

RESEARCH PAPER

Oyster Mushroom Production: An Economic Analysis in East Siang District of Arunachal Pradesh

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ABSTRACT

Oyster mushroom cultivation is an appealing crop for many farmers nowadays as it converts inexpensive agricultural byproducts into a high-value crop. This study investigates the economic viability of oyster mushroom cultivation in East- Siang district of Arunachal Pradesh, with a focus on three randomly chosen community development (CD) blocks i.e. Mebo, Pasighat, and Ruksin. A total of 60 respondents (30 oyster mushroom growers and 30 non-growers) were purposefully chosen. The cost of cultivation has been calculated per five polybag beds, and revealed that small farmers exhibited the highest total cost (₹ 612.11), followed by medium (₹ 486.94) and large farmers (₹ 441.63). However, the largest net return was earned by large farmers (₹ 506.21) succeeded by small (₹ 505) and medium (₹ 493.65). Small farmers paid ₹ 142.17, medium farmers paid ₹ 127.02, while large farmers paid ₹119.89 for producing 1 kg of oyster mushrooms. Notably, small farmers produced the highest yield (4.29 kg per 5-bags). As scale increased, the yield decreased due to the lack of close supervision. The benefit- cost ratio (BCR) calculated as 1.8 for small farmers, 2.0 for medium farmers and 2.1 for large farmers, hence, larger operations produced higher profits. The study on the resource utilization efficiency indicated that farmers frequently overutilized labour, spawn, paddy straw, and other crucial inputs. The study recommends increasing training and support, upgrading infrastructures like cold storages and other post-harvest management facilities, providing improved connections with metropolitan markets, encouraging branding and SHG- FPO linkages.

HIGHLIGHTS

- ① As scale increased, the yield decreased due to the lack of close supervision.
- ② Large farmers obtained the highest net return (₹ 506.21) followed by small (₹ 505) and medium (₹ 493.65).
- ③ Other than boosting household income, oyster mushroom cultivation also has the capacity to generate a stable source of additional income.

Keywords: Oyster mushroom, Cost and return analysis, Benefit- cost ratio, Resource use efficiency, Arunachal Pradesh

Oyster mushroom (*Pleurotus ostreatus*) belongs to the family Agaricaceae and class Basidiomycetes. It is generally known as wood fungus and in India commonly known as Dhingri (Stamets, 1993). The commercial cultivation of this mushroom was

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initiated in Germany as a means of survival during World War I (Eger *et al.* 1975). By using 100 kg of wheat and paddy straw, 600 kg of fresh oyster mushrooms can be harvested in just two months (Uddin *et al.* 2011). Mushrooms are known for its distinctive texture upon biting and wonderful taste, and are regarded as a luxury food item (Mariga *et al.* 2014; Sheu *et al.* 2007). Studies on the medicinal value of oyster mushrooms have demonstrated their hypoglycemic activity, antithrombotic effect, regulation of the immune system, reduction of blood pressure and blood lipid levels, tumor development inhibition, microbial activity and inflammation control (Kaul, 2002). According to recent studies, it was noted that mushrooms could be utilised for the production of medicines, medicinal foods, and food supplements (R. Dutta, 2007). As a result, the production of oyster mushroom (*Pleurotus ostreatus*) has increased worldwide due to its ability to grow at varying temperatures and with different agro-based residues (Sharma *et al.* 2013). In Asia, the cultivation of mushrooms was first documented in China at around 600 AD. The first mushroom ever grown in Europe was introduced in France in the 17th century. Mushrooms first grew in USA in 1900 (Shamtsyan *et al.* 2008). In 1917, Flack began cultivating oyster mushroom (*Pleurotus ostreatus*) on tree stumps and wooden logs in Germany as an experimental method. Growing technology was perfected in USA by Block, Tsao and Hau. India started cultivating different varieties of mushroom in the early 1960s. Commercial cultivation began in mid-seventies (NHB, n.d.). With a dry weight of 20-40 per cent, mushrooms are rich in protein, low in fat, and contain all the vital amino acids needed for optimal health (Kalač, 2009). Their protein digestibility is good, and they are ranked below animal proteins but above other foods like vegetables, milk and fruit (Wang *et al.* 2014). Besides being nutritious, mushrooms are considered delicacy foods due to their unique texture upon bite and their appealing color and flavor (Bellettini *et al.* 2016; Pala *et al.* 2014).

According to FAOSTAT, 2023, the production of mushroom has grown over fivefold globally since 2000 and presently, it stands at 44 million tonnes (Bijla & Sharma, 2023). White button mushroom is grown majorly on commercial basis in Europe and USA, while other mushroom species are also taken up for commercial production in Asian countries like China. Majorly six mushrooms dominate the global

production and market viz. shiitake mushroom (26%), oyster mushroom (21%), black ear mushroom (21%), button mushroom (11%), *Flammulina* (7%), paddy straw mushroom (1%), and other mushrooms (13%) (Bijla & Sharma, 2023). As per the 2nd Advance Estimates given by the Department of Agriculture & Farmers Welfare, Govt. of India, the total mushroom production of India in 2024-25 is 3,91,33,000 metric tons. Bihar is the largest mushroom producing state in India, producing 42.19 kilo tonnes and Odisha is the second largest mushroom producing state in India producing 34.6 kilo tonnes in 2023-24 (Source: *DesiKheti*). Compared to other states like Bihar and Odisha where commercial mushroom growing is more advanced, the Northeast's share of oyster mushroom production is still quite small. As per the 2nd Advance Estimates given by the Department of Agriculture & Farmers Welfare, Govt. of India, the total mushroom production of North- East India in 2024-25 is 2,530 metric tonnes. It was seen that Assam had the largest production of mushroom followed by Tripura, Nagaland, Mizoram, Meghalaya, Manipur, Sikkim and Arunachal Pradesh. This study was aimed to determine the economic feasibility of oyster mushroom production.

METHODOLOGY

This study was undertaken in the state of Arunachal Pradesh. East- Siang district was purposively selected. Out of 4 CD blocks present, Mebo, Ruksin and Pasighat were selected randomly. The respondents were drawn purposively as mushroom growers and non-growers. 30 growers and 30 non-growers were randomly selected from the CD blocks. A total of about 60 respondents were identified for the study. Mushroom growing farmers were categorised according to the number of the mushroom bags grown as given below (Table 1).

Table 1: Distribution of oyster mushroom growers based on no. of polybag bed spawned

Sl. No.	Types of farmers	No. of polybag beds	No. of oyster mushroom growers	Average no. of polybag beds
1	Small farmers	< 50	13 (43)	20
2	Medium farmers	50-100	9 (20)	57
3	Large farmers	> 100	8 (37)	209
Total		—	30 (100)	286

Note: Figure in parenthesis indicates percentage of the total.

ANALYTICAL TOOLS

Cost Concepts

Standard cost concepts given by CACP in Sen Committee in 1979 were used to estimate the cost of production or cultivation.

COST A₁ = Any cash or monetary expenses that arise from production are paid by the farmer directly. It includes:

1. Cost of hired human labour.
2. Cost of spawn.
3. Cost of paddy straw.
4. Cost of plant protection chemicals.
5. Water, electricity and miscellaneous charges.
6. Cost of packing materials.
7. Depreciation on implements and farm buildings.
8. Interest on variable costs (@ 10% per annum).

(Value of bullock labour; Value of machinery; Value of manure and fertiliser; Land revenue, cesses and other taxes were not considered in this study as they were not relevant or applicable on the crop being studied).

COST A₂ = COST A₁ + Rent paid for leased in land

COST B₁ = COST A₁ + Interest on value of owned fixed capital assets (excluding land)

COST B₂ = COST B₁ + Rental value of owned land + rent paid for leased in land.

COST C₁ = COST B₁ + Imputed value of family labour

COST C₂ = COST B₂ + Imputed value of family labour

COST C₃ = COST C₂ + Value of management input at 10 per cent of total cost (C₂).

Income Estimates

1. Gross Income = Yield per kg × Price of Product (₹/kg)
2. Net income = Gross Income (₹/kg) – Total cost (₹/kg)
3. Farm Business Income = Gross Income – Cost A₂
4. Farm Family Labour Income = Gross Income – Cost B₂
5. BCR = Gross return/Total variable cost

Resource use efficiency

It was given by Cobb-Douglas (CD) production function. The log-linear form is below:

$$\ln Y = \ln a + b_1 \ln X_1 + b_2 \ln X_2 + b_3 \ln X_3 + \dots + b_n \ln X_n + u$$

Where,

Y = Gross return (₹/5-units)

X₁ = Cost of paddy straw (₹/5-units)

X₂ = Cost of oyster mushroom spawn (₹/5-units)

X₃ = Cost of labour (₹/5-units)

X₄ = Miscellaneous and other charges (₹/5-units)

a = Constant term

b_i = Elasticity coefficients (i = 1, 2, 3, ..., 6)

u = Error term

Marginal value product was determined using the formula given below:

$$MVP_i = \beta_i P_i (\bar{Y} / \bar{X}_i)$$

Where,

P_i = Price per unit of output

β_i = Estimated regression coefficients of ith input

Ȳ = Geometric mean of gross income

X̄_i = Geometric mean of ith input

The resource usage efficiency of oyster mushroom growers was given by the formula given below:

$$r = MVP / MFC$$

Where,

r = Resource use efficiency

MVP = Marginal Value Product

MFC = Marginal Factor Cost (price of inputs per unit)

The values are interpreted as, r < 1 indicates excessive use, r > 1 indicates underutilization and if r = 1 the resources is optimally used and hence is the point of profit maximization.

RESULTS AND DISCUSSION

Analysing the economic feasibility of any agricultural endeavour requires estimating the cost of cultivation. It facilitates comprehension of the capital intensity, cost structure, and input requirements of the cultivation. To evaluate how expenses change with production scale, the current study has calculated cultivation costs individually all categories of oyster mushroom farmers. This kind of analysis is also crucial to assess the presence of economies of scale, resource efficiency, and profitability across various farm categories.

The expenditure incurred on paddy straw, spawn, water, electricity, miscellaneous expenditure etc. was reported in Table 2. It could be seen that, small farmers had the largest variable cost i.e. ₹ 457.83 accounting for 75 per cent of the overall cost, while medium farmers incurred ₹ 386.88 (79

per cent) and large farmers incurred ₹ 320.32 (72 per cent). Additionally, it was noted that the total variable cost was ₹ 388.88 (75 per cent). Fixed cost was lowest in the case of medium farmers (₹ 100.00), contributing 21 per cent of the total costs, and highest in small farmers (₹ 154.28), contributing 25 per cent. Small farmers incurred the highest overall cost (₹ 612.11), succeeded by medium and large oyster mushroom farmers (₹ 486.94 and ₹ 441.63 respectively). Additionally, the total variable cost for overall oyster mushroom growers was determined to be ₹ 388.88 (75 per cent). Likewise, it was noted that small farmers spent the most total fixed cost (₹ 154.28), accounting for 25 per cent, whereas the lowest was incurred by medium farmers (₹ 100.00), contributing 21 per cent. It was also pointed out that the overall cost was maximum in small farmers (₹ 612.11), which was then followed by medium farmers (₹486.94) and large farmers (₹ 441.63).

Table 2: Cost of cultivation of oyster mushroom (₹ per 5 units of polybag beds)

Sl. No.	Particulars	Small	Medium	Large	Average
1.	Variable cost				
(i)	Cost of paddy straw	12.69 (2)	10.74 (2)	10.24 (2)	11.23 (1)
(ii)	Cost of oyster mushroom spawn	102.79 (17)	94.22 (19)	89.61 (20)	95.54 (19)
(iii)	Family labour charges	110.77 (18)	105.62 (22)	56.68 (13)	91.03 (18)
(iv)	Hired labour charges	—	—	42.44 (10)	14.15 (3)
(v)	Water and electricity charges	59.23 (10)	44.82 (9)	33.90 (8)	45.99 (9)
(vi)	Miscellaneous expenditure	84.76 (14)	43.49 (9)	30.68 (7)	52.98 (10)
(vii)	Plant protection chemicals	6.67 (1)	29.32 (6)	14.29 (3)	16.76 (6)
(viii)	Packing materials	59.11 (10)	40.21 (8)	27.21 (6)	42.18 (8)
(ix)	Interest on variable cost/ working capital (@10% per year for 6 months)	21.80 (3)	18.42 (4)	15.25 (3)	18.49 (4)
	Sub- total	457.83 (75)	386.88 (79)	320.32 (72)	388.35 (75)
2.	Fixed cost				
(i)	Interest on fixed capital (@ 10% p.a.)	45.74 (7)	30.02 (6)	39.12 (9)	38.30 (7)
(ii)	Depreciation on shed/room, equipment etc.	106.88 (17)	68.42 (14)	80.53 (18)	85.28 (17)
(iii)	Rental value of land utilized for growing oyster mushroom	1.65 (1)	1.65 (1)	1.65 (1)	1.65 (1)
	Sub-total	154.28 (25)	100.00 (21)	121.13 (28)	125.23 (25)
3.	Total cost (1+2)	612.11 (100)	486.94 (100)	441.63 (100)	513.58 (100)

Note: Figure in parenthesis indicates percentage of the total.

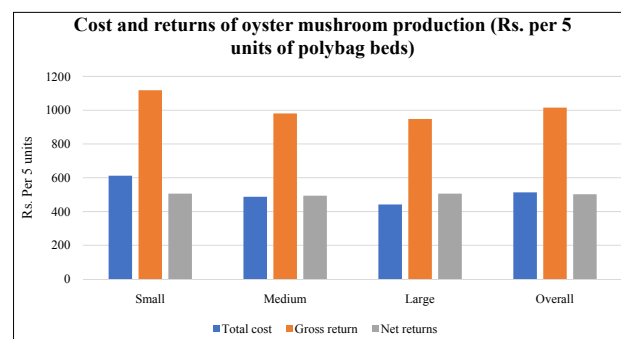
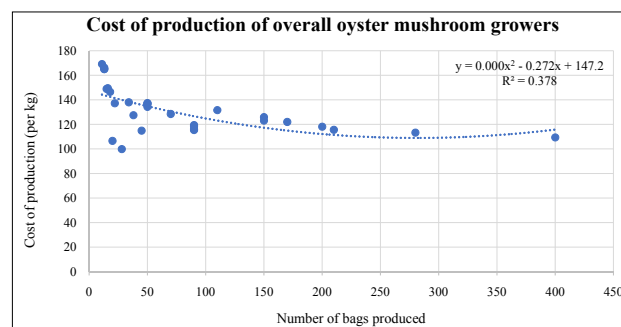
Table 3: Estimation of cost concepts (₹ per 5 units of polybag beds)

Sl. No.	Particulars	Small	Medium	Large	Average
1	Cost A ₁	453.95	349.68	344.17	382.60
2	Cost A ₂	453.95	349.68	344.17	382.60
3	Cost B ₁	499.69	379.71	383.30	420.90
4	Cost B ₂	501.34	381.36	384.95	422.55
5	Cost C ₁	610.46	485.33	439.98	511.93
6	Cost C ₂	612.11	486.98	441.63	513.58
7	Cost C ₃	673.32	535.68	485.79	564.94

Table 4: Economic evaluation of oyster mushroom

Sl. No.	Particulars	Small	Medium	Large	Average
1	Oyster mushroom yield (kg/5-units)	4.29	3.83	3.67	3.93
2	Average price of mushroom (₹/kg)	257.69	252.77	253.12	254.53
3	Returns from main produce (₹/5-units)	1103.11	965.63	932.85	1000.53
4	Returns from by-product (₹/5-units)	15.00	15.00	15.00	15.00
5	Gross returns (₹/5-units.)	1118.11	980.63	947.85	1015.53
6	Variable cost (₹/5-units)	457.83	386.88	320.32	388.38
7	Fixed cost (₹/5-units)	154.28	100.09	121.31	125.23
8	Total cost (₹/5-units)	612.11	486.98	441.63	513.57
9	Net returns (₹/5-units.)	505.99	493.65	506.21	501.95
10	Cost of production (₹/kg)	142.17	127.02	119.89	129.69
11	Benefit-cost ratio	1.8	2.0	2.1	2.0
12	Farm Business Income (₹/5-units)	664.16	630.95	603.68	632.92
13	Farm Family Labour Income (₹/5-units)	616.76	599.27	562.89	592.98

Small farmers incurred the highest Cost C_2 (₹ 612.11), but medium and big farmers incurred lesser Cost C_2 (₹ 486.98 and ₹ 441.63, respectively). Cost C_2 for overall farmers was ₹ 513.58, as seen in Table 3. This analysis considers Cost C_2 as the cost of cultivation because it takes into consideration the imputed and paid-out costs, as it offers the most thorough estimate of the overall cost of cultivation. The study revealed that small farmers had the highest cost of cultivation (₹ 612.11). It was seen that small farmers had highest yield of oyster mushroom. (4.29 kg per 5-bags). Despite these difficulties, large farmers recorded the largest net returns (₹ 506.21), followed by small (₹ 505.99) and medium oyster mushroom farmers (₹ 493.65). Small oyster mushroom growers had a benefit- cost ratio of 1.8, while large growers and medium growers had a ratio of 2.1 and 2.0 respectively. The highest cost of producing oyster mushroom was recorded for small growers (₹ 142.17/kg), succeeded by medium growers (₹ 127.02/kg) and large oyster mushroom growers (₹ 119.89/kg). Additionally, as seen in Fig. 1, small farmers had the largest gross return since they were able to give more attention on fewer bags, which led to higher yields. It was also revealed that they had received higher prices (per kg) since they sold their produce directly to local markets. The cost of production for all the oyster mushroom growers can also be seen in Fig. 2. It was discovered that the cost was higher at low scale and with the increase in the number of bags the cost was slightly decreased, but might rise at very high levels because of ineffective management.

**Fig. 1:** Cost and returns of oyster mushroom production for small, medium, large and overall farmers**Fig. 2:** Cost of production of oyster mushroom (per kg) based on number of bags produced for overall farmers

Resource use efficiency of oyster mushroom growers

From Table 5, it was seen that small farmers, the efficiency of resource use for inputs such as paddy straw, spawn, labour and miscellaneous charges were 5.01, 2.56, 2.51, 1.10 respectively, hence, indicating underutilisation of these resources. For medium farmers, the efficiency of resource use for

paddy straw, spawn, labour and miscellaneous charges were -128.47, -3.93, -6.42, 2.91 respectively, indicating that all the other inputs were overused except for miscellaneous charges. And for large farmers, the efficiency of resource use for paddy straw, spawn, labour and miscellaneous charges were -56.32, -1.31, -0.88, 0.52 respectively, which indicated over-utilisation of resources. Lastly, for overall farmers, all the resources were overused.

Table 5: Resource use efficiency of oyster mushroom growers

Sl. No.	Particulars	Small	Medium	Large	Overall
1	Paddy straw (X_1)	5.01	-128.47	-56.32	-0.47
2	Spawn (X_2)	2.56	-3.93	-1.31	-0.02
3	Labour (X_3)	2.51	-6.42	-0.88	0.07
4	Miscellaneous and other charges (X_4)	1.10	2.91	0.52	0.06

CONCLUSION

The current study on the economics of oyster mushroom production technology provided important information on the viability of mushroom growing as a source of revenue, its profitability and resource efficiency. As it is easy to grow and has high potential for profit, the results showed that oyster mushroom cultivation is a technically feasible, commercially successful, and environmentally sustainable. The cost of cultivation was highest in small farmers (₹ 612.11), followed by medium (₹ 486.98) and large farmers (₹ 441.63). As farm size increased, the yield was also reduced as high volume in production units makes close monitoring challenging. Despite these difficulties, large farmers recorded the highest net returns (₹ 506.21), followed by small (₹ 505.99) and medium oyster mushroom farmers (₹ 493.65). According to resource usage efficiency, important inputs including labour, paddy straw, spawn etc. among all farmer groups were found to be overused, which indicated that there could be room for improvement in some input combinations. Rural consumption of mushrooms is still low because of cultural preferences, lack of awareness, and marketing obstacles, despite an increase in urban demand. The district has a dense forest cover (57 per cent) so, a large amount of people has access to collect and consume wild mushrooms. Consequently, the preference for grown mushrooms

remains low among some individuals, which may hinder the spread of mushroom cultivation as a source of income generating activity. However, especially for households with less landholding, oyster mushroom cultivation significantly improves livelihoods and ensures nutritional security. The study also suggests government intervention through KVKs, State Horticulture & Agriculture departments and other organizations to increase regular, hands-on instruction. The expansion of training courses and live demonstrations can increase awareness and encourage farmers to cultivate oyster mushroom. The establishment of spawn production facilities across the region will also ensure the timely and convenient delivery of high-quality spawn, particularly in rural and remote areas. The government should also help establish low-cost agricultural facilities, cold storage, canning and drying facilities, etc. to reduce post-harvest losses, increase value addition and extend shelf life. More adoption can be promoted by the Government by offering subsidies for spawn units, mushroom houses, and other necessary facilities. To help farmers get higher prices, the government can also promote local branding (such as “organic” or “local” labels), packaging, and improved connections with metropolitan markets. For many years, women and tribal communities have engaged in small-scale mushroom farming in remote regions, so wider adoption can be encouraged by promoting Self-Help Groups (SHGs) and incorporating them into Farmer Producer Organizations (FPOs) to improve value addition and collective marketing.

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