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RETROSPECTIVE STUDY

Bhutan's Holistic Food Systems: Integrating Culture, Policy, and Climate Resilience for Sustainable Agriculture

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ABSTRACT
Bhutan, a landlocked Himalayan kingdom, shows a unique food culture deeply rooted in spiritual beliefs, traditional rituals, and profound environmental respect. This holistic approach, central to its development philosophy of Gross National Happiness (GNH), positions food beyond mere sustenance, making it integral to preserving cultural heritage, agricultural biodiversity, and ecological integrity. This article explores the symbiotic relationship between Bhutanese food culture, its embedded rituals, and the nation's commitment to sustainable agroecologically inclined agricultural practices. It highlights how these elements contribute to the conservation of traditional knowledge and genetic resources, focusing on the significance of rice, ethnobotanical knowledge, and the integration of food-related rituals into national policies. This paper discusses government policies like organic farming and climate-resilient adaptations that underpin these traditions, and instances where ceremonies exemplify cultural practices to preserve food items like rice, fruits, and tea, connecting them to community well-being and spiritual and ritual practices preserving food items and connecting them to traditional conservation practices. Ultimately, Bhutan's unique pathway showcases an integrated approach to food security and environmental stewardship. Further, this desktop review offers a deeper and wider understanding of how Bhutan's food systems are intricately woven into its socio-cultural fabric. This unique integration significantly influences the nation's pursuit of sustainable development, particularly within the context of Bhutan's vision for developing the Gelephu Mindfulness City (GMC).

Keywords: *Bhutan, Gross National Happiness, food systems, organic agriculture, climate resilience, agroecology*

INTRODUCTION

Bhutan's development paradigm, guided by the philosophy of GNH (GNH, 2008), transcends conventional economic metrics to prioritise holistic well-being and environmental health. Within this framework, Bhutan's food systems are not just a practical necessity but a vibrant reflection of core national values, deeply intertwined with spiritual beliefs, time-honoured rituals, and reverence for the natural world.

This article postulates that Bhutan's food systems holistically integrate ancient cultural heritage, resilient traditional agricultural practices, and forward-thinking national policies. This fusion creates a distinctive approach to food and nutrition security and environmental stewardship, propelling the nation towards its ambitious goal of carbon neutrality. In this context, agroecology and organic farming are more than agricultural techniques; they represent pathways for aligning food systems with the conservation and promotion of the nation's unique socio-cultural and ecological values. This alignment is also evident in how Bhutan's approach resonates with principles like diversity, synergies, efficien , and resilience, emphasised by the Food and Agriculture Organisation of United Nations (FAO) 10 Elements of agroecology for sustainable food systems.

Bhutan's pursuit of a wholly organic agricultural system, articulated in the mid-2000s (Tshomo, 2006), was a landmark national aspiration to integrate agricultural policy with environmental conservation and human well-being. While challenges persist, the national organic and agroecological vision remains a defining feature of Bhutan's agriculture. As the world is confronted with climate change, biodiversity loss, and food insecurity, Bhutan's agroecological pathways could offer unique insights for creating resilient and sustainable development.

This paper examined Bhutan's traditional and culture-based infused national policies at various agroecological zones across the country, which could be an innovative way to enhance Bhutan's food security and enhance its ecological resilience. Further, how the traditional values are incorporated into Bhutan's key policies, such as the Food and Nutrition Security Policy (FNSP, 2023), Bhutan's Agrifood Sector strategy 2034, and the National Organic Flagship Programme (NOFP) 2006, were assessed. Additionally, the study reviewed the perceived impacts of climate change on the Bhutanese agriculture systems and the adaptive strategies implemented to ensure food security and resilience. Bhutan's diverse geography creates distinct agroecological niches, each shaping unique food systems (Katwal

& Bazile, 2019). Agroecological zonation considers altitude, climate, soil fertility, and cultural adaptation in farming, which are varied over six broad zones (FAO et al., 2022), determining the type of food grown and utilised throughout the country. These zones, ranging from wet-subtropical to alpine, dictate distinct agricultural practices and crop varieties suitable for each of the zones (Bhandari & Mayer, 2024). For example, the wet-subtropical zone, characterised by altitudes between 150 to 600 meters above sea level, predominantly supports agriculture, whereas the cool temperate zone, at 2600 to 3600 meters, has marginal agricultural activity (Chhogyel & Kumar, 2018). The six primary agroecological zones in Bhutan are broadly categorised as (i) Wet Subtropical, (ii) Humid Subtropical, (iii) Dry Subtropical, (iv) Warm Temperate, (v) Cool Temperate, and (vi) Alpine, each exhibiting unique climatic conditions and agricultural potentials (Katwal & Bazile, 2019, Bhandari & Mayer, 2024). This intricate zonation directly influences the types of agricultural practices employed and, consequently, the food systems that emerge, ranging from subsistence farming to more market-oriented horticulture (Chhogyel & Kumar, 2018). These diverse agroecological conditions lead to varied agricultural practices, such as those described by (Katwal & Bazile, 2019):

- Lowland valleys: western and southern valleys form Bhutan's rice basket, where irrigated terraced paddies sustain cultural festivals and food traditions and food systems closely tied to rice-based foods with seasonal vegetables and fruits with short growing seasons.
- Mid-altitude maize zones: eastern *dzongkhags* (districts) that are topographically steep terrains with inadequate irrigated lands rely on maize, millet, and root crops, areas often more vulnerable to climate-induced droughts since most crops are rainfed or dry land farming systems. The diets and cultural practices are heavily based on maize and dry land cereals.
- High-altitude pastoral systems: highland yak-based systems in regions like Haa, Gasa, and Laya embody pastoral livestock-based traditions, wheat, barley, buckwheat, with dairy products, wool, and barter trade sustaining communities; and
- Horticultural belts: southern subtropical zones produce citrus, ginger, cardamom, and vegetables, linking Bhutan to regional markets.

METHODOLOGY

This research employed a desktop review involving a comprehensive literature review of academic publications, policy documents, and cultural records. The key literature includes the FNSP, 2023, Bhutan's Agrifood Sector Strategy, 2034, the Post NOFP strategy, Bhutan Clear report, 2023, Biovision's assessment of the NOFP, and the Low Emission Development Strategy for Food Security (LEDs-FS, 2021). Additionally, information collected by the author for past lectures and presentations on Bhutan's food, culture, climate impact and agroecology in relation to organic farming in Bhutan has been used in the paper to reflect the interconnectedness.

The analysis also incorporated insights derived from past experiences of the author in the field, as well as qualitative information gathered through informal discussions, presentations, and anecdotal village stories, traditional cultural norms, etiquette and including old folk tales, to elucidate the multifaceted role of food in Bhutanese society and its contribution to national development paradigms.

The methodology focused on understanding the interconnections between traditional use of food, agricultural practices, and their relationship to biodiversity conservation within Bhutanese socio-cultural contexts. Special emphasis was given to different ways food is valued and used as a symbol of care and concern in everyday life, and examining the influence of such societal values on the formulation of formal government policies, under the overall framework of the GNH philosophy on promoting sustainable food systems and preserving indigenous knowledge.

Further investigation explored specific occasions festival and rituals where food plays a central role, such as the *Zhugdrel Phuntshom Tshopa* (an important traditional Bhutanese religious and cultural ceremony performed at the start of all major public functions, inaugurations, celebrations, and official receptions of important guests), *Drunaghu* (a mix of nine grains for rituals), etc, to illustrate the practical application of these integrated approaches that ensure the preservation of food diversity in the community. An ethnobotanical perspective was also applied to further understand the utilisation of plant resources in traditional foods, beverages, medicines, and spiritual practices and rural rituals such as *Jinseg* (a fire ritual to repel sickness and pests) and *Nyom* (a pest ward-off practice in Eastern Bhutan). Traditional rituals and cultural practices carried out annually in the author's family and village have been used to emphasise the importance of intangible cultural practices that help to promote and conserve food and seeds in rural livelihood. Authors believe that more than 50% of the population who live in different parts of the country in different agroecological zones with different cultural practices use such cultural/ritual events as part of accepted norms, although there are no specific data to link their impact directly socio-ecological resilience of the agrarian communities.

Additionally, the impacts of climate change on Bhutanese agriculture and various adaptive strategies implemented to ensure food security and resilience were explored. The perceived impacts of climate change on food security were based on speculations and deductions from common views of farmers on the changes in crop production, crop diversity due to changes in rainfall, shift in crop growth, incidences of new pests and diseases in

crops, which were recorded by the author during numerous field visits. Thus, combining all these methods, the paper provides a deeper and wider understanding of how Bhutan's food systems are intricately woven into its socio-cultural fabric, which plays a significant role in influencing the Bhutanese unique pursuit of sustainable development within the context of Bhutan's vision of development of Gelephu Mindfulness City (GMC).

RESULTS AND DISCUSSION

Bhutan's food systems embody a deeply interconnected relationship between traditional practices, such as food rituals are directly linked to Bhutan's diverse agroecological zones—from highland yak-based systems to lowland rice terraces—farmers continue to rely on indigenous organic methods, such as composting, mixed cropping, soil fertility management, and natural pest control. These practices show similarities to sustainable agroecological principles, demonstrating that sustainability is deeply embedded in Bhutan's cultural traditions in farming and food systems. National policies, including the FNSP (2023), and national organic farming principles. LEDsFS (2021) reinforces this alignment by promoting climate-resilient, low-input farming systems and integrating local knowledge into formal agricultural planning while prioritising the sustainable economic development as supported by the 13th Five-Year Plan (FYP).

Overall, Bhutan's food systems reflect a unique model of resilience where cultural identity, ecological integrity, and policy vision converge to uphold food sovereignty and the GNH philosophy embraced by Bhutan. This positions Bhutan as a living example of how traditional knowledge and modern sustainability goals can coexist within a holistic national framework for the well-being of the people. The FNSP clearly sets the need for food and nutrition security with the sustained growth of commercialisation of main food crops, while strategically conserving traditional food and seeds through the Biodiversity Act, 2023. This is well implemented through the 13th FYP.

Cultural Integration and Food Sovereignty

In Bhutan, food is for more than a means of survival; it is a profound expression of cultural identity, inseparably linked to spiritual beliefs and daily life. Bhutanese cuisine, exemplified by dishes like *Ema Datshi* (dish made from chilli and cheese) and red rice, symbolises the nation's rich heritage. Food plays a central and often sacred role across various life stages and social interactions. Ceremonies during pregnancy, childbirth, and community events feature traditional foods as offerings. Agricultural rituals, such as *Damchoe* (initiating rice transplantation) and *Seychoe* (marking the first rice harvest with offerings of new rice, *Seep* (flattened rice snack) with milk, and fresh chilli), reinforce gratitude for harvests. National festivals like *Tsechus*, *Lochoe*, and *Losar* feature distinctive food traditions that play an important part in preserving food sovereignty.

Food in Bhutan is also a sacred practice embodying reciprocity with nature and spiritual guardians. Highland communities of Bhutan honour yak spirits before their seasonal migrations. These cultural dimensions reinforce food sovereignty, emphasising local control over seeds, land, and traditions (Bikesh et al., 2020). The significance of food and drinks in spiritual practices and seasonal agricultural rituals, particularly those tied to everyday life, preserves traditional ecological knowledge and a deep gratitude for nature's bounty (Haq et al., 2022). For instance, the *Khachey* ritual during winter snowfall celebrates its importance for agriculture, requiring recipients to host a meal with ingredients from the delivered snowball. Food offerings are also integral to rituals for sickness (*Choeney* and *Dhencho*) and death (*Semso* and *Kaylen*), where food, beverages, money, and services are offered (Tshomo, 2023). Agroecology strengthens these links by respecting farmers as custodians of biodiversity and culture, often drawing upon gendered traditional agroecological knowledge for climate change adaptation and food security (Ramirez-Santos et al., 2023). Studies in other Himalayan regions also highlight how indigenous knowledge contributes to food literacy and traditional food systems (Gartaula et al., 2019). The deep connection between food and cultural heritage is increasingly recognised as one of the key components for sustainable development (Britwum & Demont, 2022). The importance of women's role in preserving these life events, which are critical links to food use, and the need for seed conservation are often very undervalued and taken for granted.

Ethnobotanical Knowledge and Local Practices

Bhutanese livelihood relies heavily on indigenous plants used reflecting deep ethnobotanical knowledge that supports agroecological sustainability as *nakey* (fern fiddleheads), bamboo shoots, mushrooms, and wild fruits supplement rural diets aiding with seasonal nutritional requirements. Medicinal plants like Cordyceps sinensis, Rhododendron anthopogon, Artemisia, and Juniperus recurva are used in *Sowa Rigpa* medicine and household healing practices (Wangchuk & Tobgay 2015), while fodder trees such as Ficus and Quercus species support livestock during dry seasons when fodder is scarce. Natural dyes from walnut husks, madder roots, turmeric, and indigo are used in traditional weaving and crafts, while other forestry and non-forest materials like bamboo, wood, mud, and rocks are used for construction and making sacred ritual objects (Rinzin et al., 2019). Practices such as incense burning, smoke offerings (*sang-sol*), and herbal fumigation reflect spiritual practices (Centre for Bhutan and GNH Studies, 2021). The utilisation of diverse plant resources in traditional and spiritual practices underscores their significance in maintaining ecological balance and cultural identity (Yangdon et al., 2022). Such integration of ethnobiological knowledge is crucial for biodiversity conservation in the Eastern Himalayas (O'Neill et al., 2017).

Local knowledge in organic farming drawn from traditional practices is applied to modern farming, especially regarding plants with pesticidal effects or soil nutrient-improving qualities. The use of charcoal and green manuring was known for soil nutrient enrichment after exhaustive crops, and knowledge

of animal fodder and crop protection highlights a comprehensive understanding of natural resources for on-farm uses (Tshomo, 2023).

The Cultural and Policy Significance of Rice in Bhutan's Food System

Rice occupies a central position in Bhutan's cultural and dietary landscape, functioning not only as a staple food but also as a symbol of prosperity, well-being, and communal identity embedded in religious rituals, festivals, and daily meals. Rice represents a cultural continuum that links current Bhutanese livelihoods to their agrarian ancestral history (Katwal & Bazile, 2019). The preference for locally produced rice, despite its relatively high production costs resulting from topographical constraints, limited arable land, and dependence on imported inputs, underscores its profound social and cultural significanc . In Bhutan, rice cultivation extends beyond economic rationality, reflecting a commitment to preserving cultural integrity and food sovereignty (Dorji et al., 2020).

The persistence of rice cultivation in Bhutan's traditional food systems has direct implications for food security and climate resilience. Traditional rice varieties, adapted to local agroecological conditions, exhibit traits of resilience that are increasingly relevant under changing climatic conditions (Tshotsho et al., 2022). Supporting the production and consumption of such culturally rooted foods contributes to nutritional diversity and strengthens community-based resilience to external shocks, including market fluctuations and climate-induced disruptions.

Policy interventions must therefore recognise the interdependence between culture, food, and sustainability. Strengthening traditional food systems through targeted support for rice and other indigenous crops aligns with Bhutan's broader development philosophy of GNH, which emphasises ecological balance, cultural preservation, and well-being (GNH, 2008). Integrating climate-smart agricultural practices—such as improved irrigation efficien , organic soil management, and the use of locally adapted crop varieties—can enhance productivity while maintaining the cultural and ecological functions of rice cultivation. In a global context increasingly oriented toward sustainable and resilient food systems, Bhutan's commitment to protecting traditional foods offers valuable insights into harmonising food policy, cultural identity, and climate adaptation.

Bhutan's Approach to Sustainable Food Systems

This is reported in great detail in the report Bhutan Clear, a report that analyses the climate change impacts and climate resilience of smallholder farmers in Bhutan and provides actionable recommendations specific to the different agroecological and food system zones of Bhutan. Although the National Framework for Organic Farming in Bhutan (NFOFB, 2006) (Tshomo, 2007) was developed some time ago, the relevance to current development philosophy internationally is seen as applicable to guide the country's sustainable development from an agroecology assessment carried out by Biovision (2025). Bhutan's food system demonstrates a deep interconnection between ecological sustainability, cultural traditions, and the GNH policy vision, as well as the agriculture sector's plans. In this context, agroecology and organic farming are more than agricultural techniques; they represent pathways for aligning food systems with the nation's broader socio-cultural and ecological values. This alignment is also evident from Bhutan's approach with principles like diversity, synergies, efficien , and resilience, emphasised by the FAO's 10 Elements of agroecology for sustainable food systems."

Integrated Farming Systems and Organic Strategy

The majority of rural Bhutan continues to practice integrated farming, which combines agriculture, livestock, and utilisation of nearby forests for farm inputs like leaf litter and non-wood forest products for domestic use. This traditional system resembles permaculture with the people, animals, horticulture, cereal, and forestry concept, emphasising food basket diversity, on-farm inputs, and low-cost technologies for smallholder resilience (Tshomo, 2023, 2025).

The existing farming systems in Bhutan are closely aligned with the International Federation of Organic Agriculture Movement - Health, Ecology, Fairness, and Care. These principles are the foundation for organic agriculture and guide its practice to promote the health of ecosystems and people, ensuring ecological balance, being fair to all stakeholders, and exercising care in its management of all farming and trading operations (IFOAM-International, 2020). These principles are also very similar to the indicators of the GNH principles of Bhutan, which are an inspirational and operational guideline for Bhutan's development path. Continued practice of such traditional food systems with improved development and innovations based on improved scientific knowledge on local soil and plant health management and fertility management through more defined practices such as organic, agroecological, regenerative, which encourage technologies that reduce carbon emission and possibilities to link reduced use of synthetic agrochemicals to carbon credits could lead to a contribution to long-term sustainability of farming systems, seed conservation, building climate resilience and rural economic stability when linked to markets.

Currently, the Royal Government of Bhutan's Ministry

Table 1 Categories for the Development of Organic Agriculture in Bhutan

Category	Characteristics	Examples
Local Organic Assurance System	Second party, supervised practices	Farmer groups and individuals
Traditional Organic	Low external inputs, indigenous practices	Highland barley, buckwheat
Transition Systems	Farms moving from conventional to organic	Vegetable cooperatives

of Agriculture support those farmers willing to shift to organic farming by providing free certification and market linkages, rather than enforcing regulations. Farmers are grouped by their readiness and development stage, allowing tailored support from the Ministry, as shown in Table 1.

Policy Frameworks and Climate Resilience

Bhutan's commitment to sustainable food systems is enshrined in national policies and international commitments. The National Framework for Organic Farming in Bhutan initiated the transition towards organic practices (Tshomo, 2023). The GNH philosophy ensures that agriculture integrates ecological sustainability and cultural values (Tshomo, 2023). The FNS policy (2023) aims to ensure food security for all households, improve rural incomes, double exports through commercial scale and technology use, and promote sustainable/organic farming linked to markets and safe, nutritious food (MoAL, 2023; Tshomo, 2025a, 2025b). This is further supported by the Agrifood Sector Strategy 2034 (MOAL, 2023), which guides long-term agricultural development aiming to significantly contribute to Bhutan's economy through tripling exports, enhancing commercialisation, and adopting technology (MOAL, 2023). The 13th (2024 to 2029) and 14th Five-Year Plans (2029-2034) focus on essential food production for self-sufficiency, import reduction, high-end niche organic products and commercial production, market development, enhancing agro-technology, environmental conservation, and seed/genetic security (Tshomo, 2025b, 2025a). The National Organic Flagship Programme (NOFP) expanded certified organic production and branding (Tshomo, 2023). These policies align with FAO's 10 Elements of Agroecology (FAO, 2019).

Bhutan's commitment to carbon neutrality since 2009 is supported by strategies under Nationally Determined Contributions and Low Emission Development for Food Security (Tshomo, 2025). The Pesticide Act, 2000, mandates Integrated Pest Management. Bhutan faces increased climate risks, including glacial lake outburst floods, erratic rainfall, and increasing incidence of pest outbreaks (MoAL, 2023; Tshomo, 2025). The agrifood sector is highly vulnerable to extreme weather events, which damage crops, livestock, and infrastructure (MOAL, 2023). Agroecological practices enhance resilience through diversified cropping systems, improved soil organic matter, and reduced vulnerability (Tshomo, 2025). Research into drought-resistant maize, cold-tolerant rice, short-season vegetables, water harvesting, and yak pasture management is currently under investigation (MOAL, 2023).

CONCLUSION

Bhutan's food systems embody a unique integration of culture, policy, and ecology under the guiding philosophy of GNH. The National Organic Flagship Programme has demonstrated the country's capacity to mobilise institutions, farmers, and market linkages towards an integrated organic agenda, building essential infrastructure and piloting exports to demanding markets with increased areas and number of farmers and increased range of products grown and certified organic within the four years despite Covid 19 pandemic disruptions. It has also highlighted critical systemic constraints like fragmented execution, budget volatility, input shortages, certification bottlenecks, post-harvest weaknesses, and market discontinuities, which are reflected in The Post NOFP strategy (Tshomo & Tshetrimla, 2023).

The proposed organic strategy for Bhutan's upcoming mega-city, Gelephu Mindfulness City (GMC), by MOAL to support the GMC transition, offers a unique opportunity to address these constraints in a concentrated, well-resourced, and streamlined environment. With its low baseline dependence on synthetic agrochemicals, robust irrigation, protected cultivation assets, and strategic geographic position, GMC is poised for internationally recognised and credible organic certification (Tshomo et.al, 2025). This initiative represents a new model of mindful urban development, integrating traditional wisdom with modern innovation, focusing on ecological sustainability, mindful inclusivity, high international standards, and an organic, plastic-free orientation. Further, formal initiatives like the *Gyalsung* Academy for Food Security Skilling can serve as a critical pilot for integrated policy and market solutions before national scaling. The new opportunities open as a scope for mindfully integrated state-of-the-art agrotech of the highest standard, woven with traditional wisdom and practices based on agroecological principles, could potentially bring new agribusinesses and agro-ecotourism to the GMC. Such businesses based on food and sustainable agriculture that take root in the GMC may eventually influence the other *dzongkhags* as proposed according to the Bhutan's diamond strategy.

Key Recommendations

Policy and Funding: Based on the NOFP experience, future initiatives should prioritise stable, long-term funding and consistent policy signals (Tshomo & Tshetrimla, 2023). This means locking commodity and landscape lists for sustained periods, aligning budgets to a 10-year organic roadmap, and adopting phased investment matrices like GMC's template for national rollout. The recently released Bhutan 21st Century Economic Roadmap outlines an ambitious vision for economic transformation, aiming for significant GDP growth and diversification into new sectors, including knowledge and technology-driven industries (Bhutan 21st Century Economic Roadmap, 2025). This roadmap emphasises building a robust and diversified economy led by the private sector, and its strategic enablers, such as improved infrastructure and market access, are crucial for agricultural development and achieving organic transition goals. Predictable priorities and capital expenditure are crucial for attracting private investment in input plants, processing, and export programs.

Quality, standards and certification

Institutionalising robust quality and traceability systems is important. This involves continued accreditation and resourcing of national organic bodies, accrediting the Bhutan Organic Guarantee System for domestic and international certification.

Additionally, strengthening and developing national import/export codes to facilitate trade as required by the GMC will be very important. Strong quality assurance reduces rejection risk and price fluctuation of exported products in international markets; therefore, both product physical quality and food safety and integrity compliance to support branding and labelling successfully will play key roles.

De-risking Farmer Conversion with Targeted Incentives

To mitigate conversion costs and risks for farmers, standardised compensation or cost-sharing mechanisms should be deployed. Incentives should target critical pain points such as wildlife damage, water availability, and affordable bio-inputs, potentially through chain-link fencing, irrigation expansion, and initial input subsidies. Human-wildlife conflict is still a significant challenge for organic farmers (Tshomo et al, 2025).

Prioritising Domestic Input Production

An "inputs-first" action is essential. Investing in large-scale compost/vermicompost plants and bio-fertiliser units through public-private partnerships can address the current deficit in organic inputs. Simultaneously, robust enforcement against illegal chemical imports and promotion of on-farm nutrient recycling are vital (Tshomo et al, 2025).

Market Access and Value Chains

Establishing formal organic sales outlets, aggregation hubs, and institutionalising recurring organic fairs, food fests, and international events will be crucial to attract international attention and investment. Concentrating export efforts on a few "lead products" per corridor, leveraging existing business-to-business linkages, will professionalise the product flow and data of organic products. Developing inclusive value chains is key to strengthening rural livelihoods and connecting smallholder producers to markets (Pastakia, 2012; Swinnen & Kuijpers, 2020). Lessons from other developing countries emphasise the importance of meeting requirements for cost, quality, and certification to integrate into global markets (Barua et al., 2021). Successful farmer community enterprises in marketing organic products demonstrate the potential for improved livelihoods (Garming et al., 2011). Value chain analysis for organic products can also highlight areas for development (Haddas et al., 2018). Agricultural biodiversity is a crucial link between traditional food systems and contemporary development, social integrity, and ecological health (Johns et al., 2013). Challenges in marketing include small land holdings, scattered settlements, low volume, seasonal production, high transportation costs, and post-harvest losses (Food and Nutrition Security Policy of Bhutan 2023, which need organising into significant volumes for either processing or trading and export development.

Investing in Climate-Smart Infrastructure and Human Capital

Prioritising irrigation rehabilitation and new infrastructure (e.g., polycarbonate/glass greenhouses) is key for climate resilience. Scaling farmer and extension officials training, building on NOFP's achievements, and creating an Organic Knowledge Hub or Centre of Excellence and Service Centre will strengthen extension, research, and business incubation.

REFERENCES

Abdin, M. J. (2014). Vision-2021: The role of small and medium enterprises in Bangladesh economy. The Cost and Management, 42(1), 16–22.

Adelson, P. D., Bratton, S. L., Carney, N., & O'Neill, J. (2003). Values for a new millennium: Bhutan's Gross National Happiness.

Albrecht, U., & Bowman, K. D. (2012). Tolerance of trifoliate citrus rootstock hybrids to Candidatus Liberibacter asiaticus. Scientia Horticulturae, 147, 71–80. https://doi.org/10.1016/j.scienta.2012.08.036

Altieri, M. A., & Nicholls, C. I. (2017). Agroecology: A transdisciplinary, participatory and action-oriented approach. Agroecology and Sustainable Food Systems, 41(7–8), 797–824. https://doi.org/10.1080/21683565.2017.1330794

Baher, Z. F., Mirza, M., Ghorbanli, M., & Bagher Rezaii, M. (2002). The influence of water stress on plant height, herbal and essential oil yield and composition in Satureja hortensis L. Flavour and Fragrance Journal, 17, 275–277. https://doi.org/10.1002/ffj.1097

Barua, P., Rahman, S. H., & Barua, M. (2021). Sustainable management of agriculture product value chains in response to climate change for South-Eastern Bangladesh. In Proceedings of the 2nd International Conference on Science & Contemporary Technologies (pp. 574–581).

Bhandari, T., & Mayer, A. (2024). Comparing deep learning models for rice mapping in Bhutan using high-resolution satellite imagery. arXiv. https://arxiv.org

Bhutan 21st Century Economic Roadmap. (n.d.). Royal Government of Bhutan.

Bhutan Clear. (2023). Bhutan Clear Report. FAO, MOAL, & IFAD.

Biovision. (2025). National framework for organic farming in Bhutan. https://www.biovision.ch/story/national-framework-for-organic-farming-in-bhutan/

Bikesh, T., Thapa, B., Bharati, S., & G. C., A. (2020). Cultural and social enigmas: Missing pieces of food security. Food Security, 12, 869–879.

Britwum, K., & Demont, M. (2022). Food security and the cultural heritage missing link. Global Food Security, 35, 100660. https://doi.org/10.1016/j.gfs.2022.100660

Cavaye, J., Palaniappan, G., Nicetic, O., Concepcion, S., Abamo, A., Aspera, B., & Nuevo, P. (2016). The development of vegetable value chains integrated with community capacity – An initial study in the southern Philippines. Journal of Rural Studies, 45, 23–32.

Centre for Bhutan and GNH Studies. (2021). The Bhutanese way of life and nature: Ethnobotany and cultural landscapes.

Thimphu: Royal Government of Bhutan.

Chakraborty, B., Murshed, W. E., & Chakraborty, S. (2018). Analysis of solid waste management strategies in Thimphu with reference to its detrimental effect and remission approach. Journal of Material Cycles and Waste Management, 20, 1779–1790.

Chogyel, K., & Mayer, A. (2024). Climate change and potential impacts on agriculture in Bhutan: A discussion of pertinent issues. Agriculture and Food Security.

Cohen, N., & Derryk, D. (2011). Corbin Hill Road Farm Share: A hybrid food value chain in practice. Journal of Agriculture, Food Systems, and Community Development, 1, 183–196.

Das, S., & Mishra, A. J. (2022). Dynamics of indigenous community's food and culture in the time of climate change in the Himalayan region. Journal of Ethnic Foods, 9, 1–13.

Dorji, K., Lakey, L., Chophel, S., Dorji, S. D., & Tamang, B. (2016). Adoption of improved citrus orchard management practices: A micro-study from Drujegang growers, Dagana, Bhutan. Agriculture & Food Security, 5(3). https://doi.org/10.1186/s40066-016-0050-z

Dorji, K., Thinley, P., & Tshering, D. (2020). Rice cultivation and food security in Bhutan: Challenges and opportunities. Journal of Bhutan Studies, 43(1), 45–62.

Dorji, K., Tshewang, S., Lakey, L., & Tenzin, J. (2022). Young migrants and their transition to adulthood: A case study of Bhutan's Wangdue and Punakha districts. International Social Science Journal, 1–18. https://doi.org/10.1111/issj.12327

Dorji, T. (2018). Rituals, rice, and resilience: Food traditions in Bhutanese valleys. Journal of Bhutan Studies, 44, 89–112.

FAO, European Union, & CIRAD. (2022). Food system profile: Bhutan – Catalysing the sustainable and inclusive transformation of food systems. Rome, Brussels, & Montpellier.

Food and Agriculture Organization of the United Nations (FAO). (2019). The 10 elements of agroecology: Guiding the transition to sustainable food and agricultural systems.

Garming, H., Guardia, S., & Pocasangre, L. (2011). Farmers' community enterprise for marketing organic bananas from Alto Beni, Bolivia: Impacts and threats. International Journal of Fruit Science, 11, 395–407.

Gartaula, H., Patel, K., Shukla, S., & Kharel, P. (2019). Indigenous knowledge of traditional foods and food literacy among youth: Insights from rural Nepal. Journal of Food Science and Nutrition, 2, 1–10.

Gross National Happiness Commission (GNH). (2008). The Constitution of the Kingdom of Bhutan and the philosophy of Gross National Happiness. Thimphu: Royal Government of Bhutan.

Ha, D. T., & Shively, G. (2007). Coffee boom, coffee bust, and smallholder response in Vietnam's Central Highlands. Review of Development Economics, 12, 312–326. https://doi.org/10.1111/j.1467-9361.2007.00391.x

Haddas, H., Anindita, R., & Syafrial, S. (2018). Value chain analysis of organic vegetables. Agricultural Socio-Economics Journal, 18, 16–25.

Haq, S. M., Hassan, M., Jan, H. A., & Ahmad, S. (2022). Traditions for future cross-national food security—Food and foraging practices among different native communities in the Western Himalayas. Foods, 11, 3608.

International Federation of Organic Agriculture Movements (IFOAM). (n.d.). Global Market Access Programme: Linking Asian organic farmers to global markets.

International Monetary Fund (IMF). (2010). Bhutan: Poverty reduction strategy paper.

Johns, T., Powell, B., Maundu, P., & Eyzaguirre, P. B. (2013). Agricultural biodiversity as a link between traditional food systems and contemporary development, social integrity, and ecological health. Journal of the Science of Food and Agriculture, 93, 3429–3433.

Kamei, M., Wangmo, T., Leibowicz, B. D., & Reames, T. G. (2020). Urbanization, carbon neutrality, and Gross National Happiness: Sustainable development pathways for Bhutan. Energy Research & Social Science, 69, 101759.

Katwal, T. B., & Bazile, D. (2019). Agroecology and food system transitions in Bhutan. Food Security, 11(2), 405–420.

Lakey, L., & Dorji, K. (2016). Ecological status of high-altitude medicinal plants and their sustainability: Lingshi, Bhutan. BMC Ecology, 16, 45. https://doi.org/10.1186/s40066-016-0100-1

Masaki, K., & Tshering, J. (2021). Exploring the origins of Bhutan's Gross National Happiness. Journal of Bhutan Studies, 44, 140–154.

Ministry of Agriculture and Livestock (MOAL). (2023). Bhutan Agrifood Sector Strategy 2034. Royal Government of Bhutan.

Ministry of Agriculture and Livestock (MOAL). (2023). Food and Nutrition Security Policy of Bhutan 2023. Royal Government of Bhutan.

Ministry of Agriculture and Livestock (MOAL). (201 National Organic Flagship Programme. Royal Government of Bhutan.

Ministry of Agriculture and Livestock (MOAL). (n.d.). Renewable Natural Resources Strategy 2040. Royal Government of Bhutan.

Mitra, S., & Jeong, H. Y. (2017). Bhutan: New pathways to growth. Asian Development Bank.

O'Neill, A. R., Badola, H. K., Dhyani, P. P., & Rana, S. D. (2017). Integrating ethnobiological knowledge into biodiversity conservation in the Eastern Himalayas. Journal of Ethnobiology and Ethnomedicine, 13, 1–14.

Pastakia, A. (2012). Building pro-poor value chains: Experiences from rural India. Enterprise Development and Microfinance, 23, 195–210

Phungpracha, E., Kansuntisukmongkon, K., & Panya, O. (2016). Traditional ecological knowledge in Thailand:

Mechanisms and contributions to food security. Journal of Ethnobiology and Ethnomedicine, 12, 1–11.

Pradhan, P., Subba, B. K., Jamtsho, T., & Wangmo, T. (2022). Asymmetrical trusted technology networks in developing economies: A case study on critical infrastructure in Bhutan. Bhutan Journal of Research and Development, 10, 24–35.

Rai, A. (2024). Exploring Bhutan's economic development trajectory. Preprints.

Ramirez-Santos, A. G., Ravera, F., Rivera-Ferre, M. G., & Tamiotti, C. S. (2023). Gendered traditional agroecological knowledge in agri-food systems: A systematic review. Journal of Rural Studies, 100, 103024.

Rinzin, C., et al. (2019). Non-timber forest products and rural livelihoods in Bhutan. Bhutan Journal of Natural Resources and Development, 6(1).

Royal Government of Bhutan. (n.d.). Bhutan's Third National Communication to the UNFCCC. National Environment Commission.

Sarawale, P., Rajemahadik, V., Shendage, G., & Mane, S. (2006). Effect of different varieties and establishment methods on growth and yield of finger millet (Eleusine coracana Gaertn.). Journal of the Indian Society of Coastal Agricultural Research, 34, 22–26.

Sharma, D. (2019). Impact of small and medium scale enterprises in the generation of employment in Nepal. Journal of Political Science and Public Affairs, 7, 1–8.

Swinnen, J., & Kuijpers, R. (2020). Inclusive value chains to accelerate poverty reduction in Africa. Journal of Agribusiness in Developing and Emerging Economies, 10, 297–314.

Tashi, S., & Wangchuk, K. (2016). Prospects of organic farming in Bhutan: A SWOT analysis. Journal of Sustainable Agriculture, 40, 170–189.

Tobgye, S. (2018). Digital transformation in Bhutan: Culture, workforce and training. Bhutan Journal of Research and Development, 5, 1–14.

Tshomo, K. (2019). Organic agriculture pathways in Bhutan: Policy and practice. Paper presented at the Organic Symposium, Paro, Bhutan.

Tshomo, K. (2022). Agroecology and GNH: Linking food systems with culture and climate. Presentation at the Ministry of Agriculture and Livestock, Thimphu, Bhutan.

Tshomo, K. (2023). Food in Bhutanese culture: Its role in changing food systems. Lecture to Study Abroad class, Royal Thimphu College.

Tshomo, K. (2024). Food in Bhutanese culture, changing environment and food systems in Bhutan. Lecture at the Department of Agriculture, MOAL, Bhutan.

Tshomo, K. (2025). Food systems and climate change. Talk to visiting class of BES, Ministry of Agriculture and Livestock.

Tshomo, K., & Tshetrimla, L. (2023). Post-NOFP strategy. Department of Agriculture, MOAL.

Tshomo, K., Tshetrimla, L., Lepcha, N., & Pradhan, K. (2025). Strategy for 100% organic agriculture development in Gelephu Mindfulness City.

Tshotsho, J., Chhetri, N., & Wangmo, S. (2022). Agroecological zoning and crop adaptation in Bhutan. Bhutan Journal of Agricultural Research, 8(1), 25–39.

United Nations Development Programme. (2021). Low Emission Development Strategy for Food Security: Bhutan (July 20 2021). UNDP Bhutan.

Ura, K., Alkire, S., Zangmo, T., & Wangdi, K. (2012). An extensive analysis of Gross National Happiness. Centre for Bhutan Studies and GNH Research.

Wangchuk, P., & Tobgay, T. (2015). Contributions of medicinal plants to the Bhutanese traditional medicine system. Journal of Ethnobiology and Ethnomedicine, 11(48).

Yangdon, P., Araki, T., Rahayu, Y. S., & Drolma, P. (2022). Ethnobotanical study of wild edible fruits in eastern Bhutan. Journal of Ethnobiology and Ethnomedicine, 18, 1–16.