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Mushroom Cultivation as a Sustainable Agribusiness: Potential, Profitability and Challenges in Pathanamthitta, Kerala, India

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A B S T R A C T

Mushroom cultivation is increasingly recognized as a sustainable agribusiness due to its low space requirement, quick production cycle, and ability to utilize agricultural residues to produce nutritious food and value-added products. In Kerala, the predominance of small holdings and the availability of biomass such as paddy straw, rubber sawdust, and banana wastes make mushroom production an economically and environmentally suitable enterprise, while the humid tropical climate and participation of women self-help groups favour decentralized cultivation in Pathanamthitta district. This review evaluates the potential, profitability, sustainability benefits, and constraints of mushroom cultivation based on published literature, extension reports, and institutional information. Oyster mushroom (Pleurotus spp.) is the most widely adopted species because of its adaptability and low input needs, and growing consumer awareness, local demand, and institutional support have encouraged the expansion of small-scale units and value-added products that enhance income. Nevertheless, progress is limited by inadequate availability of quality spawn, short shelf life, lack of cold storage and organized marketing, price variability, and gaps in technical skills. Overall, mushroom farming shows strong promise as a livelihood option in the district through agro-waste recycling, circular bio-economy practices, and rural employment generation, and improved extension services, local spawn production, post-harvest infrastructure, and collective marketing could further increase its profitability and sustainability.

Introduction

Mushroom cultivation has emerged as one of the most promising avenues of sustainable agribusiness, especially in regions with limited landholding and high unemployment. (Chang & Miles, 2004; Ahlawat & Tewari, 2007) observed mushrooms are rich in protein, vitamins, and minerals, making them a valuable functional food with growing global demand. Unlike conventional crops, mushrooms can be produced on agricultural residues such as paddy straw, sawdust, and other organic wastes, thereby recycling farm by-products and reducing environmental load (Bhatt *et al.,* 2017). Oyster mushroom (Pleurotus spp.) is widely cultivated,

ranking second globally after Agaricus bisporus (Sanchez, 2010). Produced on lignocellulosic wastes, mushrooms are protein- and fiber-rich, serving as healthy meat substitutes (Thakur, 2020).

In India, mushroom production has expanded significantly over the last two decades, driven by increasing consumer awareness and changing dietary preferences (Singh *et al.,* 2011). Kerala, with its humid tropical climate and abundance of biomass, offers favorable conditions for mushroom cultivation. In Kerala, the 'Mushroom Village' program under the Horticulture Mission supports 100 clusters with subsidies for spawn, cultivation, and marketing, encouraging rural entrepreneurship and smallholder income.

Beyond its nutritional and economic potential, mushroom farming also supports environmental sustainability. By converting agro-waste into nutritious food and organic manure, it contributes to circular bio-economy models and aligns with the principles of sustainable agriculture (Royse *et al.,* 2017). However, challenges such as lack of technical know-how, market linkages, and post-harvest management continue to limit the profitability and scalability of this sector in Kerala (Singh & Vijay, 2018).

In this context, mushroom farming is particularly well suited to Pathanamthitta's socioeconomic conditions due to its minimal land requirement, ability to recycle agricultural residues, and strong market demand (ICAR-DMR, 2021). This district in particular, presents unique opportunities, as small and marginal farmers seek low-investment, high-value enterprises that supplement income while promoting rural entrepreneurship (Nair & Mathew, 2020).

On 2025 Pathanamthitta's cropping pattern is dominated by plantation crops like rubber, coconut, pepper, and tapioca, while paddy, though less widespread, remains culturally and nutritionally significant. The district contributes about 1.6% of Kerala's paddy area and 2% of production, mainly in Kuttanad. Recent initiatives, such as upland rice cultivation in Perunad with institutional support, have expanded its reach, though challenges like waterlogging and delayed sowing persist.

In Kozhencherry, farmers preserve cultural identity by cultivating multiple traditional rice varieties on large-scale fields. Therefore, understanding the potential, profitability, and constraints of mushroom cultivation in the district is vital for developing strategies that can strengthen its role as a sustainable agribusiness and livelihood option.

Status of mushroom cultivation in Pathanamthitta (Kerala)

Mushroom cultivation in Kerala has shown steady and decentralized growth over the past decade, particularly through women-led collectives, youth entrepreneurs, and small-scale rural units. Oyster mushrooms (Pleurotus spp.) remain the most widely cultivated due to their climate adaptability, simple technology, and year-round production potential. Elsamma & Geetha (2010) noted that Kerala's average farm size is small, making low-space enterprises like mushroom farming particularly suitable. Recent findings by Anna Jerry *et al.,* (2025) indicate a sharp rise in mini mushroom units across Kerala, driven by better access to spawn, training programs, and the success through Kudumbashree micro-enterprises.

Pathanamthitta: District-Level Status

Characterized by humid tropical climate, high literacy, and a predominantly rubber-based agrarian economy—has emerged as a promising district for expansion. According to Jose (2020), districts with high agro-waste availability (rubber wood sawdust, banana pseudostem, coconut residues) and good women workforce participation tend to show better adoption of mushroom units, which aligns strongly with area profile.

District agricultural reports and MSME updates (2022–2024) indicate

- Growing number of household-scale mushroom units, especially in Ranni, Konni, and Kozhencherry blocks.
- Youth and women SHGs (especially Kudumbashree) taking up oyster mushroom cultivation as a side income activity.
- Strong local demand in towns like Ranni, Pathanamthitta, Thiruvalla, and Adoor, reducing marketing risks.
- Pandalam KVK offers periodic training on oyster and milky mushroom production.

Factors and barriers

1. Institutional Support

- Pandalam KVK and ATMA regularly conduct mushroom training.

- Kudumbashree Mission supports cluster-based units for women.

2. Market Availability
- High demand due to health awareness and vegetarian households.
- Scope for tie-ups with hotels, bakeries, home-chefs.

3. Potential for Expansion
- District's agro-climatic conditions favor round-the-year Pleurotus cultivation.
- Rubber sawdust and banana waste provide cheap substrate.

4. Constraints
- Lack of spawn labs within district.
- Poor post-harvest shelf-life.
- Inconsistent pricing in local markets.

Sustainability aspects of mushroom cultivation

a. Low Land Requirement: Mushroom cultivation requires minimal space because production can be carried out in existing rooms, unused sheds, or compact vertical units. This characteristic makes it especially suitable for land-scarce regions like Kerala, where average farm size is below 0.2 ha. Pandey & Senthil Kumaran (2025) emphasize that mushrooms allow farmers to generate meaningful income without expanding farmland, making the enterprise ideal for semi-urban households, women-led microunits, and tightly populated districts such as Pathanamthitta.

b. Utilisation of Agro-Waste: Mushroom cultivation is strongly aligned with sustainable waste management. Species such as Pleurotus spp. efficiently grow on abundant local residues—paddy straw, rubber wood sawdust, banana pseudostem, coconut husk fiber, and leaf litter. Chand & Singh (2022) highlight that mushrooms bioconvert lignocellulosic waste into high-protein food, reducing environmental load while providing farmers with an additional income stream. In districts like Pathanamthitta, where rubber and banana residues are abundant, this offers a significant ecological advantage.

c. Low Water & Energy Footprint: Because mushrooms require humid but not water-intensive conditions, their water footprint is far lower than that of conventional vegetables. Bijla & Sharma (2025) note that controlled-environment mushroom cultivation uses 80–90% less water than leafy vegetables and requires no soil preparation, tillage, or irrigation infrastructure. The energy requirement is also minimal, especially for oyster mushroom production, which thrives in Kerala's naturally humid climate without artificial cooling systems.

d. Contribution to Circular Economy: Post-harvest, the spent mushroom substrate (SMS) remains rich in organic matter, partially decomposed cellulose, and beneficial microbes. Pandey & Senthil Kumaran (2025) report that SMS improves soil structure, increases microbial activity, and serves as a raw material for vermicomposting. In circular bio-economy models, SMS can be used for:

- Organic manure production
- Soil amendment in home gardens
- Cattle feed (after proper processing)
- Substrate for earthworm cultivation

Thus, mushrooms not only utilize waste but also *generate* valuable by-products, creating a closed-loop agricultural system—an approach highly relevant to Kerala's sustainability goals.

Market potential of mushroom cultivation in Pathanamthitta.

a. Rising Consumption: Demand for mushrooms in Kerala has increased due to urbanization, health consciousness, and growing preference for protein-rich vegetarian diets. Chand & Singh (2022) observed that oyster and milky mushrooms are becoming more popular among health-conscious consumers. Consumption is driven both by household demand and institutional buyers like hotels, bakeries, and catering services.

b. Value Addition Opportunities: Processing mushrooms into products such as pickles, powders, chips, and ready-to-cook mixes enhances shelf life, creates new market segments, and increases profitability. Anna Jerry *et al.,* (2025) report that value-added products can fetch 20–50% higher returns compared to fresh mushrooms, especially when sold through local SHG collectives, farmers' markets, and online platforms.

c. Demand–Supply Gap: Bijla & Sharma (2025) highlight that India faces a structural mushroom supply deficit, and Kerala imports a significant share from Tamil Nadu.

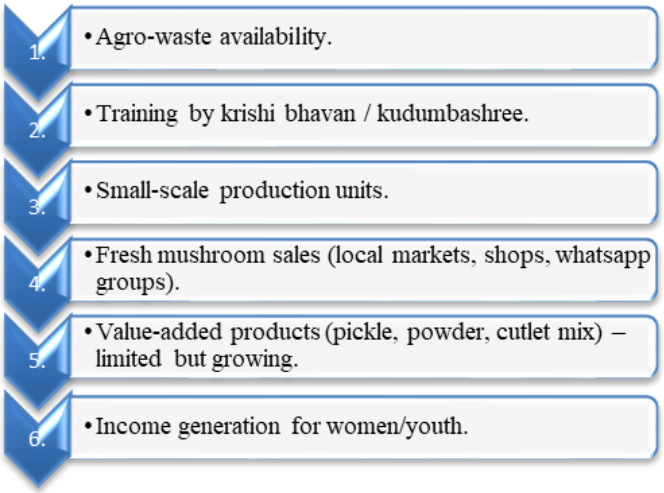
Table.1 Status of mushroom cultivation in district

Indicator	Current Status	Source/Notes
Dominant species	Oyster mushroom (Pleurotus spp.)	Supported by climate suitability (Anna Jerry *et al.,* 2025)
Secondary species	Milky mushroom (Calocybe indica)	Increasing among youth units
Common growers	Women SHGs, small farmers, unemployed youth	Kudumbashree reports (2022–2024)
Raw material availability	Rubber sawdust, banana stem, coconut waste, paddy straw	Abundant across Konni, Ranni
Market demand	High in local markets, bakeries, home consumers	District Agri Office, 2024
Challenges	Spawn shortage, marketing gaps, post-harvest perishability.	Jose (2020)

Table.2 Market Potential Indicators for Mushroom Cultivation in Pathanamthitta

Indicator	Current Status	Reference
Urban and rural demand	Increasing among households and hotels	Chand & Singh, 2022
Popular species	Oyster (Pleurotus spp.), Milky (Calocybe indica)	Chand & Singh, 2022
Value-added products	Pickles, powders, chips, ready-to-cook mixes	Anna Jerry *et al.,* 2025
Price advantage of value-added	20–50% higher margins vs fresh mushrooms	Anna Jerry *et al.,* 2025
Supply gap	Kerala imports from Tamil Nadu (~30–40%)	Bijla & Sharma, 2025
Local substrate availability	Paddy straw, rubber sawdust, banana waste	District Reports, 2024
Potential market for expansion	High for both fresh and processed mushrooms	Bijla & Sharma, 2025

Flowchart.1 Present Status of Mushroom Value Chain in Pathanamthitta.



Pathanamthitta, with its humid climate and available agro-waste (paddy straw, rubber sawdust, banana waste), has strong potential to meet part of this demand.

Profitability & economic feasibility

a. Cost of Production: According to Elsamma & Geetha (2010), oyster mushroom production costs generally remain low because substrates are locally available and infrastructure needs are minimal.

b. Return on Investment (ROI): Economic studies by Anna Jerry *et al.,* (2025) show that even small units earn consistent monthly profit, and value-added products can double income.

c. Employment Generation: Mushroom entrepreneurship enhances rural employment, particularly among women and youth, as noted by Jose (2020) and Chand & Singh (2022).

Challenges in Pathanamthitta

a. Climatic Limitations: Pathanamthitta's high humidity increases contamination and pest risks (supported by Elsamma & Geetha, 2010).

b. Lack of Quality Spawn Supply: Local availability of certified spawn remains limited, and growers depend on distant centres, as noted by Anna Jerry *et al.,* (2025).

c. Pest & Disease Issues: Green mould and mites are common issues in humid environments (Pandey & Senthil Kumaran, 2025).

d. Market Instability: Lack of cold storage and post-harvest infrastructure causes short shelf-life and fluctuating prices (Bijla & Sharma, 2025).

e. Skill Gaps: Training levels are inadequate, especially for sterilisation and quality control (Jose, 2020).

f. Limited Policy Support: Subsidies exist but accessibility and awareness remain weak (Chand & Singh, 2022).

Opportunities for expansion

a. Integration with Other Farming Systems: Integrated farming with poultry, vermicompost, and jackfruit waste reuse is supported in sustainability studies by Pandey & Senthil Kumaran (2025).

b. Establishment of Spawn Production Units: Higher profitability for spawn units is emphasised in Bijla & Sharma (2025).

c. FPO/SHG-based Collectives: Women SHG-based models have demonstrated success in Kerala (Jose, 2020).

d. Tourism Linkages: Farm visits and workshops add income potential, as observed in rural empowerment studies by Sahu (n.d.).

Technology intervention

Technological innovations such as solar dryers, automated humidity control, and ready-to-fruit bags enhance production efficiency (Anna Jerry *et al.,* 2025).

Policy recommendations

Improving extension support, providing subsidies for spawn labs, and establishing cold storage units align with recommendations from Chand & Singh (2022) and Pandey & Senthil Kumaran (2025).

Future research directions

Areas like substrate optimization, value-chain mapping, and climate-resilient mushroom strains have been highlighted by Bijla & Sharma (2025) and Elsamma & Geetha (2010) as key future research needs.

In conclusion, Mushroom cultivation offers a low-investment and sustainable livelihood option for small and marginal farmers in Pathanamthitta district by utilizing locally available agro-wastes and generating supplementary income and employment.

Despite good demand and institutional support, constraints such as limited quality spawn, short shelf life, weak marketing, and inadequate technical knowledge restrict wider adoption.

Strengthening training, local spawn production, post-harvest facilities, and collective marketing can improve profitability and long-term sustainability of the enterprise.

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Author Contributions

Athul Prasad: Investigation, formal analysis, writing—original draft.

Data Availability

The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

Declarations

Ethical Approval Not applicable.

Consent to Participate Not applicable.

Consent to Publish Not applicable.

Conflict of Interest The authors declare no competing interests.

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