 2025;156:104875. doi:10.1016/j.tifs.2025.104875.
- Marak NR, Devi CB, Devi V, Luithui Y, Sharma U, Aimol KR. Sustainable diets, indigenous food systems, and planetary health: a regionally grounded review with Meghalaya, India as a case study. *Front Sustain Food Syst.* 2026;10:1770461. doi:10.3389/fsufs.2026.1770461.
- Barwant MM, Ali UM, Fatima N, Kumar A, Ali S, Jaiswal SG. The role of endangered foods in global food security, nutritional resilience, and sustainable food systems: systematic review. *Discover Food.* 2026;6:37. doi:10.1007/s44187-025-00749-0.
- Kuhnlein HV, Erasmus B, Spigelski D, editors. Indigenous peoples' food systems: the many dimensions of culture, diversity and environment for nutrition and health. Rome: FAO and Centre for Indigenous Peoples' Nutrition and Environment; 2009.
- Charrondière UR, Stadlmayr B, Rittenschober D, Mouille B, Nilsson E, Medhammar E, et al. FAO/INFOODS food composition database for biodiversity. *Food Chem.* 2013;140(3):408-412. doi:10.1016/j.foodchem.2012.08.049.
- Medeiros MFA, Silva SGB, Teixeira CD, Lima SCVC, Marchioni DM, Jacob MCM. Assessment of biodiversity in food consumption studies: a systematic review. *Front Nutr.* 2022;9:832288. doi:10.3389/fnut.2022.832288.
- Allen T, Prosperi P, Cogill B, Flichman G. Agricultural biodiversity, social-ecological systems and sustainable diets. *Proc Nutr Soc.* 2014;73(4):498-508. doi:10.1017/S002966511400069X.
- Ruel MT, Quisumbing AR, Balagamwala M. Nutrition-sensitive agriculture: what have we learned so far? *Glob Food Secur.* 2018;17:128-153. doi:10.1016/j.gfs.2018.01.002.
- Hunter D, Borelli T, Beltrame DMO, Oliveira CNS, Coradin L, Wasike VW, et al. The potential of neglected and underutilized species for improving diets and nutrition. *Planta.* 2019;250(3):709-729. doi:10.1007/s00425-019-03169-4.
- Brock S, Baker L, Jekums A, Ahmed F, Fernandez M,

- Montenegro de Wit M, et al. Knowledge democratization approaches for food systems transformation. *Nat Food*. 2024;5:342-345. doi:10.1038/s43016-024-00966-3.
17. Balz AG, Heil EA, Jordan I. Nutrition-sensitive agriculture: new term or new concept? *Agric Food Secur*. 2015;4:6. doi:10.1186/s40066-015-0026-4.
18. Martin JCG, Kanade R, Bhadbhade N, Joy KJ, Thomas BK, Willaarts B, et al. Review of the food, water and biodiversity nexus in India. *Environ Sci Policy*. 2024;159:103826. doi:10.1016/j.envsci.2024.103826.
19. Food and Agriculture Organization of the United Nations, International Fund for Agricultural Development, United Nations Children's Fund, World Food Programme, World Health Organization. The state of food security and nutrition in the world 2021: transforming food systems for food security, improved nutrition and affordable healthy diets for all. Rome: FAO; 2021. doi:10.4060/cb5409en.
20. Seidler R, Gavai P, Bawa KS. Rethinking agrobiodiversity for agricultural sustainability. *Front Sustain Food Syst*. 2026;9:1639264. doi:10.3389/fsufs.2025.1639264.

How to cite this article: Rai, M., Rai, A. Indigenous Foods and Biodiversity for Sustainable Food Systems: A Review of Nutritional, Ecological and Socio-Cultural Perspectives. *Journal of Applied Pharmaceutical Sciences and Research*. 2026; 9(3):32-37 Doi : 10.31069/japsr.v9i3.05