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Research Note

Mushroom growing in Punjab: cost components, and determinants affecting its productivity

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Abstract The study has worked out cost and return structure of white button mushroom in Punjab and has identified the determinants affecting its productivity. The study was conducted in Amritsar and Gurdaspur districts with a sample of 80 mushroom growers. The selected mushroom growers were divided into three categories on the basis of bed area spawned. The economic analysis shows that non-recurring and recurring expenditures per square metre of bed area spawned declines with increase in mushroom farm-size due to the economies of scale. The gross returns are higher on medium mushroom farms due to comparatively higher average price realization while the net returns are higher on large mushroom farms due to lower cost. The input-output ratio has been found highest (1.81) on large mushroom farms, followed by medium (1.47) and small (1.35) mushroom farms. Judicious use of pesticides, labour-use in picking, packing and casing operations are found to improve mushroom productivity. The study emphasizes on the training of growers for disinfection of mushroom growing sheds, mechanized compost preparation plant, canning and refrigeration facility.

Keywords Cost-returns structure, value productivity, input-output ratio, marketing pattern, mushroom cultivation, Punjab

JEL classification C20, C83, Q12

1 Introduction

The mushroom crop is practically grown all over India and had a production of 76 thousand tonnes for the year 2015-16 (GOI 2016). The major mushroom-growing states are Punjab, Haryana, Tamil Nadu, Maharashtra, Andhra Pradesh and Himachal Pradesh. Solan (Himachal Pradesh), also known as city of mushrooms, has emerged as the nerve centre to impart training and supply of spawn. A National Mushroom Research and Training centre has also been established in Solan. Several small and medium growers and big companies have taken up mushroom growing on industrial scale. These units supply good quality of fresh and canned mushroom to the domestic market throughout the year. The dried mushroom is exported to several countries like Germany, Switzerland and France, while processed mushroom is exported to U.S.A and Canada (Thakare & Gupta 2004).

Punjab is one of the major mushroom-producing states and produced about 12 thousand tonnes during 2015-16. In Punjab, mushroom-growing is mainly concentrated in Amritsar, Gurdaspur, Hoshiarpur, Patiala and SAS Nagar districts. Among these, Amritsar and Gurdaspur are two major mushroom-producing districts of Punjab. It is a good subsidiary occupation of farming due to cheap and easy availability of wheat straw, faster means of communication, ready market outlets, higher purchasing power of people, and a receptive farming community. Mushroom cultivation provides additional income to farmers along with utilization of agricultural wastes and thus has bright future in the state. In addition, the left over bed of mushroom may be used as cattle feed and can be converted into quality manure which can generate additional income (Singh & Kaul 1994).

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In view of the importance of mushroom growing, the present study was undertaken with the following specific objectives:

- to study the cost and returns structure of growing white button mushroom (*Agaricus bisporus*) in different farm-size categories,
- to identify various determinants affecting its value productivity, and
- to suggest policy measures to strengthen mushroom production.

2 Data and methodology

To work out the returns from mushroom-growing and identify the factors affecting its value productivity, a field survey was planned. Firstly, a list of mushroom growers was obtained from the State Department of Horticulture, Punjab. From this list, two districts, namely Amritsar and Gurdaspur, were selected which have the highest concentration of mushroom growers in the state. From the selected districts, all the 80 mushroom growers (53 from Amritsar and 27 from Gurdaspur) given in the list were selected.

The primary data on non-recurring expenses on pucca/ kachcha sheds, platform, plastic sheets and other equipment used in mushroom growing were collected using a specially designed and pre-tested questionnaire. The data on mushroom production and inputs such as wheat straw, fertilizers, insecticides, pesticides, human labour, electricity, etc., were collected from the selected respondents. The selected respondents were classified into three categories on the basis of their bed area spawned using cumulative cube root frequency method. Thus, there were 35 (43.75%) small, 26 (32.50%) medium and 19 (23.75%) large mushroom growers in the sample (table 1).

2.1 Analytical tools

In the study, Cobb-Douglas function was considered the most appropriate, the logarithmic form of which is given in equation (1):

$$\log Y = \log A + b_1 \log x_1 + b_2 \log x_2 + \ldots\ldots\ldots\ldots + b_9 \log x_9 + u \quad \ldots(1)$$

where, Y represents the value productivity per sq. metre of bed area spawned. xi, the selected explanatory variables (Rupees per sq. metre); A, the technical efficiency parameter and b_i the elasticity of production of the respective variable at the mean level of input use and output. The 'u' is an error term.

Various explanatory and explained variables included in the model were as follows:

Y = Gross returns from mushroom growing (₹/sq.m.)
x_1 = Cost of wheat straw (₹/sq.m.)
x_2 = Cost of spawn used (₹/sq.m.)
x_3 = Cost of fertilizers used (₹/sq.m.)
x_4 = Cost of pesticides used (₹/sq.m.)
x_5 = Cost of casing material (₹/sq.m.)
x_6 = Cost of labour for composting (₹/sq.m.)
x_7 = Cost of labour for filling and spawning (₹/sq.m.)
x_8 = Cost of labour for casing (₹/sq.m.)
x_9 = Cost of labour for picking and packing (₹/sq.m.)

3 Results and discussion

3.1 Cost on mushroom growing

The component-wise break-up of the cost of mushroom growing on the sample farms is given in table 2. On overall basis, the total cost works out to be ₹ 380/sq.m. bed area spawned. The total cost shows a decreasing trend with increase in the size of bed area spawned due to economies of scale. The scale of economies are apparent for both fixed and operational costs. On

Table 1. Classification of mushroom growers according to bed area spawned, Punjab, 2011-12

Bed area spawned (sq. metre)	Mushroom growers selected (No.)			Per cent of growers selected	Average farm size (sq.metre)
	Amritsar district	Gurdaspur district	Total		
Small mushroom farms (< 400)	19	16	35	43.75	266
Medium mushroom farms (400-800)	20	6	26	32.50	646
Large mushroom farms (> 800)	14	5	19	23.75	1884
Total	53	27	80	100.00	773

Table 2. Component- wise cost of mushroom growing on sample farms in Punjab, 2011-12

(₹/sq. m.)

Particulars	Mushroom growers			
	Small	Medium	Large	Overall
Operational cost				
Value of composting	116 (25.05)	115 (26.56)	90 (26.01)	99 (26.05)
Value of spawning	22 (4.75)	23 (5.31)	20 (5.78)	21 (5.53)
Value of casing	13 (2.81)	14 (3.23)	11 (3.18)	12 (3.16)
Value of labour	164 (35.42)	142 (32.79)	110 (31.79)	123 (32.37)
Electricity, water and other miscellaneous cost	57 (12.31)	55 (12.70)	44 (12.72)	48 (12.63)
Interest on variable cost @ 9 per cent for half period	8 (1.73)	8 (1.85)	6 (1.73)	7 (1.84)
Subtotal (A)	380 (82.07)	357 (82.45)	281 (81.21)	310 (81.58)
Fixed costs				
Interest on fixed capital @ 9 per cent p.a.	30 (6.48)	28 (6.47)	24 (6.94)	26 (6.84)
Depreciation on shed/room, platform, plastic sheet & equipment	25 (5.40)	24 (5.54)	21 (6.07)	22 (5.79)
Rental value of land used for mushroom growing	28 (6.05)	24 (5.54)	20 (5.78)	22 (5.79)
Sub-total (B)	83 (17.93)	76 (17.55)	65 (18.79)	70 (18.42)
Total cost (A+B)	463	433	346	380

Note: Figures within the parentheses are percentages of the total

overall farms, the operational cost account for 81.58% and fixed cost 18.42% of the total cost. In total cost, the expenditure on labour is the most important component accounting for (32.37%) followed by cost on composting (26.05%). In fact, this basic input of labour explains the positive association with value productivity per square metre of the bed area spawned. By farm wise- the total cost per sq. metre is estimated to be ₹ 463 on small, ₹ 433 on medium and ₹ 346 on large mushroom farms with a major share of nearly 82% of the operational costs.

Table 3 indicates that the mushroom growing is profitable. The net returns are estimated ₹ 251/sq.m. of spawned area on average. Both the returns over variable cost as well as net returns from mushroom cultivation are directly related to the farm size. Table 3 also reveals that the cost of mushroom production decreases with increase in farm size. Thus, larger farmers appear to using the resources more efficiently as compared to smaller farms. The returns from mushroom cultivation depict a positive association with farm size; these are ₹ 23/kg, ₹ 30/kg and ₹ 40/kg for small, medium and large mushroom farms, respectively. The input-output ratio is the highest on large mushroom farms (1.81), followed by medium (1.47) and small (1.35) farms. Thus, in the overall scenario, one rupee invested in mushroom growing, yields ₹ 1.65.

3.2 Determinants of value productivity of mushrooms

The results of Cobb-Douglas regression on small, medium, large and overall mushroom farms are presented in table 4.

Table 3. Gross and net returns from mushroom growing on sample farms in Punjab, 2011-12

Particulars	Mushroom growers			
	Small	Medium	Large	Overall
Mushroom yield (kg/sq. m.)	7.04	6.83	7.02	6.98
Average price of mushroom (₹/kg)	89	93	89	90
Gross returns from mushroom (₹/sq. m.)	626	635	625	628
Variable cost (₹/sq. m.)	380	357	281	310
Fixed cost (₹/sq. m.)	83	76	65	70
Total cost (₹/sq. m.)	463	433	346	380
Net returns (₹/sq. m.)	163	202	279	248
Returns to fixed farm resources (₹/sq. m.)	246	278	344	318
Cost of production (₹/kg)	66	63	49	54
Variable cost (₹/kg)	54	52	40	44
Returns per kg (₹/kg)	23	30	40	36
Input-output ratio	1.35	1.47	1.81	1.65

3.3 Small mushroom farms

A perusal of Table 4 reveals that the value of adjusted coefficient of multiple determination ($\bar{R}^2$) is very high explaining 96% of the variations in mushroom productivity by the explanatory variables included in the model. The coefficient of expenditure on pesticides is positive and significant at five per cent level of significance showing thereby that with increase in expenses on pesticide-use by one per cent, the resultant value productivity of mushroom would increase by 0.13%. The regression coefficient of expenses on labour for composting is also be positive and significant at five per cent level of significance which reveals that with one per cent increase in expenditure on this variable, the value productivity of mushroom would increase by 0.15%. Similarly, the regression coefficient for expenditure on labour use for casing operation is also found to be positive and significant at five per cent level of significance revealing that with increase in expenditure on labour for casing operation by one per cent, the value productivity of mushroom would increase by 0.14 per cent. The regression coefficients of other explanatory variables are insignificant.

3.4 Medium mushroom farms

For medium mushroom farms, the value of adjusted coefficient of multiple determination ($\bar{R}^2$) suggest that 83 per cent of the variations in the value productivity of mushroom could be explained by the independent variables included in the model. The coefficient of expenditure on pesticides is found positive and significant at five per cent of significance level which shows that with one per cent increase in the value of the variable, the resultant value productivity of mushroom would increase by 0.038%. The coefficients of labour use for casing operation and spawn used are also positive and significant at five per cent level of significance. Thus, with increase in expenses on labour for casing by one per cent the value productivity of mushroom would increase by 0.34%. The regression coefficients of expenses on wheat straw, fertilizers and casing were negative, showing their over-use on medium farms but these were non-significant variables. The coefficients of expenses incurred on spawn, labour for filling and spawning and labour used for picking and packing operations are positive but non-significant.

3.5 Large mushroom farms

On large farms, the explanatory variables could explain 94% of the variations in productivity of mushroom. The coefficient of expenditure on pesticides is positive and significant at five per cent of significance level which shows that with one per cent increase in the value of this variable, the resultant value productivity of mushroom would increase by 0.28%. The coefficient of labour for composting is also found to be significant at 5% level of significance, thereby showing increase in productivity by 0.46% with unit per cent rise in expenses on labour for composting operation. The

Table 4. Farm-size-wise regression coefficients of Cobb-Douglas function for mushroom farms in Punjab, 2011-12

Particulars	Regression coefficient			
	Small farms	Medium farms	Large farms	All farm
Intercept	5.266	3.128	2.852	6.180
Wheat straw (₹)	0.193	-0.190	0.585	0.017
	(0.172)	(0.166)	(0.293)	(0.86)
Spawn (₹)	-0.062	0.203**	0.221	0.009
	(0.101)	(0.111)	(0.140)	(0.056)
Fertilizers (₹)	-0.019	-0.113	0.53	-0.037
	(0.062)	(0.073)	(0.131)	(0.041)
Pesticides (₹)	0.126**	0.038**	0.283**	0.190*
	(0.49)	(0.096)	(0.122)	(0.032)
Casing soil (₹)	-0.112	-0.017	0.465	-0.076
	(0.073)	(0.124)	(0.267)	(0.053)
Labour for composting (₹)	0.150**	-0.052	0.460**	0.047
	(0.079)	(0.088)	(0.187)	(0.41)
Labour for filling and spawning operation (₹)	-0.079	0.003	0.345	-0.057
	(0.052)	(0.139)	(0.204)	(0.039)
Labour for casing operation (₹)	0.136**	0.342**	0.102	0.128*
	(0.069)	(0.162)	(0.089)	(0.043)
Labour for picking and packing (₹)	-0.009	0.013	0.001	-0.033
	(0.067)	(0.126)	(0.012)	(0.040)
Coefficient of multiple determination ($\bar{R}^2$)	0.97	0.84	0.97	0.96
Adjusted coefficient of multiple determination ($\bar{R}^2$)	0.96	0.83	0.94	0.95

Figures in parentheses are standard errors of regression coefficients
**5 per cent level of significance

regression coefficients of wheat straw, spawn, fertilizers, casing, labour for filling and spawning operation, labour for casing operation and labour for picking and packing operations are positive but non-significant.

3.6 All farm

On overall basis, 95% of the variations in productivity of mushroom could be explained by the independent variables included in the model. The coefficients of expenditure on pesticides and labour for casing operations are positive and significant at one per cent level of significance showing that with increase in expenditure on these variables by one per cent, the resultant value productivity of mushroom would increase by 0.19 and 0.13%, respectively.

The coefficients of expenses incurred on wheat straw, spawn and labour for composting are positive, but non-significant. The regression coefficients of other explanatory variables such as expenses on fertilizers, casing and labour for filling and spawning operation are negative, but non-significant.

Thus, regression analysis shows that efficient use of pesticides and labour can further enhance the value productivity of mushroom in a significant way.

4 Conclusions

The study has worked out component-wise cost-return structure of mushroom growing along with the returns realized by the mushroom growers in the state of Punjab. It is seen that mushroom growing is a labour-intensive enterprise and it is the most important constituent of the variable cost, followed by expenses on composting and spawning. A negative association is observed between the total cost per square metre of bed area spawned with increase in the farm-size revealing the economies of scale. The net returns have been found higher on large mushroom farms, followed by medium and small farms. The study has revealed that the judicious use of pesticides to control diseases

and labour-use in compost preparation and casing operations can help in enhancing the value productivity of mushrooms significantly. Thus, there is a scope of decreasing the cost of mushroom production along with increasing the returns per square metre of bed area spawned by increasing the farm size.

5 Policy Implications

- Mushroom growers should be educated about the farm-size economies of mushroom growing.
- Mushroom growers should be provided training on proper disinfection of pucca sheds and preparation of good quality compost.
- The canning facility should be developed may be by some private entrepreneurs to augment the income of mushroom growers.
- There is the need to disseminate the nutritive value of mushroom to increase its consumption and thereby production.

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