Local Food Based Nutrition Resilience: Integrating Biological Resources, Nutritional Knowledge, and Community Management for Sustainable Rural Development

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Abstract

Rural nutrition resilience depends not only on food availability but also on the diversity of biological resources, people's capacity to use nutritious foods, and the ability of communities to manage food-related resources and practices. This paper develops an integrative conceptual framework for strengthening nutrition resilience through local food systems by connecting biological resources, nutritional knowledge, community management, and local wisdom. An integrative narrative literature review was used to synthesize interdisciplinary evidence from food systems, nutrition, biodiversity, rural development, and community governance research. The synthesis indicates that local biological diversity can expand the range of nutritious foods available to households, but availability alone does not guarantee dietary diversity because food choices are shaped by knowledge, affordability, culture, and access. Nutritional knowledge functions as a conversion mechanism through which resources can be translated into healthier food selection and preparation. Community management provides an enabling institutional layer by coordinating production, knowledge sharing, food distribution, conservation, and collective action, while local wisdom supports adaptation to ecological and cultural conditions. The proposed framework positions these elements as mutually reinforcing. An integrated local-food approach can strengthen community resilience, reduce dependence on external food systems, support biodiversity conservation, and contribute to SDGs 2, 3, 12, and 15.

Keywords: biological resources; community management; local food; nutritional knowledge; rural development

I. INTRODUCTION

Rural food and nutrition security is increasingly understood as a food-system challenge rather than a problem of food production alone (Woodhill et al., 2022). A community may possess agricultural land, livestock, home gardens, wild food resources, fisheries, and traditional crops, yet households can still experience poor dietary quality when these resources are not accessible, culturally accepted, economically affordable, or understood in nutritional terms (Enthoven & Van den Broeck, 2021). The distinction is important because food availability and nutrition outcomes are connected through several social and behavioural pathways. Contemporary food systems emphasize the need to link production, food environments, dietary practices, institutions, and ecological sustainability, rather than treating each domain as a separate policy issue (Sharma et al., 2021).

The rural context makes this challenge particularly significant. Rural households often depend directly on local ecosystems and agricultural production, making the condition of biological resources closely related to livelihoods and food access (Hailemicheal et al., 2024). Agricultural biodiversity can provide different crops, varieties, fruits, vegetables, livestock, aquatic foods, and other edible resources that potentially broaden household food choices (Kennedy et al., 2022). However, the relationship between agrobiodiversity and nutrition is not automatic. Evidence from low and middle-income countries indicates that greater

diversity in agricultural production can be associated with better dietary outcomes, but the strength of the relationship depends on whether diverse resources are actually consumed and how they are distributed within households (Oduor et al., 2019). According to Medeiros et al. (2022) the pathway from biodiversity to nutrition involves food availability, access, conservation, markets, processing, and consumption.

This problem becomes more complex as rural food systems are exposed to environmental change, market pressures, changing consumption patterns, and increasing dependence on external inputs and food supply chains. Food-system transformation requires simultaneously improving nutrition and reducing pressure on natural resources. The concept of food biodiversity is therefore increasingly relevant because the diversity of species and varieties used for food can contribute to dietary richness, agroecological resilience, livelihoods, and cultural continuity (Hanley-Cook et al., 2023). At the same time, biodiversity cannot be considered only as a biological stock. It is also embedded in knowledge systems, production practices, cultural preferences, and community institutions that determine which resources are maintained, exchanged, prepared, and consumed.

Resilience provides a useful lens for connecting these issues. In social–ecological systems research, resilience is commonly understood as a combination of persistence, adaptability, and transformability, that is, the capacity of a system to absorb disturbance, adjust to change, and reorganize when existing conditions can no longer be sustained (Folke, 2006). Applied to food systems, Tendall et al. (2015) define resilience as the capacity of a food system and its units, across multiple levels and over time, to provide sufficient, appropriate, and accessible food to all in the face of various and even unforeseen disturbances. Two implications follow for rural nutrition. First, resilience cannot be inferred from production levels in normal years; it must be judged by whether households can continue to obtain diverse and nutritious diets when harvests fail, prices rise, or livelihoods are disrupted. Second, resilience is a property of the relationships among ecological, knowledge, and institutional components, which is why a framework that treats these components jointly is needed.

Nutritional knowledge represents a second critical component. Having nutritious foods available does not necessarily mean that households recognize their nutritional value, know how to combine them, or prioritize them in daily meals (Silva et al., 2023). Nutrition knowledge can influence food choice, preparation, intra-household allocation, and the adoption of dietary practices. Evidence from rural China, for example, shows that nutrition knowledge training can improve dietary diversity and selected nutrient intakes, indicating that knowledge can help convert food availability into improved consumption (Zheng et al., 2023). Similar evidence from rural nutrition-sensitive agriculture programmes demonstrates that changes in caring, feeding, and food-production practices depend on how interventions interact with local knowledge, social relations, and everyday routines (Nguyen et al., 2022).

Reviews of nutrition-sensitive agriculture reinforce this point. Ruel et al. (2018), in a broad assessment of the evidence, reported that agricultural programmes have shown clearer effects on intermediate outcomes such as dietary diversity than on child anthropometric outcomes, and they highlighted nutrition education or behaviour change communication and attention to women's roles and empowerment as important design features. These findings suggest that knowledge and gender-sensitive design are not optional additions to production-oriented interventions but central mechanisms through which agricultural resources influence diets.

The third component is community management. Local food resources do not manage themselves. Seed selection, communal land use, irrigation, home gardens, livestock management, food storage, processing, food sharing, local markets, and conservation practices require coordination among households and institutions. Community management provides mechanisms for collective decision-making, resource mobilization, knowledge

exchange, monitoring, and adaptation. Social capital can support food access through social networks, reciprocal assistance, shared norms, and collective action, while local institutions can connect households to public programmes, markets, agricultural services, and health and nutrition initiatives (Paul et al., 2019). Recent work in Indonesia also illustrates how social capital, participation, trust, and communal practices can reinforce rural food security, while highlighting the need to guard against exclusion and unequal access (Yusriadi, 2025). Local wisdom links these three dimensions to place. Knowledge about which plants grow under specific ecological conditions, when they should be harvested, how foods are preserved, which varieties are preferred, and how resources are shared is often accumulated through generations. Such knowledge can complement scientific nutrition and agricultural knowledge rather than being treated as an alternative to them. Kennedy et al. (2022) demonstrate that traditional knowledge and food biodiversity can support healthy diets, agroecological resilience, livelihoods, and sociocultural wellbeing. The implication is that sustainable rural nutrition strategies should not simply introduce external technologies or standardized food packages; they should identify and strengthen locally appropriate practices while adding evidence-based nutritional and ecological knowledge.

Despite these advances, the literature remains fragmented. Biological studies tend to emphasize species diversity and ecosystem functions; nutrition studies focus on dietary diversity, knowledge, and health outcomes; agricultural studies examine production and livelihood systems; and public administration and rural-development studies emphasize institutional capacity and collective action. These bodies of knowledge address related problems but often use different units of analysis. As a result, an important conceptual gap remains: how can local biological resources, nutritional knowledge, and community management be integrated into one operational framework for rural nutrition resilience? A framework that connects these elements is particularly useful because nutrition resilience depends on the capacity of a community to maintain food access and dietary quality while adapting to environmental, economic, and social shocks.

This paper addresses that gap by developing an integrative conceptual framework entitled Local Food Based Nutrition Resilience. The framework treats local food not simply as a geographic category but as a system of biological resources, knowledge, institutions, and practices. The objective is to explain the mechanisms through which local biological resources can contribute to dietary diversity, how nutritional knowledge converts availability into utilization, and how community management creates the institutional conditions required for continuity and sustainability. The paper also considers local wisdom as a contextual foundation and identifies implications for sustainable rural development and the Sustainable Development Goals (SDGs), particularly SDG 2 on zero hunger, SDG 3 on good health and well-being, SDG 12 on responsible consumption and production, and SDG 15 on life on land. Food-system research increasingly recognizes that these goals are interconnected and cannot be achieved through isolated sectoral interventions (Singh et al., 2023).

II. METHOD

This paper uses an integrative narrative literature review to synthesize interdisciplinary evidence on local food, biological resources, nutrition knowledge, community management, traditional knowledge, and sustainable rural development. The approach was selected because the research problem crosses disciplinary boundaries and the relevant literature uses different concepts, methods, and outcome measures. An integrative review is appropriate when the purpose is not merely to estimate one effect size but to connect findings from heterogeneous bodies of research and develop a conceptual explanation or framework

(Snyder, 2019). The review was designed to move from fragmented evidence toward a coherent model of nutrition resilience.

A targeted literature search was conducted using a combination of terms: local food systems, food biodiversity, agrobiodiversity, dietary diversity, nutrition knowledge, nutrition-sensitive agriculture, traditional knowledge, community-based management, social capital, rural food security, food system transformation, and sustainable rural development. Priority was given to studies published between 2016 and 2026 to ensure the resulting synthesis reflects contemporary debates, while still incorporating relevant foundational evidence from earlier periods that explains the conceptual link between agricultural biodiversity and nutrition. Studies were deemed relevant if they examined at least one of the following four substantive domains:

1. Biodiversity or local food resources
2. Nutrition knowledge or food utilization within diets
3. Community, institutional, or social mechanisms regarding food resource management
4. Sustainability and rural development outcomes

The synthesis followed three analytical stages. First, findings were coded into the four domains and their principal mechanisms. Second, relationships among domains were compared across studies, with particular attention to recurring pathways such as availability-to-consumption, knowledge to behaviour, and collective management-to-resilience. Third, the findings were integrated into a conceptual framework that distinguishes core resources, conversion mechanisms, institutional enabling conditions, and outcomes. This procedure follows the logic of literature synthesis in which the value of a review derives from transparent selection and analytical integration rather than from simply listing previous studies (Snyder, 2019). Because the paper is conceptual, it does not claim to test causal relationships statistically and it does not report original household survey data. The proposed framework should subsequently be subjected to empirical validation through case studies, household surveys, mixed-method research, or comparative rural studies. This distinction is important because evidence from individual interventions can demonstrate particular pathways without proving that all components operate with equal strength in every rural context.

III. RESULTS AND DISCUSSIONS

A. Result

The synthesis of the literature yields four interconnected findings. First, biological resources constitute the material foundation for local nutritional security, yet their nutritional value depends on diversity, accessibility, and actual utilization. Second, nutritional knowledge acts as a conversion mechanism between resource availability and dietary practices. Third, community-based management provides an institutional layer that coordinates resources, communities, and knowledge over time. Fourth, local wisdom offers region-specific knowledge, ensuring that biological resources and management practices remain both ecologically and culturally appropriate. These four dimensions form a mutually reinforcing system rather than merely a linear chain of interventions.

Table 1. Core dimensions of the Local Food Based Nutrition Resilience framework

Dimension	Core Role	Key Mechanisms	Illustrative outcomes
Biological resources	Provide a diverse local food base	Species/variety diversity, seasonal production, conservation, access	Food availability, dietary options, ecological resilience

Nutritional knowledge	Convert available foods into informed dietary practices	Food literacy, selection, preparation, storage, meal combination	Dietary diversity, improved nutrient intake, safer food use
Community management	Coordinate resources, actors, and collective action	Participation, social capital, local institutions, markets, monitoring	Continuity, access, collective resilience, institutional responsiveness
Local wisdom	Adapt practices to local ecological and cultural conditions	Traditional food knowledge, seasonal calendars, preservation, customary rules	Contextual fit, cultural continuity, adaptive capacity

The first finding concerns the role of biological resources. Food biodiversity expands the potential food basket available to households by maintaining a wider range of species, varieties, and production niches. Harris et al. (2022) show that agrobiodiversity and nutrition are connected through availability, access, conservation, and consumption, while Medeiros et al. (2022) demonstrate that food-consumption research increasingly needs indicators capable of capturing biodiversity within and across food groups. This distinction matters because conventional dietary-diversity indicators may count food groups without recognizing differences among species or varieties that can have different nutrient profiles. Hanley-Cook et al. (2023) further argue that food biodiversity is relevant to dietary quality and environmental resilience, suggesting that the diversity of foods underlying diets should be treated as an important dimension of sustainable nutrition.

The evidence also indicates that production diversity alone does not guarantee dietary diversity. Oduor et al. (2019), for example, found an association between on-farm agrobiodiversity and improved diet quality among young children in rural Kenya, while also identifying an unrealized opportunity because available agrobiodiversity was not fully reflected in household diets. This finding is consistent with the broader conclusion that the pathway from production to nutrition is mediated by household preferences, knowledge, gender relations, labour, markets, cultural norms, and food preparation. Therefore, a local-food strategy should avoid assuming that farmers automatically consume what they produce. The policy question is not simply "How diverse is local production?" but also "Which resources reach households, who controls them, how are they prepared, and how often are they consumed?"

The same caution emerges from cross-country evidence. Using data from smallholder households in Indonesia, Kenya, Ethiopia, and Malawi, Sibhatu et al. (2015) found that farm production diversity had only a small association with household dietary diversity, whereas market access and income showed stronger relationships, and they concluded that increasing production diversity is not necessarily the most effective way to improve diets. This does not invalidate the role of biological resources. Rather, it indicates that local food strategies should combine diversified production with functioning local markets, adequate income, and consumption-oriented knowledge. In the proposed framework, markets are therefore treated as part of community management and local-government support, not as a separate external factor.

The second finding is that nutritional knowledge helps convert resources into dietary practices. Zheng et al. (2023) provide direct evidence that nutrition knowledge training can increase dietary diversity and improve selected nutrient and calorie intakes among rural households. Sharma et al. (2021) similarly show that nutrition-sensitive agriculture

interventions operate through multiple pathways involving food production, income, food availability, dietary practices, and care. Knowledge is therefore best understood as a capability rather than merely information. A household needs to know not only that a food is nutritious but also how to select, combine, process, store, and serve it within its economic and cultural circumstances. Nutrition education becomes more effective when it is connected to foods that households can realistically obtain and prepare.

The third finding concerns community management. Local food systems require coordination across households, producers, community groups, agricultural extension services, health workers, schools, local markets, and government. Paul et al. (2019) show how social capital can influence local food security through networks, reciprocal support, shared norms, and health-related behaviours. Evidence from nutrition-sensitive agriculture implementation further indicates that programmes are affected by enabling environments, institutional coordination, contextual knowledge, and flexibility (Di Prima et al., 2022). This means that even well-designed interventions can underperform when institutional responsibilities are fragmented or when local actors are not given meaningful roles in planning and implementation.

Institutional research on common-pool resources offers further insight into how such coordination can be sustained. Ostrom (1990) showed that communities can govern shared resources through self-organised institutions when users have clearly defined boundaries, rules that fit local conditions, arrangements that allow them to take part in modifying the rules, monitoring, graduated sanctions, accessible conflict-resolution mechanisms, and recognition of their right to organise. These principles are relevant to local food systems because many food-related resources, including communal land, water sources, seed-exchange networks, wild-food areas, and village markets, share the characteristics of resources that require collective rules. They also underline that community management is an institutional achievement that must be supported and protected, not an automatic property of rural communities.

Community management should therefore be interpreted as a governance capacity with at least five functions:

1. Resource coordination includes collective management of seeds, water, land, livestock, gardens, storage facilities, and local markets.
2. Knowledge sharing connects older generations and local practitioners with extension agents, teachers, health workers, and nutrition professionals.
3. Collective decision-making allows communities to determine which resources should be prioritized and how benefits and responsibilities are distributed.
4. Access facilitation helps households connect with public programmes, markets, and technical services.
5. Monitoring and adaptation enable communities to respond to seasonal shortages, climate variability, disease, price changes, and changes in dietary behaviour.

The fourth finding is the importance of local wisdom as an enabling knowledge system. Kennedy et al. (2022) identify traditional knowledge as an important source of information about food biodiversity, cultivation, harvesting, preparation, and conservation. Local wisdom can contribute to resilience because it embodies experience accumulated under specific ecological conditions. However, it should not be romanticized or treated as universally sufficient. Some traditional practices may be nutritionally incomplete, environmentally unsustainable under changed conditions, or inaccessible to marginalized groups. The appropriate strategy is therefore knowledge integration: combine validated local practices with contemporary evidence in nutrition, agriculture, food safety, ecology, and public health.

The adaptive value of local knowledge has been documented in the resource-management literature. Berkes et al. (2000) described traditional ecological knowledge as a body of knowledge, practice, and belief that includes local rules, social mechanisms for

regulating resource use, and learning from environmental feedback, and they argued that such systems offer lessons for adaptive management. In food systems, comparable mechanisms include seasonal harvesting calendars, restrictions on harvesting at sensitive times, preservation techniques that carry food across lean seasons, and exchange networks for seeds and planting materials. These practices are relevant to nutrition resilience because they can stabilise access to diverse foods over time, but, as noted above, their continued relevance must be assessed against changing ecological, demographic, and market conditions.

The synthesis leads to a central proposition:

1. Biological resources provide the potential food base
2. Nutritional knowledge determines whether that potential is translated into appropriate consumption
3. Community management creates the institutional conditions for maintaining, sharing, and adapting the resource base
4. Local wisdom contextualizes the system.

This integrated relationship is consistent with the emerging view that food-system transformation requires solutions that are locally appropriate, multi-stakeholder, and capable of producing co-benefits across nutrition, livelihoods, biodiversity, and climate resilience.

Table 2. Literature synthesis and implications for rural nutrition resilience

Evidence domain	Main evidence	Identified limitation	Implication for the framework
Food biodiversity	Greater agricultural and food biodiversity can support dietary diversity and ecological resilience.	Production diversity may not translate into consumption diversity.	Track both resource diversity and household utilization.
Nutrition knowledge	Training and nutrition-sensitive programmes can improve dietary practices.	Knowledge effects depend on access, affordability, culture, and household dynamics.	Link nutrition education to locally available foods and practical skills.
Community management	Social capital and institutional coordination can strengthen food access and resilience.	Community actors may lack authority or resources; participation can be unequal.	Use shared governance with public-sector support and equity safeguards.
Traditional/local knowledge	Place-based knowledge supports food biodiversity, conservation, and culturally appropriate practices.	Some practices may require validation or adaptation under changing conditions.	Integrate local knowledge with contemporary nutrition, ecology, and food-safety evidence.
Sustainability	Food-system transformation requires co-benefits across nutrition, livelihoods, biodiversity, and climate.	Sectoral programmes can remain fragmented.	Use cross-sector planning and multi-dimensional indicators.

B. Discussion

The proposed framework extends the local-food discussion in three ways. First, it moves beyond a narrow definition of local food based on geographical proximity. Enthoven & Van

den Broeck (2021) show that the effects of local food systems are heterogeneous and depend on supply-chain characteristics, product type, and context. Therefore, "local" should not be treated as an automatic guarantee of sustainability or health. In the present framework, local food becomes meaningful when geographical proximity is accompanied by biological diversity, nutritional value, community capacity, and ecological responsibility. A local food system that produces a narrow set of crops, depends heavily on external inputs, or reproduces unequal access may be local without being resilient.

Second, the framework treats nutrition as an active process of conversion rather than a passive outcome of food availability. This distinction is supported by evidence showing that nutrition-sensitive agriculture interventions have multiple impact pathways and that knowledge, care practices, gender relations, and institutional environments influence whether agricultural changes produce nutritional benefits (Di Prima et al., 2022; Sharma et al., 2021). The implication for rural development is that agricultural programmes should be designed with nutrition objectives from the beginning. Production planning, extension messages, seed distribution, home-garden programmes, livestock support, food processing, and local-market interventions should be connected to dietary outcomes rather than evaluated only by yield or income.

Third, the framework brings public administration and community management into the centre of local nutrition resilience. Food-system outcomes depend on the ability of multiple actors to coordinate across administrative boundaries and sectoral mandates. Singh et al. (2023) argue for multi-stakeholder dialogue and capacity building as part of food-system transformation. The same principle is relevant at the village and rural-community level. Health agencies may possess nutrition expertise, agriculture agencies may control production programmes, education institutions can shape food literacy, village institutions can mobilize collective action, and community organizations hold contextual knowledge. Without coordination, these resources remain institutionally fragmented. Community management can provide the relational infrastructure needed to connect them.

A key implication is that community management should not mean transferring all responsibility to communities. Rural communities often face limited financial resources, unequal power relations, weak infrastructure, and exposure to market and environmental shocks. The appropriate governance model is therefore shared responsibility: communities participate in identifying priorities, managing local resources, monitoring outcomes, and adapting interventions, while government provides enabling regulation, technical assistance, infrastructure, financing, data, and protection for equitable access. The framework also highlights the importance of resilience as a dynamic capability.

A resilient food system is not simply one that produces enough food under normal conditions. Consistent with the definition of Tendall et al. (2015), it is one that can continue to provide sufficient, appropriate, and accessible food in the face of disturbances, which requires the capacity to absorb shocks, maintain essential functions, adapt practices, and reorganize when conditions change (Folke, 2006). Biological diversity contributes to this capacity by spreading ecological and production risks across species and varieties. Knowledge contributes by expanding the repertoire of possible responses. Community management contributes by enabling collective action and resource sharing. Local wisdom contributes by connecting adaptation to place. These mechanisms suggest that resilience should be assessed through both material and institutional indicators. For biological resources, potential indicators include the diversity of edible species and varieties, the proportion of households maintaining food-producing gardens, the availability of nutrient-dense local foods across seasons, seed diversity, and the extent to which locally adapted resources are conserved. For nutritional knowledge, indicators may include knowledge of food groups and nutrients, ability to prepare diverse meals, knowledge of safe storage and processing, and the ability to identify nutritious local alternatives during shortages. For community management,

indicators may include participation in food-related groups, frequency of knowledge-sharing activities, availability of communal facilities, institutional coordination, access to agricultural and health services, and community mechanisms for responding to food shocks. These indicators can be adapted to different rural settings rather than applied as a rigid universal checklist.

The framework also has implications for the design of rural development programmes:

1. Interventions should begin with a local food-resource inventory. The inventory should identify cultivated, semi-domesticated, wild, aquatic, and livestock-based food resources, together with their seasonal availability and cultural uses.
2. The resource inventory should be linked to a nutrition profile so that households and service providers understand the nutritional contribution of local foods.
3. Communities should identify constraints preventing available resources from becoming regular dietary components, such as lack of knowledge, labour constraints, storage problems, market incentives, food taboos, or unequal intra-household access.
4. Interventions should be co-designed with local actors and tested through small-scale implementation before wider scaling.

The approach is consistent with evidence from community-engaged nutrition-sensitive agriculture. Sly et al. (2023) found that a community-engaged agricultural intervention in rural Rwanda increased household dietary diversity, although changes in hunger and broader nutritional outcomes were more limited. This illustrates an important point for the proposed framework: dietary diversity is a valuable intermediate outcome, but it should not be treated as the only measure of nutrition resilience. Nutritional adequacy, child and maternal health, food safety, income stability, environmental sustainability, and equity also matter. A strong evaluation framework should therefore combine dietary, ecological, economic, and institutional indicators.

Read together, the cases cited in this review show how the framework's dimensions operate in different settings. In rural Kenya, on-farm agrobiodiversity was associated with better child diet quality, but the diversity present on farms was not fully reflected in diets (Oduor et al., 2019), which points to the conversion gap that nutritional knowledge and household decision-making must close. In rural China, nutrition knowledge training improved dietary diversity and selected nutrient intakes (Zheng et al., 2023), illustrating the conversion mechanism directly. In Rwanda, a community-engaged intervention increased household dietary diversity but had more limited effects on hunger and broader outcomes (Sly et al., 2023), showing that community engagement can improve intermediate outcomes while structural constraints persist. Qualitative evidence from rural Vietnam showed improved caring, feeding, and food-production practices after nutrition-sensitive agriculture interventions (Nguyen et al., 2022), and evidence from India indicated that responses to such interventions depend on intrahousehold power and cooperation (Harris-Fry et al., 2023), which reinforces the need for gender-sensitive community management. In Indonesia, social capital and communal practices have been linked to rural food security in agroforestry settings, although exclusion and unequal access remain risks (Yusriadi, 2025). No single case demonstrates the full framework, but each illuminates one or more of its pathways, which is consistent with the argument that the dimensions are interdependent.

The role of gender and intra-household relations also deserves explicit attention. Nutrition is often shaped by who controls food resources, who prepares meals, who receives nutrition information, and who makes decisions about spending and production. Evidence from rural India indicates that intrahousehold power and cooperation can shape responses to nutrition-sensitive agriculture interventions (Harris-Fry et al., 2023). Consequently, community management cannot be evaluated only through aggregate participation. A village organization may appear highly participatory while women, poorer households, Indigenous groups, or other marginalized residents have limited influence. Nutrition resilience requires

inclusive governance in which access to biological resources, knowledge, and decision-making opportunities is distributed fairly.

The framework has a direct relationship with the SDGs. SDG 2 is supported through improved access to diverse and nutritious foods and stronger local food systems. SDG 3 is addressed through healthier diets and nutrition knowledge. SDG 12 is connected to responsible production, consumption, food preservation, reduced waste, and more sustainable resource use. SDG 15 is linked to conservation and sustainable management of terrestrial biodiversity. The framework therefore supports an integrated SDG perspective rather than treating each goal as an isolated target.

The framework also suggests a practical governance architecture. At the household level, the focus is on food choice, preparation, storage, and dietary practices. At the community level, the focus is on collective gardens, seed systems, food storage, local markets, knowledge-sharing groups, and community monitoring. At the local-government level, the focus is on cross-sector coordination, infrastructure, extension services, nutrition programmes, public procurement, and support for local producers. At higher governance levels, the focus is on financing, standards, research, biodiversity conservation, food-system policy coherence, and social protection. These levels should be connected through feedback rather than organized as a one-way hierarchy. Finally, the framework should be understood as a research agenda as much as a policy model. Future empirical studies can operationalize the three core dimensions and test whether their interaction predicts nutrition resilience. Quantitative studies could examine relationships among local food biodiversity, nutrition knowledge, community management, dietary diversity, and household food security. Qualitative studies could investigate how local wisdom, gender relations, and institutional trust influence these pathways. Mixed-method research could combine household surveys with biodiversity inventories and participatory mapping. Comparative research across rural regions could identify which mechanisms are context-specific and which appear consistently across settings. Such research would move the framework from conceptual synthesis toward empirical validation.

To illustrate how the framework could be applied, consider a hypothetical upland village in Indonesia where households grow rice and vegetables, keep home gardens and small livestock, and also use locally available tubers, legumes, and wild or semi-cultivated leafy vegetables. A resource inventory would first document these foods and their seasonal availability. A nutrition profile would then identify which of them contribute protein, micronutrients, or fibre and which are underused because they are regarded as low-status foods, are laborious to prepare, or are unfamiliar to younger household members. Nutrition education, delivered through existing community health and women's groups, would focus on practical combinations of these foods in daily meals and on safe storage and processing. Community management would address constraints that individual households cannot solve alone, such as seed or seedling exchange, a communal garden or storage facility, and links to local markets or school meals. Elders and local practitioners would contribute knowledge about harvest timing and preservation, which health workers and extension agents would review for nutritional adequacy and food safety. Monitoring would track indicators from Table 3, for example the diversity of foods consumed by women and children, the number of households maintaining gardens, and the seasonal food gaps reported by the community. The example is hypothetical and is intended only to show how the four dimensions can be sequenced operationally; it is not evidence of effectiveness, which remains an empirical question.

Table 3. Suggested implementation indicators for local nutrition resilience

Level	Dimension	Possible indicators	Purpose

Household	Biological resources	Number/diversity of locally available food species, seasonal availability, household food production	Assess the local food base
	Nutritional knowledge	Food-group knowledge, meal diversity, preparation/storage knowledge	Assess conversion of resources into dietary practice
Community	Community management	Participation, collective food initiatives, knowledge-sharing, local market coordination	Assess collective capacity
	Local wisdom	Use of local food calendars, preservation practices, traditional seed/food knowledge	Assess contextual knowledge and continuity
Institutional	Governance	Cross-sector coordination, service access, programme integration, monitoring	Assess enabling environment
Outcome	Nutrition resilience	Dietary diversity, food-security stability, food access during shocks, perceived resilience	Assess system-level performance
	Sustainability	Biodiversity conservation, reduced waste, soil/water stewardship, livelihood stability	Assess long-term sustainability

C. Limitations and Future Research

This study has several limitations. First, it is a narrative integrative review rather than a systematic review: the search was targeted, and no formal protocol, database-specific search strings, screening flow, or quality appraisal were applied, so the selection of studies reflects the authors' judgement and the evidence base is not exhaustive. Second, the literature reviewed is mainly English-language and peer-reviewed, and evidence from Indonesian and other Southeast Asian communities, including grey literature and local-language studies on traditional food knowledge, is comparatively limited. Third, much of the evidence on which the framework relies concerns intermediate outcomes, particularly dietary diversity, and cannot establish causal effects on nutritional status or resilience. Fourth, the framework is conceptual, and the relative weight and interaction of its dimensions have not been tested empirically.

These limitations suggest that the framework should be treated as a set of testable propositions: that biological resource diversity, nutritional knowledge, and community management each contribute to dietary diversity and food-security stability; that nutritional knowledge and community management moderate the relationship between resource

availability and diet quality; and that inclusive governance strengthens these relationships. Future research can test these propositions through household surveys linked to biodiversity inventories, participatory mapping, and qualitative case studies, ideally compared across ecological zones and governance contexts.

IV. CONCLUSION

The synthesis demonstrates that rural nutrition resilience is best understood as the interaction of biological resources, nutritional knowledge, community management, and local wisdom rather than as the outcome of food availability alone. Local biological diversity provides a wider and potentially more resilient food base, but its nutritional contribution depends on household access and utilization. Nutritional knowledge enables communities to translate available resources into healthier dietary practices, while community management coordinates resources, knowledge, institutions, and collective responses over time. Local wisdom strengthens contextual fit by connecting these processes to ecological and cultural conditions. The resulting Local Food Based Nutrition Resilience framework offers an integrated basis for rural development programmes that simultaneously pursue nutrition, biodiversity, social capacity, and sustainability. Its principal value is conceptual: it connects domains that are frequently addressed separately and provides a basis for future empirical testing through household, community, and comparative studies. When implemented through inclusive governance and evidence-informed knowledge integration, the approach can contribute to more resilient rural food systems and advance progress toward SDGs 2, 3, 12, and 15.

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