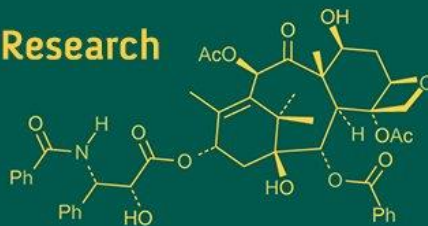


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Oyster mushroom production in Kerala: An economic analysis

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Abstract

The study was undertaken to evaluate the economic viability of oyster mushroom (*Pleurotus* spp.) production in Kerala, with a focus on cost and returns, factors affecting yield, and major production and marketing constraints faced by farmers. Primary data was collected from 120 oyster mushroom growers selected from six districts representing the northern, central, and southern zones of Kerala. Mushroom farmers were categorised into small, medium and large based on their scale of operation. Costs and returns revealed that total costs and yields increased with farm size, while the cost of production per bed decreased, indicating the existence of economies of scale. The benefit-cost ratio was found to be 1.08, 1.55, and 2.46 for small, medium, and large farmers, respectively, highlighting higher profitability among large-scale producers. Number of beds and type of shed were identified as major determinants of yield, emphasising the role of production scale and infrastructure in improving output. Thus, oyster mushroom production can be viewed as a profitable and sustainable agribusiness opportunity in Kerala when adequate technological, financial, and marketing support mechanisms are provided.

Keywords: Oyster mushroom, cost-benefit analysis, mushroom bed, profitability, constraints

Introduction

Mushrooms are a valuable source of nutrients and has culinary versatility. The production and consumption of mushrooms are expanding across the globe due to the increased awareness of their nutritional value. Being rich in protein, crude fibre, vitamins, and minerals while low in fat, calories, and starch, mushrooms provide high-quality carbohydrates that support human health. They are often considered as excellent alternative to meat and possess a nutrient composition similar to many vegetables (Thakur, 2020) ^[17].

Major producers like China, USA, and several European countries contribute significantly to the world's mushroom production; however, India's output remains comparatively modest at 0.18 million tonnes. The technological advancements along with diversification efforts have led to exponential growth in mushroom production globally, often doubling or even tripling farmer's income within a single year (Thakur, 2020) ^[17]. India produces 258.81 metric tonnes of mushrooms, whereas the production in Kerala was 0.04 metric tons with a percentage share of 0.02 percent (APEDA, 2024) ^[2]. Intensive mushroom cultivation can serve as a promising source of alternative income for small family enterprises that lack sufficient land for crop cultivation or livestock rearing (Kumar *et al.* 1995) ^[8].

Among the various cultivated species, the oyster mushroom (*Pleurotus* spp.), a member of the family *Tricholomataceae*, ranks as the second most widely cultivated mushroom in the world after *Agaricus bisporus* (Sanchez, 2010) ^[14]. Oyster mushroom cultivation has expanded globally due to its valuable medicinal benefits and its ability to thrive across a broad temperature range using diverse agro-based residues. Its strong adaptability to different agro-climatic conditions and capacity to grow on various types of agricultural wastes have further contributed to its widespread adoption (Jandaik and Goyal, 1995) ^[6].

Mushrooms are recognised as a highly nutritious and naturally available food with growing popularity in Kerala. Among the various cultivated mushrooms, oyster mushrooms stand out for having the largest number of commercially grown species that can be produced throughout the year. The humid tropical climate of Kerala and the availability of abundant agricultural by-products make it highly suitable for mushroom production (Akhil *et al.* 2023)

[1]. However, empirical research on the economic viability of oyster mushroom production in the region remains limited. Hence, the present study was undertaken to assess the cost and returns associated with mushroom production, analyse the major factors influencing production, and identify the different production and marketing constraints involved. The findings are expected to provide valuable insights for entrepreneurs, exporters, and policymakers in promoting mushroom production as a viable agribusiness opportunity in Kerala.

Materials and Methods

The study was conducted in six districts of Kerala, which included Kozhikode and Wayanad from the Northern zone, Palakkad and Thrissur from the Central zone and Kottayam and Thiruvananthapuram districts from the Southern zone. The respondents were selected from the list of mushroom farmers registered under the State Horticulture Mission (SHM) in the selected districts. Twenty farmers were randomly selected from each district, making a total sample of 120. The study was based on primary data, collected from the sample respondents using semi-structured interview schedules. Based on the number of mushroom beds per cycle of cultivation, the respondents were classified into three categories: small (<300), medium (300-1000), and large (≥ 1000) farmers, which included 71, 34 and 15 farmers, respectively, under each category.

Cost of production was estimated by working out both establishment and maintenance costs, while profitability was assessed through a cost-benefit analysis. The economic feasibility of mushroom production was analysed using the indicators such as Net Present Value (NPV), Internal Rate of Return (IRR) and Benefit-Cost (B-C) ratio.

The determinants of mushroom production were analysed using multiple regression analysis, and the model used is as follows:

$$Y_i = \beta_0 + \beta_1 X_{1i} + \beta_2 X_{2i} + \beta_3 X_{3i} + \beta_4 D_{1i} + \beta_5 D_{2i} + \varepsilon_i$$

where,

Y_i = Yield of mushrooms (kg) per year

X_1 = Total number of mushroom beds

X_2 = Total labour employed in man-days

X_3 = Farmer's experience in mushroom cultivation (years)

D_1 = Dummy variable: 1 = high-tech shed, 0 = conventional shed

D_2 = Dummy variable: 1 = paddy straw, 0 = pellet

β_0 = Intercept

$\beta_1, \beta_2, \beta_3, \beta_4, \beta_5$ = Regression coefficients

ε_i = Error term

Production and marketing constraints were identified and ranked using the Garrett ranking technique (Garrett and Woodworth, 1969) [5], and the formula used is given below:

$$\text{Percent position} = 100(R_{ij} - 0.5)/N_j$$

Where,

R_{ij} = Rank provided for the i^{th} variable by the j^{th} respondent;

N_j = the number of variables ranked by the j^{th} respondent.

Results and Discussions

Cost-Benefit analysis

The establishment and maintenance costs incurred by small, medium, and large farmers for mushroom production are

summarised in Table 1. The total fixed costs were estimated at Rs. 10,599.37, Rs. 37,635.29, and Rs. 1,11,222.48, representing 5.19 percent, 10.74 percent, and 12.67 percent of the total costs for small, medium, and large farmers, respectively. Depreciation on buildings was calculated at Rs. 3,378.17 for small, Rs. 10,122.35 for medium, and Rs. 64,582.50 for large farmers. The proportional increase in depreciation across farm sizes was a result of differences in infrastructure facilities (Singh and Suresh, 2007) [16]. While small farmers typically depended on conventional sheds with lower investment, large farmers adopted high-tech sheds that required higher capital expenditure.

Among the variable cost components, labour constituted the highest proportion, accounting for 67.82 percent, 54.32 percent, and 25.95 percent of the total cost for small, medium, and large farmers, respectively. This indicated the greater reliance of small-scale farmers on manual labour, whereas larger farms tend to adopt more mechanised and efficient production systems, thereby reducing their labour cost share. The cost of substrate ranked next, contributing 7.82 percent, 9.63 percent, and 24.45 percent for small, medium, and large farmers, respectively. Pellets were identified as the major substrate used among the sample respondents. Expenditure on spawn also emerged as a significant component of variable costs, accounting for 4.84 percent, 9.74 percent, and 19.93 percent of the total cost across the respective farm sizes (Singh and Singh, 2018) [15].

The total variable costs were estimated at Rs. 1.93 lakhs for small-scale farmers, Rs. 3.13 lakhs for medium-scale farmers, and Rs. 7.67 lakhs for large-scale farmers. Their share of the total cost was 94.81 percent, 89.26 percent, and 87.33 percent, respectively. This indicates that mushroom cultivation is largely dependent on variable inputs, including spawn, substrate, and labour. The total costs of production were calculated to be Rs. 2.04 lakhs, Rs. 3.5 lakhs, and Rs. 8.78 lakhs for small, medium, and large farms, respectively. The higher variable costs, particularly in larger farms, were a result of their greater scale of operations, higher input requirements, and investment in substrates and quality spawn to enhance productivity and efficiency.

The average total yield was estimated at 517.18 kg for small, 1286.47 kg for medium, and 5184 kg for large farmers, from an average number of beds of 128.45, 442.65, and 2070, respectively. Net returns across the categories were found to be Rs. 15771.95 for small, Rs. 1.92 lakhs for medium and Rs. 12.82 lakhs for large farms. The cost of production per bed was calculated to be Rs. 460.41, Rs. 236.34, and Rs. 124.75 across the respective categories. This clear decrease in cost per bed highlights the presence of economies of scale in mushroom production. The benefit-cost ratio (BCR) was observed to be 1.08, 1.55, and 2.46 for small, medium, and large-scale mushroom farmers, respectively, as depicted in Table 2, indicating a progressive increase in profitability with the scale of operation, suggesting that larger farms were able to achieve better economic efficiency and benefit from economies of scale (Koundal and Kumar, 2024) [7].

The economic feasibility of mushroom production was analysed using the indicators such as Net Present Value (NPV), which was found to be Rs. 35.33 lakhs and Internal Rate of Return (IRR), which was found to be 38.44 percent, indicating that mushroom production is a financially viable enterprise. These findings suggest that mushroom production offers a favourable return on investment and can

serve as a sustainable and economically rewarding agribusiness venture (Dhungana, 2022; Bijla and Sharma, 2023; Maurya and John, 2025) ^[4, 3, 9].

Factors affecting oyster mushroom production

The multiple regression model explained a significant proportion of the variation in mushroom production. The explanatory variables included in the model were number of beds, labour, type of shed, substrate, and years of experience.

The results presented in Table 3. revealed that, for small ($R^2 = 0.712$) and medium ($R^2 = 0.767$) farmers, the model explained 71.2 percent and 76.7 percent of the variation in yield, respectively. Among the explanatory variables, number of beds and type of shed were found to significantly influence the yield, indicating that expansion of production units and adoption of improved shed structures contributed to increased output. For large farmers ($R^2 = 0.987$), the model accounted for 98.7 percent of the variation in yield, indicating a very strong relationship between the explanatory variables and output levels. The number of beds was the only significant factor influencing yield, since all the large-scale farmers were using high-tech sheds, confirming that, once the infrastructure is standardised, the scale of operation played a crucial role in determining output levels.

These results highlight the fact that expanding the scale of operation and investing in better infrastructure could significantly enhance productivity and efficiency in mushroom cultivation.

Constraints in mushroom production

An analysis of production and marketing constraints in mushroom production was carried out using the Garrett Ranking technique to assess their relative importance as perceived by the farmers. The results revealed considerable variation in the ranking of constraints across different farm size categories, which reflected the various challenges encountered in the production and marketing of mushrooms. Major constraints in mushroom production were identified and ranked using the Garrett ranking technique and presented in Table 4.

It is evident from the table that climatic variations with a Garrett score of 62.25 was ranked first among the production constraints, indicating that it was perceived as the major constraint by the small-scale mushroom farmers. This highlights the high vulnerability of mushroom production to changes in temperature and humidity, which will adversely affect the overall yield, since the small-scale mushroom farmers operate with conventional sheds with limited environmental control (Singh *et al.* 2008) ^[10]. The bed disposal with a score of 36.77 was ranked last, indicating that small-scale farmers do not perceive waste management as a major constraint, as they used the disposed bed as compost for homestead plants.

For medium and large-scale farmers, high initial investment was ranked first with a Garrett score of 68.68 and 74.20, respectively. The majority of medium and large-scale farmers rely on high-tech sheds, which demand considerable investment in infrastructure and equipment to ensure controlled environmental conditions (Pipaliya and Ansari, 2023) ^[12]. The least ranked was the non-availability of quality spawn, with a Garrett score of 36.38 and 38.93,

respectively, suggesting that access to quality spawn was less problematic for these categories of farmers, as reported by Olawale *et al.* (2024) ^[11].

Among the marketing constraints, low shelf life was identified as the major constraint for small-scale farmers, with a Garrett score of 56.76. This indicates the high perishability of mushrooms, which limits their storage and marketing time, thereby affecting sales and profitability at the small-scale level. In contrast to that, lack of awareness and high transportation costs were identified as the major constraints for medium and large farmers, respectively. The limited consumer awareness regarding mushrooms and mushroom products challenged the market expansion for medium-scale producers (Raman *et al.* 2018) ^[13], while the larger market reach and volume handled by large-scale farmers increased the transportation cost and created a significant barrier to efficient marketing.

Table 1: Cost of production of oyster mushroom per year

Particulars	Small	Medium	Large
Fixed cost (Rs.)			
Depreciation on buildings	3378.17	10122.35	64582.50
Depreciation on equipments	1990.53	4835.86	9025.29
Rental value of owned land	2285.07	15882.35	16280.00
Rope	152.82	505.88	1926.67
Sterilization units	1090.85	1544.12	5933.33
Trays	255.63	348.53	1040.00
Sprayer	235.92	260.61	266.67
Light	74.75	103.24	251.33
Interest on fixed cost @ 12percent per annum	1135.65	4032.35	11916.69
Total fixed cost	10599.37	37635.29	111222.48
Variable cost (Rs.)			
Substrate	15958.73	33750.00	214650.00
Polythene cover	1926.76	6639.71	31050.00
Family labour	85576.90	132779.71	125024.00
Hired labour	52800.00	57600.00	102857.14
Spawn	9870.42	34147.06	174950.00
Sterilization chemicals	580.76	964.80	884.16
Cooking gas	1550.00	2400.00	3900.00
Electricity charge	1610.70	10023.53	35400.00
Transportation cost	2768.31	2469.12	3860.00
Maintenance cost	3204.23	3617.65	4500.00
Interest on variable cost @ 10percent per annum	17584.68	28439.16	69707.53
Total variable cost	193431.50	312830.72	766782.83
Total cost	204030.87	350466.01	878005.31
Cost of production per cycle (Rs/cycle)	59139.38	104616.72	258236.86
Average number of beds per cycle	128.45	442.65	2070.00
Cost of production per bed (Rs/bed)	460.41	236.34	124.75

Table 2: Benefit-cost analysis per year

Particulars	Small	Medium	Large
Average total yield (kg)	517.18	1286.47	5184.00
Gross returns (Rs. in lakhs)	2.19	5.42	21.60
Total cost (Rs. in lakhs)	2.04	3.50	8.78
Net returns (Rs.in lakhs)	0.15	1.92	12.82
B:C ratio	1.08	1.55	2.46

Table 3: Estimated regression coefficients for factors affecting mushroom yield

Particulars	Coefficients	Standard error	t-stat	p-value
Small				
Intercept	245.280	33.630	7.293	5.25E-10
Number of beds	1.672**	0.181	9.213	2.09E-13
Labour	0.261	0.217	1.200	0.235
Type of shed	250.337**	72.657	3.445	0.001
Substrate	-6.275	24.893	-0.252	0.802
Years of experience	4.415	5.963	0.740	0.462
R ²	0.712			
Medium				
Intercept	230.918	163.077	1.416	0.168
Number of beds	2.117**	0.339	6.251	9.33E-07
Labour	0.072	0.481	0.151	0.881
Type of shed	343.039**	110.070	3.117	0.004
Substrate	32.598	77.194	0.422	0.676
Years of experience	3.481	19.023	0.183	0.856
R ²	0.767			
Large				
Intercept	-1012.460	970.145	-1.044	0.321
Number of beds	2.601**	0.196	13.259	1.14E-07
Labour	0.753	3.813	0.198	0.847
Substrate	903.086	69.872	0.168	0.870
Years of experience	11.756	461.802	1.956	0.079
R ²	0.987			

Note: ** indicates significance at 1 percent

Table 4: Constraints in mushroom production

Production constraints	Small		Medium		Large	
	Garrett score	Rank	Garrett score	Rank	Garrett score	Rank
High initial investment	61.38	3	68.68	1	74.20	1
Non-availability of quality spawn	40.23	4	36.38	6	38.93	6
Lack of technical guidance or training	37.23	5	40.03	4	41.00	4
Pest and disease incidence	62.14	2	59.85	2	60.67	2
Climatic variations	62.25	1	56.29	3	40.80	5
Bed disposal	36.77	6	38.76	5	44.40	3
Marketing constraints						
High transportation cost	36.76	4	48.59	3	61.53	1
Low shelf life	56.76	1	52.91	2	45.87	3
Lack of collection centres	50.01	3	42.24	4	48.47	2
Lack of awareness	56.46	2	56.26	1	44.13	4

Conclusion

The study revealed that the costs and returns of mushroom production varied considerably with farm size. As the scale of operation increased, the total cost and yield also increased, while the cost of production per bed declined, indicating the presence of economies of scale. Large-scale farmers achieved the highest profitability mainly due to the adoption of high-tech sheds and better resource utilisation. The number of beds and the type of shed had a significant influence on yield, highlighting the importance of expanding production capacity and improving infrastructure. The positive Net Present Value and Internal Rate of Return further confirmed the financial feasibility of mushroom production. Despite its profitability, the enterprise faces certain constraints, such as climatic variations for small farmers, high initial investment for medium and large farmers, and marketing constraints like short shelf life, low consumer awareness, and high transportation costs. Strengthening infrastructure support, promoting technology adoption, and developing efficient marketing systems would enhance the overall sustainability and profitability of mushroom production across all categories of farmers in the study area.

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