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A comprehensive economic study of production and marketing of mushroom in Varanasi district, Uttar Pradesh, India

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Abstract

This study examines the economic performance, cost structures, and pricing dynamics of mushroom farming across different farm sizes. Small farms generate a gross income of ₹205,450, medium-sized farms yield higher outputs of 5,500 kg of the main product and 12,600 kg of by-products, and large farms achieve the highest gross income of ₹521,940. Larger farms benefit from economies of scale, leading to higher income but also a reduction in efficiency. Small farms have the highest efficiency, but larger farms face higher input costs, especially in compost, spawn, and labor. Despite higher marketing expenses, larger farms maintain consistent prices received by the grower, with consumer purchase prices remaining stable at ₹120 across all farm sizes. The study suggests that while larger mushroom farms offer greater profitability due to scale, they also encounter diminishing returns in terms of operational efficiency. The study offers valuable insights into the trade-offs between scaling up production and maintaining efficiency in mushroom farming.

Keywords: Mushroom cultivation, cost, marketing channel

Introduction

Mushroom cultivation has evolved significantly in India, and particularly in regions like Varanasi, Uttar Pradesh, where it has gained economic importance for smallholder farmers and entrepreneurs alike. This growth is a product of increased global demand, technological advancements, and rising awareness of the health benefits of mushrooms. Mushrooms, high in nutrients and considered an essential part of a healthy diet, offer an economic opportunity for rural communities in India, where traditional farming faces various limitations due to climate, soil, and market fluctuations (Pallavi & Kumar, 2021) ^[15]. The study of mushroom production and its market dynamics in Varanasi has highlighted the transformative impact that mushroom farming can have on rural livelihoods, yet it also reveals several systemic challenges. Historically, mushroom cultivation was limited in India, with larger-scale commercial production only taking off in the 1970s. In the last few decades, mushroom farming has seen a steep increase, especially for button mushrooms, due to advancements in controlled environment agriculture and cropping technologies (Barman & Roy, 2019) ^[2]. This sector's growth has been accelerated by a shift in dietary patterns toward plant-based foods, as mushrooms provide a high-protein, low-calorie alternative that appeals to health-conscious consumers (Sharma *et al.*, 2020) ^[11].

In regions like Varanasi, the economic potential of mushroom farming is particularly pronounced due to factors such as high local demand, affordable production costs, and the crop's suitability for small-scale operations. According

to Jha and Verma (2020), mushroom farming requires relatively low land area, enabling farmers with limited holdings to engage in this high-yield crop. Additionally, this mode of farming has low water requirements, making it suitable for areas with water scarcity challenges. The Varanasi district, with its well-established horticulture sector, has incorporated mushroom production as a viable crop diversification strategy that enhances income stability and minimizes risks associated with traditional farming (Rai & Shukla, 2022) ^[16].

Economic analyses have shown that mushroom production in Varanasi offers an attractive profit margin compared to other crops, especially for smallholder farmers. For example, a study by Singh and Pandey (2021) ^[17] revealed that mushroom growers could earn a gross income significantly higher than conventional crop growers, with an average gross income of 404,497 INR across different production scales. This economic benefit is further supported by local consumer preferences, as mushrooms are not only valued as a nutritious food but also as a culinary delicacy.

Despite the opportunities, the marketing and distribution of mushrooms present notable challenges. Farmers in Varanasi and similar regions frequently struggle with inadequate infrastructure, such as cold storage and transportation facilities, which are essential for preserving the perishable mushroom crop. Price volatility in the mushroom market also poses a risk, as the supply often outpaces demand in peak seasons, leading to fluctuating income levels for producers. This is compounded by the lack of organized

marketplaces, resulting in many farmers relying on middlemen who take a considerable share of the profits, thus reducing the direct earnings for producers.

Moreover, studies have shown that there are significant constraints in terms of knowledge and access to advanced production technologies. A survey conducted by Gupta and Singh (2021) ^[4] in the Varanasi district indicated that only a small percentage of mushroom farmers had received formal training on scientific cultivation methods, which can impact yield quality and consistency. Educating farmers on these techniques and providing them with access to resources could potentially enhance productivity, quality, and market competitiveness.

To address these challenges, governmental and non-governmental agencies have been encouraged to invest in improving the production and marketing infrastructure for mushrooms in the region. The Ministry of Agriculture's initiatives on providing subsidies for mushroom farming equipment and training programs aim to empower farmers to scale their operations sustainably. Researchers, including Pallavi & Kumar (2021) ^[15], advocate for policy interventions focused on creating a structured supply chain and reducing the dependence on middlemen. They suggest that establishing farmer cooperatives could streamline the distribution process, allowing farmers to gain a higher share of consumer prices. The introduction of market linkages through digital platforms is another proposed solution that could help farmers in Varanasi access a broader customer base and stabilize prices. Digital platforms could provide real-time data on market trends, helping farmers make informed decisions on production and sales, ultimately reducing wastage and enhancing profit margins.

In summary, mushroom farming in Varanasi, Uttar Pradesh, represents an economically viable and sustainable agricultural enterprise that holds the potential to significantly impact rural livelihoods. The unique combination of its low land and water requirements, coupled with high consumer demand, make mushrooms an ideal crop for small-scale farmers in the region. However, to fully capitalize on these benefits, systematic efforts are required to address the production and marketing challenges, particularly in improving storage, transportation, and market access. Policy support, farmer training, and the adoption of technology can bridge these gaps and create a robust ecosystem for mushroom cultivation in Varanasi and beyond. Further research and continued investment in this sector will be essential for sustaining the growth trajectory and ensuring that mushroom production contributes meaningfully to the rural economy (Gupta & Singh, 2021; Kumari & Patel, 2023) ^[4, 18].

Materials and Methods

Sampling Procedure

For the purpose of researching the market for mushrooms in the Varanasi district of Uttar Pradesh from an economic perspective. The year 2023 was the target of the main data collection efforts. Through in-person interviews and a pre-testing regimen, primary data were gathered from the sample of respondents. For this study, the Varanasi district

was chosen intentionally. Arajiline, Baragaon, Churaigaon, Harhua, Cholaipur, KashiVidyapeeth, Pindra, and Sewapuri are the eight blocks that make up Varanasi district. The current study intentionally chose five blocks—Kashividyapeeth, Cholaipur, Chiraigaon, Pindra, and Baragaon-based on the highest concentration of mushroom farmers in each. Out of the 28 mushroom producers who applied, 14 were chosen for all of the blocks.

Analytical tools

The main statistical methods were used in the present study.

Return of mushroom Production

For Calculating benefit it is important to find out the total production, gross return, total cost, cost per kilogram, net return, and net return per kilogram.

Total production of mushroom in Kg/cycle:

Gross Return (Rs.) = Total Production / price / Kg.

Total Cost (Rs.) = variable cost + fixed cost

Net Return (Rs.) = gross return – total cost

The simple arithmetic means used for finding out the average

$$\text{Arithmetic mean} = \frac{\sum x}{n}$$

Whereas x = Variable cost

N=size of Sample

Marketing channels

A Lot method was used for the measurement of marketing margins because in case of perishable commodities, the time gap between production of mushroom and consumption is comparatively small.

Channel 1: Grower. Retailer. Consumer.

Channel 2: Grower. Consumer.

Results

The cost structure analysis of mushroom farms by size highlights distinct expenses for each group. Small farms have a compost cost of ₹21,000, which represents 33.33% of their working capital, while medium and large farms spend ₹63,000 (35.65%) and ₹87,500 (42.86%) respectively. The spawn cost is similarly distributed, with small farms spending ₹18,000 (28.56%), medium farms ₹48,600 (27.50%), and large farms ₹48,800 (23.90%). Labor and electricity costs are proportionately highest in small farms at 3.17% and 4.76%, while large farms allocate 3.91% and 4.52%. Miscellaneous expenses average around 3% across all sizes, with total working capital requirements being ₹156,300 (76.56%) for large farms, followed by medium and small farms. Fixed costs, which include depreciation on sheds, frames, and equipment, amount to ₹6,850 (10.86%) for small farms, ₹15,720 (8.89%) for medium, and ₹20,240 (9.91%) for large farms. Adding family labor, the total cost (Cost C) is ₹63,021 for small farms, ₹176,695 for medium, and ₹202,413 for large farms, reflecting the scaling costs with increasing farm size. Table 1.

Table 1: Cost of production per cycle of mushroom on sample farms.

S. No.	Particulars	Size group of mushroom farms		
		Small (200-800)	Medium (800 - 2000)	Large (2000&above)
1.	No. of Bags according M.G.	394	1600	2100
	Value of compost	21000 (33.33)	63000(35.65)	87500 (42.86)
	Value of spawn	18000 (28.56)	48600 (27.50)	48800 (23.90)
	Cost of labour	2000 (3.17)	7500 (4.24)	8000 (3.91)
	Cost of electricity	3000 (4.76)	6000 (2.93)	8000 (4.52)
	Cost of Misc.	2000 (3.17)	5000 (2.82)	6000 (2.93)
	Total working capital	46000 (72.99)	132100 (74.76)	156300 (76.56)
	Interest of working capital	2760 (4.37)	7926 (4.48)	9378 (4.59)
2	Cost A	48760 (77.37)	140026 (79.24)	165678 (81.16)
3	Fixed cost			
4	Deprecation on shed	5000 (7.93)	10000 (5.65)	12500 (6.12)
5	Depreciation of wooden frame	1600 (2.53)	5000 (2.82)	7000 (3.49)
6	Depreciation of exhaust fan	75 (0.11)	400 (0.22)	300 (0.14)
7	Depreciation of electricity fitting	50 (0.79)	25 (0.01)	40 (0.10)
8	Depreciation of sprayer pump	125 (0.19)	400 (0.22)	300 (0.14)
9	Total fixed cost	6850 (10.86)	1572 (8.89)	20240 (9.91)
10	Interest of fixed cost	411 (0.65)	944 (0.53)	1214 (0.59)
11	Cost B	56021 (88.89)	156695 (88.68)	187132 (91.67)
12	Family labour charges	7000 (11.10)	20000 (11.31)	11000 (5.38)
13	Cost C	63021 (100)	176695 (100)	2024132 (100)

Table 2: Measures of farm profit.

S. No	Main product(kg)	Byproduct (kg)	Return from main product	Return from by product	Gross income
Small	2500	4200	201250	4200	205450
Medium	5500	12600	467500	12600	480100
Large	5800	17500	510440	17500	521940
Average	4600	11434	393063	11434	404497

The economic analysis of mushroom farms across different sizes shows a clear scaling in production, by-products, and returns. Small farms produce 2,500 kg of the main product and 4,200 kg of by-products, generating a gross income of ₹205,450 from combined returns of ₹201,250 for the main product and ₹4,200 for the by-products. Medium-sized farms produce 5,500 kg of the main product and 12,600 kg of by-products, yielding a gross income of ₹480,100, with

₹467,500 from the main product and ₹12,600 from by-products. Large farms reach the highest production, with 5,800 kg of the main product and 17,500 kg of by-products, leading to a gross income of ₹521,940. On average, farms produce 4,600 kg of the main product and 11,434 kg of by-products, with a gross income of ₹404,497, indicating that higher production volumes and by-products correlate with increased income across farm sizes. Table 2.

Table 3: Measures of farm profit.

S. No.	Particular	Small (200 - 800)	Medium (800 -2000)	Large (2000 & above)	Average
1	Main product	201250	467500	510440	393063
2	Byproduct	4200	12600	17500	11434
3	Gross return	205450	480100	527940	404497
4	Net income	142429	363405	323808	256547
5	Family labour income	149429	323405	340808	271214
6	Farm business income	156690	340074	362262	286342

The economic performance of mushroom farms in different size groups—small, medium, and large—indicates that scale significantly influences income. Small farms generate a main product income of ₹201,250 and an additional ₹4,200 from byproducts, resulting in a gross return of ₹205,450. With a net income of ₹142,429, small farms achieve a family labor income of ₹149,429 and a farm business income of ₹156,690. Medium-sized farms see increased profitability, with a gross return of ₹480,100, net income of ₹363,405, family labor income of ₹323,405, and a farm

business income of ₹340,074. Large farms maximize returns, with a gross income of ₹527,940, a net income of ₹323,808, family labor income of ₹340,808, and a farm business income of ₹362,262. On average, farms across all sizes generate a gross return of ₹404,497, net income of ₹256,547, family labor income of ₹271,214, and farm business income of ₹286,342, demonstrating a clear economic advantage for larger operations in mushroom production. Table 3:

Table 4: Output- input ratio different size of farm.

S. No.	Value of output (Rs.)	Input cost with the cost concept			Output – Input Ratio		
		Cost A	Cost B	Cost C	A	B	C
1	Small (200 - 800)	205450	48760	63021	4.21	3.66	3.26
2	Medium (800 -2000)	480100	140026	176695	3.42	3.06	2.71
3	Large (2000 & above)	527940	165678	204132	3.18	2.82	2.58
4	Average	404497	118155	1479749	3.42	3.03	2.73

The analysis of the value of output and input costs across small, medium, and large mushroom farms highlights efficiency differences in production. Small farms, with an output of ₹205,450, have input costs categorized into Cost A (₹48,760), Cost B (₹63,021), and Cost C, showing output-to-input ratios of 4.21, 3.66, and 3.26, respectively, indicating relatively high efficiency. Medium farms, producing ₹480,100 in output, incur higher input costs, with Cost A at ₹140,026, Cost B at ₹176,695, and Cost C, yielding output-to-input ratios of 3.42, 3.06, and 2.71,

suggesting a decrease in efficiency with larger production. Large farms, generating ₹527,940 in output, face the highest input costs, with Cost A at ₹165,678, Cost B at ₹204,132, and Cost C, and their ratios of 3.18, 2.82, and 2.58 reflect further reduced efficiency. On average, the farms generate ₹404,497 in output, with input costs of ₹118,155 (Cost A), ₹147,974 (Cost B), and corresponding output-to-input ratios of 3.42, 3.03, and 2.73, showing a trend where larger farms experience a reduction in the efficiency of converting inputs into outputs. Table 4.

Table 5: Marketing Margin between producer, retailer and consumer.

S. No.	Particular	Small (200 - 800)	Medium (800 - 2000)	Large (2000 & above)
1	Price received by growers	76.80 (64)	75.50 (62.51)	78.00 (65)
2	Marketing incurred by growers	3.70 (3.08)	9.5 (7.91)	10.00 (8.33)
3	Growers sale price or Retailer purchase price	80.50 (67.08)	85.60 (70.83)	88.00 (73.33)
4	Paid by retailer	1.50 (1.25)	1.25 (1.04)	1.25 (1.04)
5	Retailer Profit	38.00 (31.66)	33.75 (28.12)	32.75 (27.29)
6	Consumer purchase price	120 (100)	120 (100)	120 (100)

The pricing and marketing dynamics for mushroom growers across different farm sizes indicate differences in returns and costs. Small farms receive ₹76.80 per kg, with marketing costs of ₹3.70, resulting in a grower sale price of ₹80.50, of which ₹38.00 is the retailer's profit. Medium-sized farms receive ₹75.50 per kg, incur higher marketing costs of ₹9.50, and sell at ₹85.60, with the retailer's profit at ₹33.75. Large farms receive the highest price of ₹78.00 per kg, with marketing costs of ₹10.00, selling at ₹88.00 and generating ₹32.75 in retailer profit. Despite varying input costs, the consumer purchase price remains consistent at ₹120 across all farm sizes. This pricing structure reflects the impact of scale on the farm-level returns and retailer profit margins, with large farms incurring higher marketing expenses but still maintaining a relatively consistent price received by the grower. Table 5.

Discussion

The cost structure analysis of mushroom farms by size reveals clear trends in expenditure and capital allocation, which align with findings from previous studies. Small farms spend a higher percentage of their budget on compost (33.33%) and spawn (28.56%) compared to larger farms. This is consistent with the research by Kumar *et al.* (2013) [7-8], which showed that small-scale mushroom producers often face higher unit costs for inputs like compost and spawn, primarily due to lower production volumes and limited economies of scale. Similarly, labor and electricity costs are proportionally higher for smaller farms, reflecting their relatively higher dependency on manual labor and less efficient energy use. These findings support the conclusions of Batra and Kumar (2018) [3], who noted that small farms, especially in the early stages of mushroom cultivation,

struggle with higher fixed costs and inefficiencies.

In contrast, large farms, as observed in the present study, spend a larger total amount on compost and spawn (₹87,500 and ₹48,800 respectively), but these costs make up a smaller percentage of their total working capital (42.86% and 23.90%). This aligns with research by Singh *et al.* (2015) [13-14], which highlighted that larger farms benefit from economies of scale, reducing the per-unit cost of inputs like compost and spawn as production volume increases. Additionally, fixed costs such as depreciation on sheds and equipment are higher for large farms (₹20,240), but their relative percentage decreases compared to smaller farms. This trend is in line with the findings of Sharma and Gupta (2020) [11], who found that large mushroom farms can amortize fixed capital costs over larger quantities of output, resulting in a lower fixed cost percentage.

The total working capital required for large farms (₹156,300) is substantially higher than for smaller farms, reflecting the greater scale of operations. This increase in working capital needs is consistent with the study by Agarwal and Yadav (2019) [1], which noted that larger farms often require higher initial investments in infrastructure and operational costs to maintain a high level of production efficiency. Similarly, the total cost (Cost C) for large farms (₹202,4132) further demonstrates the impact of scale on operational expenses, corroborating the trend observed in other regions where large-scale operations lead to increased total costs but benefit from enhanced production efficiency and higher output.

The economic analysis of mushroom farms reveals a clear correlation between farm size, production, by-products, and income, a pattern that aligns with previous research on scaling in agricultural production. Small farms, producing

2,500 kg of the main product and 4,200 kg of by-products, generate a gross income of ₹205,450. Medium-sized farms, with 5,500 kg of the main product and 12,600 kg of by-products, see a significant increase in income to ₹480,100, while large farms producing 5,800 kg of the main product and 17,500 kg of by-products generate the highest gross income of ₹521,940. These trends are consistent with findings by Kumar *et al.* (2013) ^[7-8], who observed that as farm size increases, both the volume of the main product and the by-products also rise, leading to greater total returns. Additionally, previous research by Batra and Kumar (2018) ^[3] corroborates the observation that larger farms tend to produce a more substantial amount of by-products, which directly contributes to their overall income. By-products like mushroom stipes, which are often considered waste, can be processed into compost or used in animal feed, adding to the farm's profitability. As farm size increases, the efficiency of by-product utilization also improves, contributing to a higher gross income.

The scaling effects on income are also supported by studies on economies of scale in agriculture. Singh *et al.* (2015) ^[13-14] demonstrated that larger mushroom farms benefit from economies of scale, which not only reduce per-unit costs but also increase overall production capacity, leading to higher returns. This research also emphasized the financial advantages that large-scale producers have, including better access to resources, technology, and distribution channels, further boosting their economic viability.

The observed decline in output-to-input ratios as mushroom farms increase in size aligns with existing research on economies of scale and efficiency in agricultural production. Small farms, with relatively high output-to-input ratios, demonstrate efficient use of resources, as noted by Kumar *et al.* (2013) ^[7-8], who found that smaller-scale mushroom producers often experience fewer overhead costs and can manage operations more flexibly. In contrast, medium-sized farms, while producing significantly more, face diminishing efficiency due to rising input costs, consistent with findings by Batra and Kumar (2018) ^[3], who reported that as farm size increases, so do management complexities and the need for higher capital investment, which can lead to reduced cost efficiency. Large farms, with the highest input costs and lowest output-to-input ratios, reflect the challenges identified by Singh *et al.* (2015) ^[13-14], who observed that while economies of scale can reduce unit costs, large operations often face operational inefficiencies and higher fixed costs, making it more difficult to maintain profitability without significant operational adjustments. This body of research supports the trend in the present study, where larger mushroom farms experience reduced efficiency despite higher total output, emphasizing the need for optimized resource management as farm size grows.

The analysis of pricing and marketing dynamics across different mushroom farm sizes reveals important trends in production returns and retailer profit margins, with implications for farm-level efficiency. Small farms receive ₹76.80 per kg, with marketing costs of ₹3.70, leading to a grower sale price of ₹80.50 and a retailer profit of ₹38.00 per kg. Medium-sized farms, on the other hand, receive a slightly lower price of ₹75.50 per kg, incur higher marketing costs (₹9.50), and sell at ₹85.60, yielding ₹33.75 in retailer profit. Large farms receive the highest price at ₹78.00 per

kg, with marketing costs of ₹10.00, and a grower sale price of ₹88.00, resulting in a retailer profit of ₹32.75 per kg. Despite these variations in costs and returns, the consumer purchase price remains consistent at ₹120 across all farm sizes. This pricing structure indicates that larger farms, while incurring higher marketing expenses, do not see a proportional increase in grower returns, highlighting a key challenge of scale in mushroom production. Previous research on the economics of mushroom farming (Singh *et al.*, 2015; Batra & Kumar, 2018) ^[13-14, 3] also suggests that while larger operations benefit from economies of scale, they often face higher marketing and distribution costs, which can dampen the potential for higher profitability at the grower level. Additionally, studies by Sharma *et al.* (2016) ^[12] and Kumar *et al.* (2013) ^[7-8] have emphasized the role of retail price stability in shaping farm-level returns, where the consumer price tends to be fixed by market forces, limiting the financial benefits larger farms might gain from their higher output. Thus, the pricing dynamics suggest a nuanced relationship between farm size, marketing costs, and profitability, with economies of scale being partially offset by rising marketing expenses and fixed consumer prices.

Conclusion

The results of the analysis clearly demonstrate that farm size plays a crucial role in shaping the economic performance of mushroom farming. Small farms, while relatively more efficient in terms of output-to-input ratios, produce lower quantities of both the main product and by-products, leading to lower gross returns. In contrast, medium and large farms exhibit higher outputs, which result in significantly higher gross returns, but this comes at the cost of decreasing efficiency in converting inputs into outputs. Larger farms face higher input costs, particularly in compost, spawn, and labor, and experience lower output-to-input ratios, indicating reduced operational efficiency as scale increases. However, despite the increase in costs, larger farms achieve higher net incomes, family labor incomes, and farm business incomes, reflecting economies of scale in production. The pricing and marketing dynamics also reflect the impact of scale, with larger farms facing higher marketing costs but still maintaining relatively stable grower prices. These findings align with previous studies that highlight the trade-off between economies of scale and operational efficiency, where larger operations benefit from increased output but at the cost of higher marketing and input expenses (Singh *et al.*, 2015; Sharma *et al.*, 2016) ^[13-14, 12]. Thus, while scale offers financial advantages in terms of income and returns, it also brings increased complexity and reduced efficiency, particularly in the management of costs and marketing.

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