https://doi.org/10.55925/btagr.26.9105

Evaluating Systemic Challenges and the Future Viability of Bhutan's Organic Agriculture Movement

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Abstract

Bhutan's organic agriculture movement, anchored in the nation's Gross National Happiness (GNH) framework, represents a unique effort to harmonise agricultural livelihoods with ecological conservation. Since the formalisation of the National Organic Programme in 2006, Bhutan has sought to transition from awareness-driven initiatives to commercially viable organic production. This study synthesises secondary data from government reports, monitoring datasets, and international databases spanning 2010-2023 to evaluate achievements, challenges, and strategic lessons for Bhutan's organic sector. The analysis focuses on four thematic pillars: certified area, input production, commodity value chains and market development. Findings reveal notable progress, including the establishment of a dual-track certification system (LOAS and third-party certification), the development of 17 organic input production units, and targeted capacity-building programmes. However, systemic constraints persist, including weak market linkages, fragmented smallholder value chains, low adoption of organic fertilisers, and vulnerability to external shocks, as exemplified by the COVID-19 pandemic. The study identifies four key challenges: conceptual narrowness, institutional and structural deficits, economic disincentives, and cross-sectoral missed opportunities. To ensure the future viability of Bhutan's organic sector, strategic interventions are recommended, including the creation of a national organic production and market database, performance-linked incentives, and diversification into high-value, climate-resilient crops and non-wood forest products. Collectively, these measures can consolidate Bhutan's organic sector, enhancing both ecological sustainability and economic resilience while providing evidence-based guidance for policy and investment in emerging organic economies.

Keywords: *Organic Agriculture; Certification; Value Chains; Market Development; Sustainability*

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1 Introduction

The global organic agriculture movement has evolved from a niche practice to a significant component of sustainable food systems, driven by consumer demand for safe food and growing concerns over environmental degradation (Willer et al., 2023). In this context, Bhutan's development paradigm, anchored in the principle of Gross National Happiness (GNH), offers a distinctive framework. GNH pillars of environmental conservation and sustainable development make organic agriculture a natural strategic fit (Neuhoff et al., 2014).

Formalised by the National Framework for Organic Farming in 2006, Bhutan's organic journey aimed to harmonise agricultural livelihoods with its pristine ecological heritage (Department of Agriculture [DoA], 2006). Initial efforts under the National Organic Programme (NOP) focused on awareness and capacity building. However, they were hampered by a lack of commercial focus, limited infrastructure, and insufficient investment in value chains, resulting in a persistent gap between policy ambition and on-the-ground implementation (La & Tshomo, 2023).

To address these systemic gaps, the Royal Government of Bhutan (RGoB) launched the National Organic Flagship Programme (NOFP) during the 12th Five-Year Plan (2019–2023). The NOFP marked a strategic pivot from advocacy to commercialisation, targeting priority commodities, strengthening domestic and export certification systems, and scaling up organic input production (La & Tshomo, 2023).

The national policy impetus for organic agriculture in Bhutan has been systematically embedded within successive Five-Year Plans, reflecting its strategic importance in achieving environmentally sustainable and socially inclusive agricultural development (Ministry of Agriculture and Livestock [MoAL], 2025). Organic agriculture initiatives have been implemented through a multi-agency approach, coordinated primarily by the Department of Agriculture (DoA) under the Ministry of Agriculture and Livestock (MoAL), with support from regional research and extension centres.

A significant institutional milestone was the establishment of the National Centre for Organic Agriculture (NCOA) under the DoA, which is mandated to lead research, technology development, and the coordination of organic farming activities nationwide (National

Organic Agriculture Centre [NCOA], 2025). This development marked a critical step toward institutionalising organic agriculture within Bhutan's broader agricultural research and innovation system.

However, despite these institutional advancements, progress in terms of area-wide adoption, production scale, and measurable economic returns has remained modest. Organic agriculture continues to face systemic constraints, including limited commercialisation, weak market linkages, and inadequate private sector engagement (Neuhoff et al., 2014; Willer et al., 2023). Consequently, while policy integration and institutional frameworks have advanced, translating policy intent into tangible economic outcomes remains a persistent challenge for Bhutan's organic agriculture movement (Paull, 2023).

Although several official reports have documented the achievements and incremental progress of Bhutan's organic agriculture initiatives, there has been limited breakthrough success in realising transformative outcomes (McCrae-Hokenson, 2014). Moreover, a comprehensive and critical synthesis of the sector's cumulative achievements, persistent challenges, and strategic lessons remains largely absent from the existing literature. This study addresses that gap by examining two key questions: (1) What are the principal achievements and challenges of Bhutan's organic agriculture sector? and (2) What policy lessons can be drawn from past interventions to guide future organic pathways?

By engaging with these questions, this paper provides an evidence-based evaluation of Bhutan's organic agriculture movement, aiming to support the strategic transition from fragmented, project-based initiatives to a fully integrated, economically viable, and ecologically resilient national organic system.

2 Materials and Method

This study employed a systematic qualitative synthesis of secondary data, complemented by a comparative policy analysis and targeted quantitative assessments. Multiple verified data sources were used to ensure triangulation and strengthen analytical validity. Primary programmatic data were obtained from progress reports, monitoring datasets, and evaluation summaries of the National Organic Programme (NOP) and the Ministry of Agriculture and Livestock (MoAL) covering the period from 2010 to 2023. Additional secondary sources

included the Annual Agriculture Statistics and certification reports from the Bhutan Food and Drug Authority (BFDA).

Marketing data were sourced from Bio Bhutan Pvt. Ltd., a leading private-sector exporter of organic products in Bhutan. Export revenue data were aggregated by commodity and year and analysed using time-series techniques to assess market trends, revenue volatility, and export concentration by product. Due to the limited availability of systematically published data on organic agriculture, data from the World of Organic Agriculture series published by FiBL were also analysed. The FiBL data on certified organic areas, originally reported in hectares, were converted to acres using a conversion factor of 1 hectare = 2.471 acres to ensure consistency across datasets.

The analysis was conducted in three sequential phases. First, a descriptive mapping of organic agriculture activities was undertaken across four thematic pillars: certified area, input production, commodity value chains, and market development, through which key performance indicators were identified. Second, thematic analysis was applied to assess achievements and challenges, to interpret quantitative outputs, and to link findings to relevant literature on organic transitions. Finally, strategic integration aligned emergent themes with Bhutan's future organic pathway, examined the transferability of institutional mechanisms, and identified potential synergies and risks.

2.1 Conceptual Framework

To analyse the systemic challenges and future viability of Bhutan's organic agriculture movement, this study employs a conceptual framework adapted from the Multi-Level Perspective (MLP) on socio-technical transitions (Geels, 2011). The MLP is particularly appropriate, as it enables analysis of complex transitions by examining interactions among three analytical levels: the socio-technical landscape, the socio-technical regime, and technological niches.

In this framework (Figure 1), the Landscape denotes the broad, exogenous context that exerts pressure on the existing regime but is difficult to change. The regime is the dominant, incumbent system, in this case, Bhutan's conventional agricultural system and its associated policies, practices, and markets. The niche is the protected space where innovations emerge.

Here, it represents the organic agriculture movement, including certified farmers, the LOAS system, and organic input producers.

The transition to a viable organic sector is conceptualised as a process where landscape pressures create windows of opportunity for niches to grow and challenge the dominant regime. However, this transition is hindered by systemic barriers, which are multifaceted impediments that prevent the niche from scaling and replacing the regime.

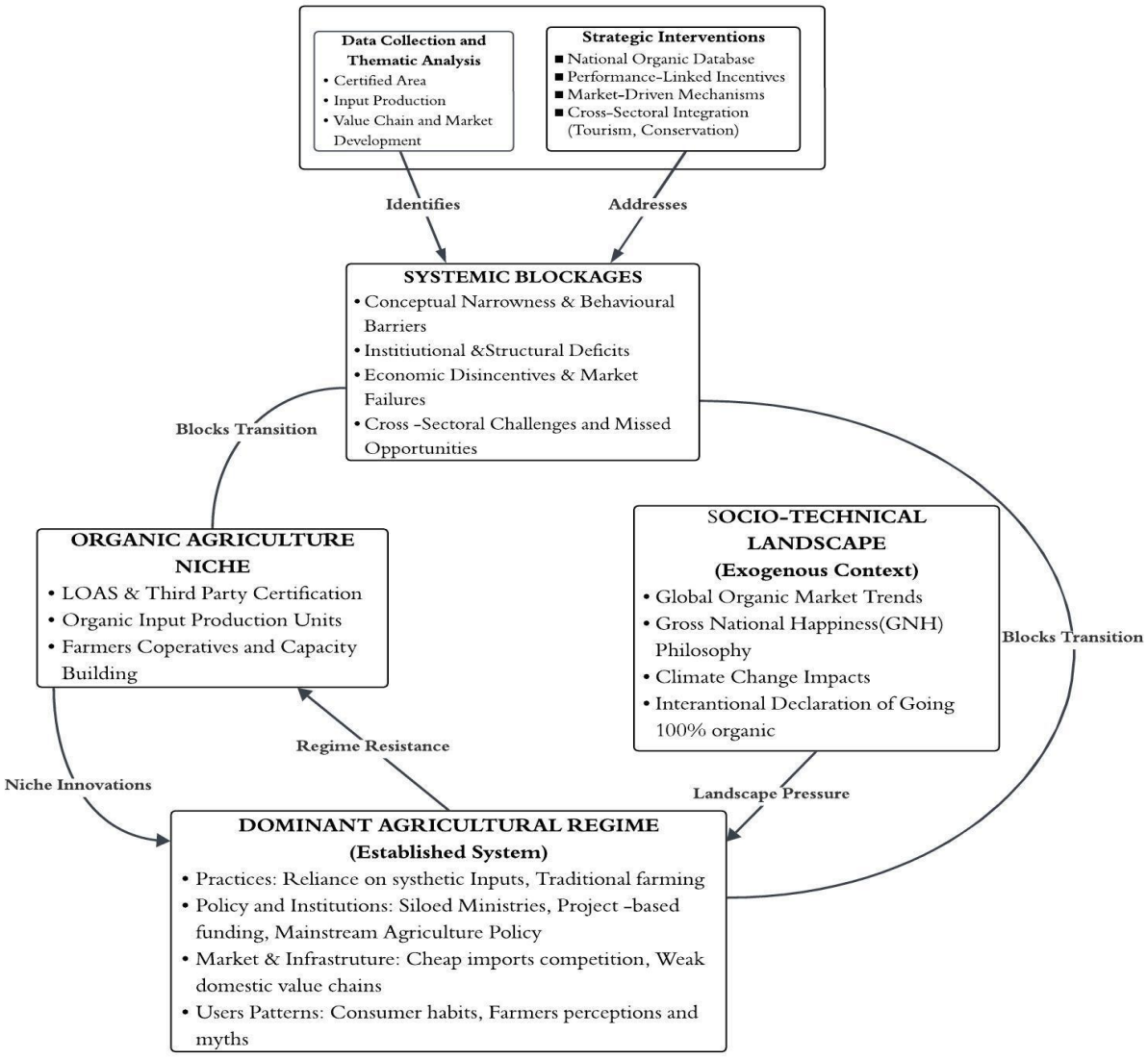

Figure 1. Conceptual framework

This study's analysis is structured to identify these blockages. It synthesises data across four thematic pillars, certified area, input production, value chains, and market development, to diagnose the specific failures at the regime level and weaknesses within the niche that are preventing a successful transition. The ultimate output is a set of targeted strategic

interventions designed to overcome these blockages, thereby aligning the regime with the niche and landscape pressures to create a more resilient and viable organic sector.

3 Results and Discussion

The following analysis evaluates the progress of Bhutan's organic sector through the lens of the Multi-Level Perspective (MLP). The data reveal that the niche innovation, the organic movement, is struggling to disrupt a deeply entrenched socio-technical regime of conventional agriculture. The primary impediments to this transition are not a lack of technical solutions, but persistent regime-level blockages in markets, infrastructures, and policy, which are exacerbated by specific niche-level weaknesses in economic resilience and farmer organisation. This section diagnoses these blockages across the core thematic pillars.

3.1 Area under Organic Certification

The expansion of organically certified agricultural areas in Bhutan demonstrates a complex trajectory over the period 2011-2023 (Table 1, Figure 3). The certified agricultural area showed a marked decline after 2012, while the certified non-wood forest product (NWFP) area fluctuated significantly (Figure 2). These trends suggest volatility driven by project-based funding cycles and shifting certification priorities, rather than sustained, market-driven growth. This pattern of "boom and bust" in the certified area is not unique to Bhutan and is often observed in contexts in which policy-driven initiatives are not firmly anchored in stable market demand (Luttikholt, 2007; Smith & Marsden, 2004; Willer et al., 2023).

Table 1. The certified organic areas under agriculture and non-wood forest products reported under FiBL

Year	Certified agriculture area (ac)	Certified NWFP area (ac)	Total area (ac)	Total agriculture producers (No)	Area per producers (ac)	NWFP dependency (%)
2011	51878.65	38559.96	90438.60	0	NA	43
2012	15211.48	38559.96	53771.43	0	NA	72
2013	16619.95	38559.96	55179.90	0	NA	70
2014	16874.46	15604.37	32478.82	2680	6.296	48
2015	17173.45	15604.37	32777.82	2680	6.408	48
2016	16387.67	39009.68	55397.35	4293	3.817	70
2017	16387.67	39009.68	55397.35	4295	3.816	70
2018	16387.67	19140.37	35528.04	4354	3.764	54
2019	16387.67	19140.37	35528.04	4354	3.764	54
2020	10118.75	5493.03	15611.78	1265	7.999	35

2021	13857.37	5493.03	19350.40	1998	6.936	28
2022	13857.37	5493.03	19350.40	1998	6.936	28
2023	9152.58	5493.03	14645.62	2760	3.316	38

A key institutional achievement was the introduction of a dual-track certification system: the Local Organic Assurance System (LOAS) for domestic markets and third-party certification for exports (La & Tshomo, 2023). This innovative model is a critical success factor, balancing inclusivity for smallholders with the stringency required for international trade. Such Participatory Guarantee Systems (PGS), such as LOAS, have been shown to reduce barriers to entry and foster local market development in other countries (IFOAM, 2025).

However, a critical analysis reveals inherent challenges. The dual-track system risks creating a perceptual hierarchy in which LOAS-certified produce is viewed as of lower quality by both domestic consumers and farmers, potentially limiting its market value and undermining farmers' motivation to pursue more stringent export certification. Furthermore, the long-term integrity of PGS systems depends heavily on robust social capital and continuous community engagement, which can be eroded by fluctuating farmer interest and external shocks (Luttikholt, 2007; Smith & Marsden, 2004). The sharp contraction in certified producers during the COVID-19 pandemic underscores this vulnerability, indicating that the LOAS niche lacked the institutional and market depth to withstand landscape-level pressures.

The core vulnerability is the number of certified organic producers, which decreased to 1,265 in 2020 from 4,354 in 2019. This sharp contraction indicates the sector's severe vulnerability to external shocks like the COVID-19 pandemic and underscores a lack of structural resilience, a common issue in nascent organic sectors that lack diversified market channels (Nemes, 2009; Reganold & Wachter, 2016; Wynen Els, 2002). Furthermore, the certified organic area constitutes only 1.39% of Bhutan's total cultivated land (Paull, 2023), a stark contrast to the national ambition. The high NWFP dependency (ranging from 28% to 72% of total certified area) highlights the ecological integration of Bhutan's systems but also a potential vulnerability to changes in forest management and climate impacts on forest ecosystems (Rijal et al., 2011).

The central challenge illuminated by this data is the weak market linkage. LOAS-certified products often lack reliable price premiums, providing insufficient economic motivation for farmers to sustain certification amid higher labour inputs and perceived risks. This finding

underscores a critical lesson for Bhutan and similar contexts: certification infrastructure alone is insufficient; parallel mechanisms to ensure guaranteed market access and premium prices are required, without which participant attrition is inevitable (Crowder & Reganold, 2015; Nemes, 2009). The economic rationale for farmers is paramount; studies consistently show that secure offtake agreements and visible price differentials are the strongest predictors of sustained organic adoption (Wilson et al., 2021).

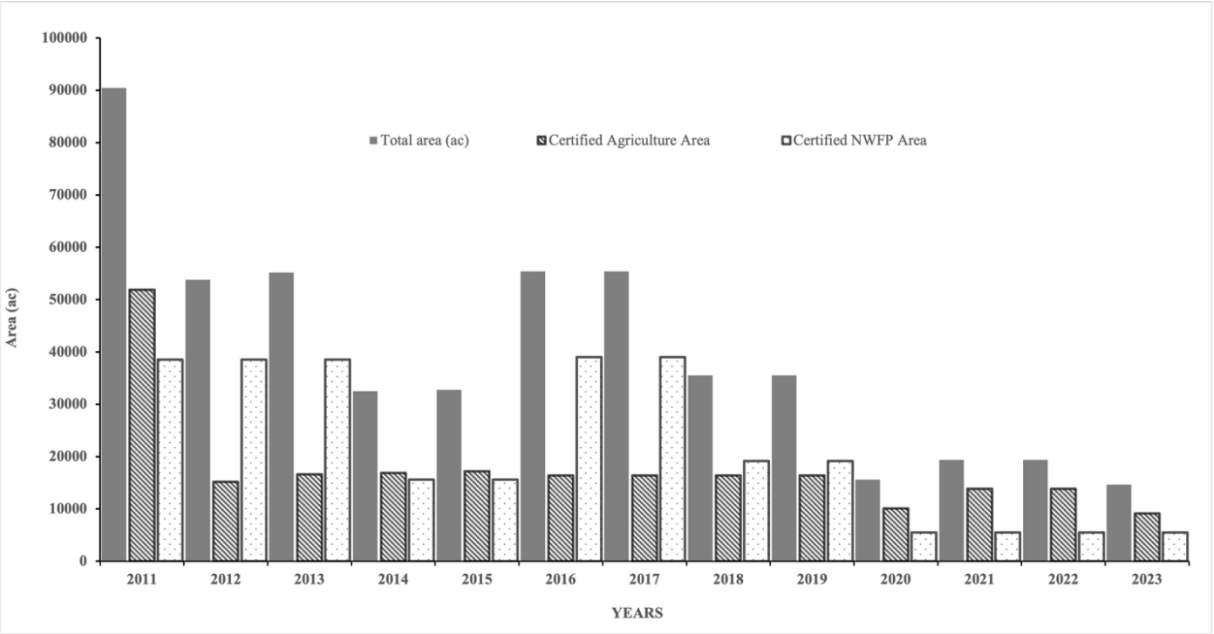

Figure 2. Structural composition of certified organic area by agriculture and non-wood forest products (NWFPs), illustrating persistent dependence on forest-based certification

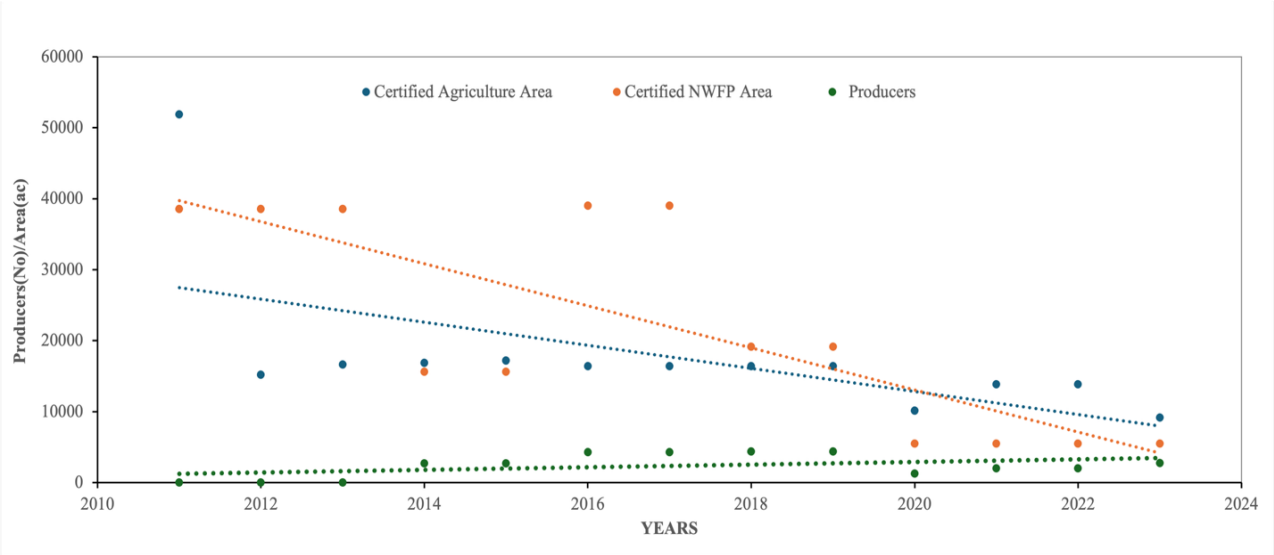

Figure 3. Long-term trends in certified agricultural area, NWFP area, and producers (2011–2023), highlighting sectoral volatility and sensitivity to external shocks

3.2 Organic Fertiliser Production

The commercial production of organic fertilisers in Bhutan has emerged as a critical achievement, marking a significant shift from exclusive reliance on household-level farmyard manure. Since 2015, substantial progress has been made in establishing a domestic bio-input industry, with 17 production units currently operational (Table 2). As illustrated in Figure 4, Chicken manure and vermicompost dominated until FY 2021-22; since then, compost production has surged, attributed to compost plants established under the National Organic Flagship Program. Collectively, these enterprises have created an annual production capacity of 4,827 metric tons, supplemented by Effective Microorganisms (EM) produced and distributed by the Agricultural Research and Development Centres (ARDCs) (La & Tshomo, 2023). This expansion of production infrastructure demonstrates both technical feasibility and growing commercial interest in supplying local organic inputs.

Table 2. The organic fertiliser producers and their production capacity in the country

Organic fertilizers	Number of producers	Production capacity/annum (MT)
Compost	8	4016
Chicken manure compost	1	500
Vermicompost	7	309
Biofertilisers	1	2

However, despite increased availability, farmer adoption rates remain critically low. The disconnect between production capacity and on-farm utilisation points to significant structural and economic barriers. Organic fertilisers face practical challenges, including bulkiness, slow nutrient release, and higher costs relative to conventional chemical alternatives. As Scialabba & Hattam (2002) note, these characteristics often lead farmers to prefer readily available synthetic fertilisers, despite awareness of their long-term ecological benefits. The experience of successful organic transitions in countries like Austria and Denmark underscores that production capacity alone is insufficient without parallel mechanisms to address affordability, distribution, and farmer education (Läpple & Rensburg, 2011).

For Bhutan's organic sector to advance, a more integrated strategy is essential. This should include targeted subsidies to reduce cost disparities, enhanced extension services to

demonstrate effective application techniques, and regulatory measures that gradually restrict the use of the most harmful chemical inputs. Without such comprehensive support, the nascent organic input sector risks operating below capacity, undermining both its commercial viability and Bhutan's broader organic agricultural ambitions.

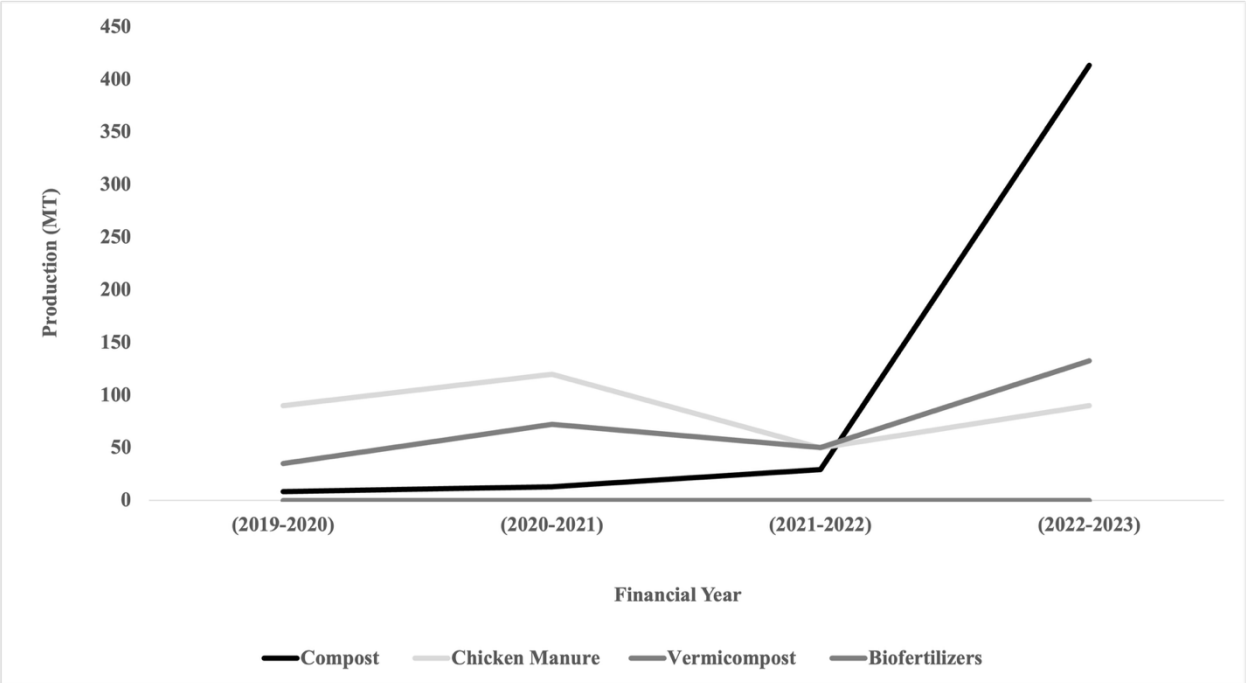

Figure 4. The trend in organic fertiliser production from 2019 to 2023

3.3 Organic Plant Protection

The use of organic plant protection measures in Bhutan has remained very limited over the past decade, with adoption rates showing little improvement and, in some cases, even declining (Figure 5). This slow uptake is attributed to factors such as limited technical capacity, lack of locally produced organic inputs, and heavy reliance on intermittent government or donor funding rather than sustained institutional or market support (National Plant Protection Centre [NPPC], 2022). During the fiscal year 2021–2022, imports of organic plant-protection materials temporarily increased, largely due to funding support provided under the National Organic Flagship Programme (NOFP). However, this improvement was short-lived, underscoring that the adoption and promotion of organic plant protection in Bhutan are closely tied to the availability of external financial assistance (CARLEP, 2022).

Currently, the use of organic plant-protection products remains insignificant, with only approximately 5 metric tonnes (MT) of organic inputs used, compared with approximately 44

MT of synthetic agrochemicals (National Statistics Bureau [NSB], 2025). Furthermore, the diversity of organic options is limited, with farmers primarily relying on pheromones, sticky traps, and neem-based products (Wangmo et al., 2023). This narrow range of available solutions highlights the need for sustained investment in research, development, and extension services to diversify organic pest management options and promote long-term adoption beyond short-term funding cycles (Paull, 2023).

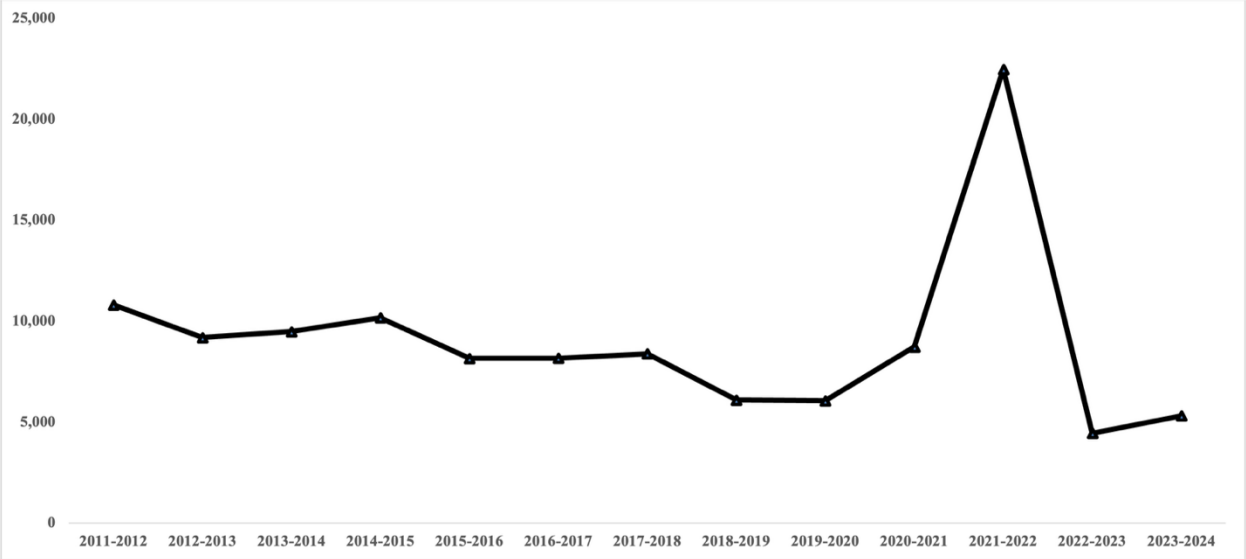

Figure 5. The organic plant protection supply trend in the country from 2011-2024

3.4 Commodity Value Chains: From Production to Market

A persistent and structurally significant constraint on Bhutan's organic agriculture movement is the absence of robust, transparent, and disaggregated market data. This condition reflects the marginalised status of the organic niche within the dominant agri-food regime. National agricultural statistics do not systematically distinguish organic from conventional production, obscuring the sector's true economic footprint and constraining evidence-based planning and investment. As Nemes 2009 argues, the inability to quantify organic sector performance is a fundamental barrier to mobilising sustained policy and private-sector support.

The limited export data available from Bio Bhutan Pvt. Ltd. nevertheless provides important insights into the structural weaknesses of Bhutan's organic value chains. As illustrated in Figure 7, organic export revenues between 2015 and 2024 are highly volatile and heavily concentrated in a single commodity (lemongrass essential oil). Other certified products, including ginger, honey, turmeric, mustard, and rhododendron, contribute only marginal and

irregular export values. The stacked composition of exports (Figure 6) reinforces this picture, showing that lemongrass accounts for roughly four-fifths of cumulative organic export revenue over the period, with no other commodity achieving a stable or meaningful market share.

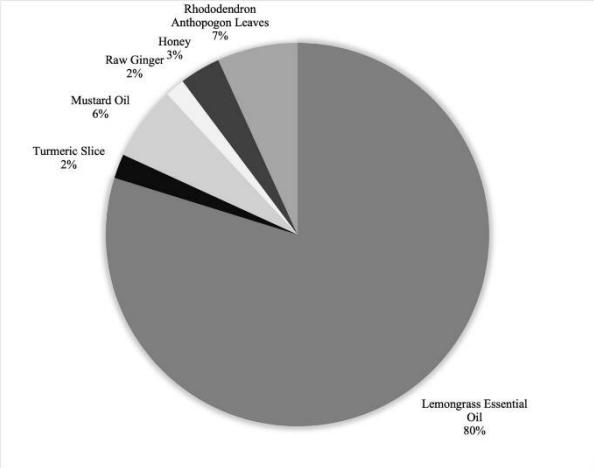

Figure 6. Cumulative composition of organic export revenues by commodity (2015–2024)

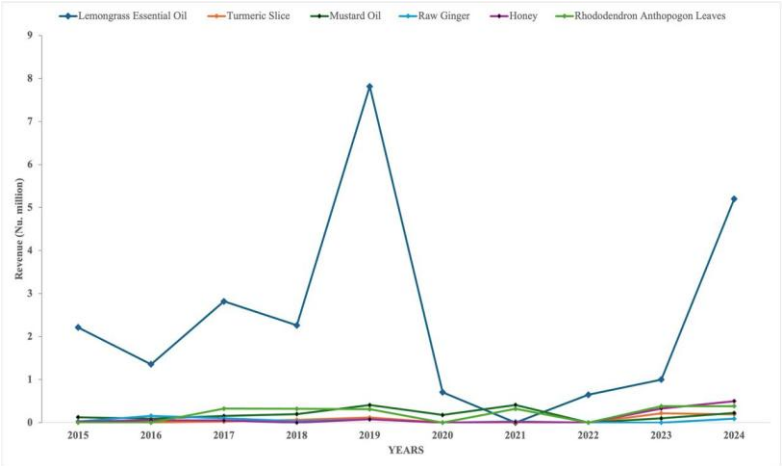

Figure 7. Time series trends in organic export values (2015–2024)

From a multi-level perspective, this extreme concentration suggests a niche that has not yet developed diversified and resilient market pathways capable of challenging the dominant regime. Rather than reflecting comparative advantage alone, the dominance of a single export commodity points to a deeper regime-level blockage: the absence of dense, reliable market linkages. Organic production remains fragmented among geographically dispersed smallholders, resulting in volumes that are costly and inefficient to aggregate (McCrae-Hokenson, 2014; Neuhoff et al., 2014). Without effective aggregation mechanisms, exporters and processors tend to engage only with commodities that offer low transaction costs and predictable volumes, thereby reinforcing path dependency around a narrow product base.

The pronounced year-to-year fluctuations in export values, especially the sharp expansion in 2019 followed by contraction during the COVID-19 period, indicate that organic production in Bhutan is largely reactive to short-lived market opportunities rather than anchored in stable demand or contractual arrangements. The core constraint, therefore, is not simply the absence of price premiums but the lack of secure offtake mechanisms. Without guaranteed buyers, forward contracts, or structured procurement platforms, farmers carry a disproportionate

share of market risk, including the possibility of unsold surplus. This risk undermines farmer confidence and makes the higher labour requirements and transition costs of organic farming economically unattractive, a dynamic widely observed in early-stage organic sectors that lack coordinated value chains (Bijaman et al., 2010; Nemes, 2009).

The business case for organic production is further weakened by competition from cheaper, often subsidised conventional imports, a regime-level economic barrier that the organic niche cannot overcome without targeted policy support. As Scialabba and Hattam (2002) note, the failure to internalise the environmental and social externalities of conventional agriculture systematically disadvantages organic systems in price-based competition. In Bhutan, this imbalance reinforces farmers' dependence on conventional markets, despite strong policy rhetoric in favour of organic agriculture.

Taken together, the export data and value-chain analysis show that Bhutan's organic sector is constrained less by technical capacity or certification systems than by systemic market failures at the regime level. Addressing these barriers will require deliberate institutional innovation, including the development of farmer cooperatives, specialised intermediaries, and coordinated aggregation and marketing platforms that can achieve economies of scale and stabilise organic supply chains. Without such interventions, the organic niche is likely to remain confined to a narrow range of opportunistic export products, limiting its ability to evolve from a policy-driven initiative into a commercially viable and resilient agricultural system.

3.5 Synthesis of Systemic Challenges and Strategic Imperatives

The analysis of past interventions reveals that, while foundational pillars were established, multifaceted systemic challenges impede the development of organic agriculture. These can be synthesised into four interconnected categories:

3.5.1 Limited Understanding and Conceptual Narrowness

A narrow understanding of organic farming as mere input substitution, rather than a holistic ecosystem management approach, prevails. This is compounded by persistent myths about yield reduction, creating psychological barriers to adoption that are unsupported by local evidence. Meta-analyses show that while yields can be lower for certain staples, they are often comparable for many crops, especially when assessed over longer timeframes, and the

profitability can be higher due to premiums (Crowder & Reganold, 2015; Ponisio et al., 2015).

3.5.2 Institutional and Structural Deficits

The organic sector suffers from fragmented implementation due to fiscal decentralisation, weak inter-ministerial coordination, and critical shortages in the commercial input supply chain, thereby perpetuating dependence on conventional inputs. The siloed approach to agricultural policy, in which organic goals are not integrated into mainstream agricultural and rural development plans, is a common pitfall identified in the policy integration literature (Candel & Biesbroek, 2016).

3.5.3 Economic Disincentives and Market Failures

The absence of reliable price premiums and clear market differentiation for certified organic produce constitutes a fundamental market failure. The business case for the transition to organic production is further undermined by competition from lower-cost imports and variable product quality. The work of Scialabba & Hattam (2002) emphasises that internalising environmental costs into conventional production is key to levelling the economic playing field for organic systems.

3.5.4 Cross-Sectoral Challenges and Missed Opportunities

Beyond immediate agricultural concerns, cross-cutting issues present additional barriers to organic scaling. Chronic rural labour shortages encourage herbicide use, while human-wildlife conflicts disproportionately affect organic farmers (Wilson et al., 2021). Potential synergies with tourism (e.g., agro-eco-tourism, organic homestays) and biodiversity conservation remain largely untapped, representing a significant missed opportunity for value addition and brand storytelling, as successfully demonstrated in regions like Tuscany, Italy (Sidali et al., 2019).

Addressing these challenges requires a coordinated, systemic response centred on creating a virtuous cycle of market demand and farmer profitability. This necessitates reframing extension services to provide localised evidence, securing input supply chains through strategic investment, engineering market demand through credible labelling and tourism partnerships, and enhancing institutional coordination via a cross-sectoral apex body with the authority to align policy and budgets, a model proven effective in complex multi-stakeholder initiatives (Bryson et al., 2015).

4 Conclusion

Bhutan's organic agriculture movement demonstrates a remarkable alignment between national development philosophy and sustainable agricultural practice. Anchored in the principles of Gross National Happiness (GNH), the country has made meaningful strides in building the foundational pillars of a national organic sector. The country has laid important institutional and technical foundations, including an adaptive certification system, expanding organic input infrastructure, and sustained investments in human capacity. These achievements demonstrate that organic agriculture in Bhutan is not merely aspirational but operationally feasible, institutionally credible, and increasingly visible within national development discourse.

Despite these successes, the sector faces persistent systemic challenges that threaten its long-term viability. Weak market linkages, fragmented smallholder production, and limited adoption of organic fertilisers hinder the economic attractiveness of organic farming, contributing to volatility in certified area and producer numbers. Structural and institutional deficits, such as insufficient inter-ministerial coordination, lack of integration with mainstream agricultural policy, and dependency on project-based funding, further constrain sectoral growth. Cross-sectoral challenges, including labour shortages, human-wildlife conflicts, and underutilised opportunities in agro-tourism and biodiversity-linked value addition, underscore the need for a holistic, multi-dimensional approach to organic agriculture.

The analysis highlights that technical capacity and certification infrastructure alone are insufficient to sustain an economically viable organic sector. A future-oriented strategy must prioritise market-driven mechanisms that ensure reliable price premiums and secure offtake agreements, alongside targeted incentives and regulatory frameworks to reduce dependence on chemical inputs gradually. Building a comprehensive national database on organic production and markets will enhance evidence-based governance, improve monitoring, and attract private-sector investment. Strategic diversification into high-value, climate-resilient crops and premium Non-Wood Forest Products can strengthen income resilience and tap niche domestic and international markets, while integrating organic initiatives with tourism and conservation agendas can create synergistic value chains.

This study is subject to several limitations that should be acknowledged. First, the analysis relies predominantly on secondary data from government reports and international sources;

sinconsistencies, data gaps, and the absence of a comprehensive national organic database limit the precision of economic and value-chain assessments. Second, the lack of primary squalitative data from farmers, traders, and policymakers' limits insight into the behavioural, socio-cultural, and institutional dynamics that shape organic adoption and market participation.

Despite these limitations, this study provides a comprehensive synthesis of Bhutan's trajectory in organic agriculture and identifies critical leverage points for future interventions. At this critical juncture, consolidating past achievements, coupled with targeted policy interventions and systemic market development, can transform the country's organic agriculture from a policy-driven initiative into a self-sustaining, economically viable, and ecologically resilient sector. By addressing structural, economic, and cross-sectoral challenges in a coordinated manner, Bhutan can realise its vision of a fully integrated organic agricultural system, thereby serving as a model for sustainable rural development globally.

5 Acknowledgement

The authors sincerely thank the Ministry of Agriculture and Livestock (MoAL), National Centre for Organic Agriculture-Yusipang, National Plant Protection Centre, and CARLEP for providing access to data and reports, and the Bhutan Food and Drug Authority (BFDA) for their cooperation.

6 Authors' contribution statement

Mrs. Kesang Tshomo provided overall guidance and led the conceptualisation of this research. Mr. Tshetrim La led the development of the conceptual framework and contributed to the research design and writing of the article.

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