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Economic viability, technological gap and problems of mushroom cultivation in Mandi district of Himachal Pradesh

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Abstract

Increases income, reduces risk and promotes sustainability. Mushroom is one of the supplementary enterprises which fits well in diversification. A study was carried out in Mandi district of Himachal Pradesh. Out of 60 mushroom growers, 80 per cent raised only one crop of button mushroom in a year and most of the growers placed spawned compost bags in the month of October. The fixed cost of production / 100 bags of button mushroom varied from 44.47 per cent on small farms to 22.42 per cent on large farms. The variable cost varied from 55.53 per cent on small farms to 77.58 per cent on large farms implying the economical use of fixed and variable resources by large growers. The gross returns per 100 bags basis ranged between Rs. 37,200 and Rs. 40,200 on small and large farms for button mushroom. The overall benefit-cost ratio was 1.87:1. Break-even output varied from 279 kg to 147 kg for small and large growers and break-even point was at 93 and 42 compost bags for small and large growers respectively. Technological gap included the important parameters like temperature, relative humidity, CO_2 concentration, surface cleaning by formalin , storage temperature etc. The mushrooms growers faced production, marketing, financial and institutional problems. However, the intensity of the production problems was much higher than others.

Key words: Benefit-cost ratio, break-even output, technological gap.

Mushroom is a fungal growth that typically takes the form of a domed cap on a stalk, with gills on the underside of the cap. Mushrooms also called 'white vegetables' or 'boneless vegetarian meat' contain ample amounts of proteins, vitamins and fibre. The land resources in the world for raising the food crops are limited. Since, most of the crops are grown outside in the fields. The mushroom production is an indoor activity hence, does not need agricultural land thus, suited to small farmers and landless labourers. Besides mushroom have high bio efficiency i.e., conversion of dry substrate into fresh mushroom. Spent mushroom substrate can be used to produce organic manure. It can generate self-employment. Families living below poverty line can be brought above poverty line through mushroom production and improving their socio-economic status. It can provide nutritional security particularly to poor people through incorporating mushrooms in their diets. Mushrooms occur under various ecological conditions. They comprise a large heterogeneous group with different shapes, sizes, colour and edibility. Of the 2000 known edible species, only a few are commercially cultivated and some are poisonous in nature. The edible species are popularly known as mushrooms, the poisonous ones as toadstools. There are different types of mushroom Terrestrial/Tericolous mushroom (which grows on soil), Lignicolous mushroom (which grows on wood) and Mycorrhizal mushroom (which grows due to some association with plants). In the coming decades, agricultural residues are bound to increase and need to be utilized judiciously. Utilization of agro-residues for mushroom production will not only help to reduce the environmental pollution but will profitably recycle them into quality food, besides improving soil health due to recycling of spent mushroom substrate. India is blessed with varied agro climate, abundance of agricultural wastes and manpower making it most suitable for the cultivation of all the types of temperate, subtropical and tropical mushrooms. Mushroom cultivation was initiated in 1961 in India, but its commercial cultivation started in 1968. Government of Himachal Pradesh took initial steps for its development in the year 1962 in collaboration with the Indian Council of Agricultural Research, ICAR. Though mushroom production in India started in 60's, it was during 90's that there was sudden jump in mushroom production due to Hi-tech projects set up in

collaboration with the foreign companies. This resulted in significant increase in mushroom production from 4,000 tonnes (1985) to 30,000 tonnes (1995) and 38,000 tonnes (1997) and at present it is estimated to be around 1.2 lakh tonnes/annum. But major share (80%) is contributed by button mushroom though specialty mushrooms have greater scope in the country.Production of mushroom in Himachal Pradesh is 7,200 metric tonnes (Thakur, 2014)

Materials and Methods

The study was conducted in Mandi district of Himachal Pradesh. This district was purposively selected for the study due to sufficient number of mushroom growers in the district. Himalayan Research Group (HRG), a NGO is located at village *Dhangiara* in Mandi district of Himachal Pradesh. HRG developed a full technology package (from making an arrangement of raw material till setting up the market linkages) for the guidance and benefit of the growers. Keeping in view, the suitable climatic conditions with temperature variation from 10-30 degree Celsius, Relative humidity varies from 60 per cent and easy availability of raw material was gaining popularity of mushroom production amongst growers in Mandi District.

For the selection of the sample two stage random sampling technique was adopted. In Mandi district, there were 10 developmental blocks. In the first stage, the list of mushroom growers in different blocks was procured with the help of Department of Horticulture, Agriculture and compost suppliers. Depending upon the number of mushroom growers five blocks namely Chauntra, Darang, Sundernagar, Chachyot and Balh were selected. In the second stage of sampling, among the selected blocks a sample of 60 growers was selected by proportional allocation method. The mushroom growers were further classified into two groups using cumulative cube root frequency method. The mushroom growers having compost bags up to 100 were categorized into small category and growers having 100 compost bags and more were in large category.The primary data were collected from mushroom growers on well designed and pre tested schedules through survey method by personally visiting the mushroom growers in the study area. Marketing costs, marketing pattern and practices followed by sample growers. The technological gap in the mushroom cultivation was examined by using following algorithm

$$\text{Technological gap (\%)} = \frac{\text{Recommended technology} - \text{Existing technology}}{\text{Recommended technology}} * 100$$

Results and Discussion

Status of mushroom production in Himachal Pradesh

Himachal Pradesh stood at sixth position in terms of all mushroom production. Production of mushroom in Himachal Pradesh is 7,200 metric tonnes due to the establishment of two commercial/export oriented units at Paonta Sahib and Nalagarh. Mushroom production is highly profitable and its farming is gaining popularity among farmers, women and youths in Himachal Pradesh. (Kangotra and Chauhan, 2013). Mushroom production is an important secondary source of income for millions of rural families and has assumed important role in providing employment and generating income opportunities to rural masses. Mushroom growing is a good activity for landless farmers as it required only small area. Himachal Pradesh is a state of small and scattered land holdings. About 87 per cent of total holdings belong to marginal and small farmers with average holdings of 0.41 and 1.39 ha, respectively. Agriculture provides direct employment to 69 per cent of the total workers of the state; however, more than 80 per cent of the people in the state directly or indirectly depend on agriculture for their livelihood. The state has a large geographical area of 5.6 million ha but the total cropped area is nearly 17 per cent and about 80 per cent of the net sown area is rainfed. Therefore, agriculture alone cannot provide sufficient support to the ever- growing population. The mushroom production in Himachal Pradesh recorded a compound growth rate of 8.58 per cent per annum from 2000-01 to 2012-13 (Table 1).

Classification of growers

It was revealed that majority (80 %) of the growers raised one crop of button mushroom in a year while 13.33 per cent could grow two crops of button mushroom and 6.67 per cent raised one crop of oyster mushroom (*dhingri*) with one crop of button mushroom. The mushroom growers were categorized on the basis of compost bags. The mushroom growers having compost bags up to 100 were categorized into small category and growers having 100 compost bags and more were in large category.

Table 1. Growth of mushroom production in Himachal Pradesh

Sr. No.	Year	Total mushroom production (tonnes)
1.	2000 -01	2945.35
2.	2001 -02	3227.00
3.	2002 -03	3236.40
4.	2003 -04	4484.70
5.	2004 -05	4700.48
6.	2005 -06	4985.88
7.	2006 -07	5322.90
8.	2007 -08	5475.52
9.	2008 -09	5895.36
10.	2009 -10	7377.10
11.	2010 -11	7790.77
12.	2011 -12	7201.63
13.	2012 -13	7261.50
Compound growth rate (%)		**8.58**

Source: Directorate of Horticulture, Shimla

Socio economic characteristics of sample mushroom growers

Socio-economic characteristics of the mushroom growers play an important role in decision making process. Table 2 presents some salient features of the mushroom growers according to gender, age, education and occupation. It is revealed from the table that in the overall unit size category about 65 per cent growers were male and 35 per cent mushroom growers were female. Table 2 also depicted the age structure of the mushroom growers on sample farms. About 32 per cent growers were in the age group of 25-40 years. 48 per cent of them were in the age group of 40-60 and remaining 12 per cent were more than 60 years of age. The study of educational status is one of important factors to determine the ability of the farming communities to make judicious decisions to adopt new technologies and innovations. Keeping this in view, the educational status of the growers is depicted in Table 2. It can be seen from the table that the literacy rate of the mushroom growers was 100 per cent. Among the different strata of education, a good number of growers were matriculate on both small (36 per cent) and large farms (29 per cent) categories. On an average the proportion of growers having education up to graduation and above was about 10 per cent on small and large farms. Under the overall farm scenario, the percentages of growers in educational category of primary, middle, matriculation, senior secondary and graduation were: 13.33, 13.33, 64.47, 30 and 19.78 per cent, respectively.

Table 2 depicted the occupational pattern and income of the growers on sample farms. The perusal of the table, on small farms about 44 per cent of the growers were agriculturist whereas on large farms 38 per cent of the growers were agriculturist. 17 per cent of sample growers on small farms were in government service and 3 per cent growers were as ex-servicemen. It was revealed from the table that all the sample mushroom growers were literate.

Cost of mushroom production

The cost of production of 100 compost bags of button mushroom has been computed. The total cost component has been bifurcated into fixed and variable costs. Fixed cost included interest on fixed capital and depreciation on mushroom house and implements used. Variable cost included expenses on compost bags, medicines, electricity charges, packing materials, labour charges, transportation charges, etc.

On small farms the total fixed cost constituted 44.47 per cent of the total cost. The major component of fixed cost was interest on fixed capital and accounted for about 32.81 per cent of total cost (Table 3). The depreciation on building had minimum share in fixed cost and accounted for 3.92 per cent of the total cost. Among variable cost the expenses on compost bags were the main component and accounted for about 26.90 per cent of the total cost. The next highest expenses were on labour which constituted about 19.90 per cent of total cost. The expenses on transportation and loading-unloading were to the tune of 2.36 per cent. On large farms fixed and variable cost accounted for about 22.42 and 77.58 per cent of the total cost. Among the items of fixed cost, interest on fixed capital was the major constituent which accounted for about 16 per cent of the total cost. Among variable cost, the expenses on compost bags were the major item and constituted about 54 per cent of total cost. On overall farm situation the fixed cost and variable cost had the similar pattern. In fixed cost the interest on fixed capital and depreciation on implements (iron racks, wooden racks, hygrometer, thermometer, packing machine, exhaust fan, cooler, etc.) were the major items which constituted about 22 and 6 per cent of the total cost. Fixed cost was estimated at about 30 per cent of total cost on overall farms.

Table 2. Socio-economic characteristics of sample mushroom growers (Number)

Sr. No.	Particulars	Farm Size		
		Small	Large	Overall
1.	Gender			
	i) Male	28	11	39
		(71.80)	(28.20)	(65.00)
	ii) Female	11	10	21
		(52.40)	(47.60)	(35.00)
	Total	39	21	60
		(100)	(100)	(100)
2.	Age group (years)			
	i) 25-40	12	7	19
		(30.77)	(33.33)	(31.67)
	ii) 40-60	21	8	29
		(53.85)	(38.1)	(48.33)
	iii) >60	6	6	12
		(15.38)	(28.57)	(20.00)
	Total	39	21	60
		(100)	(100)	(100)
3.	Education			
	i) Illiterate	0	0	0
		(0)	(0)	(0)
	ii) Primary	6	2	8
		(15.38)	(9.52)	(13.33)
	iii) Middle	4	4	8
		(10.26)	(19.05)	(13.33)
	iv) Matric	14	6	22
		(35.9)	(28.57)	(74.00)
	v) Senior Secondary	11	7	18
		(28.21)	(33.33)	(30.00)
	vi) Graduate and above	4	2	6
		(10.26)	(9.52)	(19.78)
	Total	39	21	60
		(100.00)	(100.00)	(100.00)
	Literate persons	39	21	60
		(100.00)	(100.00)	(100.00)
	Literacy rate (%)	100	100	100
4.	Occupational Pattern			
	i) Agriculture	17	8	25
		(43.59)	(38.1)	(41.67)
	ii) DPL/Private	6	3	12
		(15.38)	(14.29)	(18.33)
	iii) Govt. Service	7	3	10
		(17.95)	(14.29)	(16.67)
	iv) Ex-Servicemen	1	0	1
		(2.56)	(0)	(1.67)
	v) Wage earning	0	4	4
		(0)	(19.05)	(6.67)
	Total	39	21	60
		(100.00)	(100.00)	(100.00)

Figures in parentheses indicate percentages to the total in each category

It was evident from the Table 3 that in fixed cost the depreciation on implements and interest on fixed capital were the major items. However, in a variable cost the major items of expenses were compost bags and labour charges. The high prices of compost bags and wages of labour attributed to high cost of production.

Returns and benefit-cost ratio

Table 4 showed the returns and benefit-cost analysis on different size of mushroom farms. A close perusal of the table revealed that mushroom was the major source of income. The gross return increased with increase in farm size. The net returns were found to be more on large farms as compared to small farms. It can be seen from the table 4 that the overall production for button mushroom in a year was 326 kg. The production of mushroom increased with the size of farm. It was depicted from the table 4 that production of large farms was more (335 kg) as compare to small farms (310 kg). The net returns per rupee were found to be more on large farms 1.27 as compared to small farms (0.11). The benefit-cost ratio was observed to be 1.11, 2.27 and 1.87 on small, large and overall farm situations respectively.

Break-even analysis

The per farm total cost incurred on mushroom farms was segregated into fixed and variable costs to find out the break-even output. The fixed cost included interest on fixed capital investment, depreciation on buildings and equipments. All other operational expenditure was included in variable cost. The cost of production included the fixed as well as variable cost and selling price of mushroom (Rs /kg). While considering one crop of button mushroom, break-even output was obtained as 279 kg, 147 kg and 193 kg mushroom production on small, large and overall categories of farms, respectively (Table 5). In physical terms the break-even output was met with 93, 42 and 60 compost bags on small, large and overall mushroom farms. To conclude it was stated that the mushroom growers must place at least 60 compost bags on their farms to meet total cost of production.

Technological gap

Technological gap revealed the extent of deviation between existing and recommended practices in the process of crop production. Table 6 depicted the technological gap in respect of utilization of different parameters viz., temperature, Carbon dioxide concentration, humidity, number of foot dips, presence of double doors, surface cleaning by formalin, storage temperature and harvesting diameter. The technological gap on small, large and overall farms was computed to estimate the extent of adoption of technology and the deviation from the recommended level.

The maximum positive technological gap was observed in case of double doors (68.33 per cent). This indicated that growers were using less double door technology on their farms. However, it was observed that in general, on an average farm situation, farmers were operating in more temperature than the recommended storage temperature and therefore, having the maximum negative technological gap of 57.89 per cent on overall farms. Humidity in growing room was very important. If humidity was 100 per cent then there was no evaporation and no movement of nutrients within the compost bags and there was no formation of mushroom. If humidity was less than 80 per cent more evaporation and more movement of nutrients took place and majority of mushroom collapsed due to competition for nutrients for existence. On the first day after placing compost bags the positive technological gap in case of humidity was found i.e. 12.12 per cent which means the growers were using less water as the recommended water. However, the technological gap on humidity on 10^{th} day after placing compost bags was found to be negative (-4.71 per cent) which reflected that growers were using more water in the compost bags. Higher concentration of carbon dioxide was good for vegetative growth of mushroom but data were not available regarding CO_2concentration in the study area.

Problems and constraints

This section depicted the various problems and constraints experienced by mushroom growers in Himachal Pradesh. The problems faced by mushroom growers have been categorised into three sub-heads viz; production, marketing and institutional problems. The mushroom growers were interviewed in respect of various problems and their per cent response has been given in various sub-heads. It observed from the Table 7 that the main problem related to production was that of insect-pest attack and incidence of diseases was high and about 50.55 per cent of the respondents encountered this problem. Other main problem was non-availability of spawned compost bags (30.85 per cent). Problem related to lack of awareness (17.55 per cent) was also observed in the

Table 3. Cost of production of button mushroom on sample farms (Rupees/100 bags)

Sr. No.	Particulars	Farm size		
		Small	Large	Overall
A.	Fixed cost			
	i) Interest on fixed capital (@ 12% p.a.)	10,976 (32.81)	2,871 (16.24)	5,708 (22.04)
	ii) Depreciation charges			
	a) Buildings (@ 2% p.a.)	1,312 (3.92)	325 (1.84)	671 (2.57)
	b) Depreciation on implements (@ 10% p.a.)	2,588 (7.74)	766 (4.34)	1,433 (5.53)
	Sub-total-I	14,876 (44.47)	3,962 (22.42)	7,782 (30.14)
B.	Variable cost			
	i) Compost bags	9,000 (26.90)	9,500 (53.76)	9,325 (44.36)
	ii) Transportation and loading-unloading charges	791 (2.36)	388 (2.20)	529 (2.26)
	iii) Labour charges	6,656 (19.90)	2,429 (13.74)	3,908 (15.90)
	iv) Electricity charges	507 (1.51)	294 (1.67)	369 (1.61)
	v) Medicine	450 (1.35)	343 (1.94)	380 (1.73)
	vi) Packing material	225 (0.67)	172 (0.97)	190 (0.87)
	vii) Miscellaneous	676 (2.02)	382 (2.16)	485 (2.11)
	viii) Total(i-vii)	18,304 (54.71)	13,508 (76.44)	15,187 (68.33)
	ix) Interest on variable capital (@12% for 1 ½ months)	275 (0.82)	203 (1.15)	228 (1.03)
	Sub-total-II	18,579 (55.53)	13,711 (77.58)	15,414 (69.86)
C.	Total cost (A+B)	33,454 (100.00)	17,672 (100.00)	23,196 (100.00)

Figures in parentheses indicate percentages to the total in each category

study area. Major market related problem expressed by the growers was its high cost (27.75 per cent) followed by inadequate arrangement for grading and storage (27.25 per cent) and lack of market information (24.55 per cent). On the study area growers also reported institutional problems. It was evident from the table that about 38 and 25 per cent of the respondents, respectively, reported that package of practices on available and training facilities were not adequate. The social problems were also finding out in the study area. 32 per cent of family members were not interested in the mushroom production and 8 per cent members were having the problem of inadequate space for mushroom production.

Table 4. Returns and benefit-cost ratio **(Per 100 bags)**

Sr. No.	Particulars	Units	Farm size		
			Small	Large	Overall
A.	Total cost	Rupees	33,454	17,672	23,196
	i) Fixed cost	Rupees	14,876	3,962	7,782
	ii) Variable cost	Rupees	18,579	13,711	15,414
B.	Total production	Kilograms	310	335	326
C.	Gross Returns	Rupees	37,200	40,200	39,150
D.	Net Returns	Rupees	3,746	22,528	15,954
E.	Returns over variable cost	Rupees	18,6 22	26,489	23,736
F.	Net returns per rupee of investment	Rupees	0.11	1.27	0.87
G.	Benefit -cost ratio	Ratio	1.11	2.27	1.87

Table 5. Break-even point for different categories of mushroom farms **(Per 100 compost bags)**

Sr. No.	Particulars	Farm size		
		Small	Large	Overall
A.	Cost of production			
	i)Fixed cost	14,876	3,962	7,782
	ii)Variable cost	18,579	13,711	15,414
	iii)Total cost	33,454	17,672	23,196
B.	Total production (kg)	310	335	326
C.	Selling price of mushroom (Rs/kg)	120	120	120
D.	Break -even output (mushrooms in kg)	279	147	193
E.	Break -even point (number of compost bags)	93	42	60

Table 6. Technological gap in mushroom production on sample farms **(Per farm)**

Sr. No.	Particulars	Units	Level/ range recommendation	Existing practic es			Technological gap (%)		
				Small	Large	Overall	Small	Large	Overall
1.	**Environmental conditions from day one to day nine after placing casing soil**								
	i) Temperature	^{o}C	20-25	18.5	19	18.75	+17.78	+15.56	+16.67
	ii) CO_2 concentration	ppm	10,000	NA	NA	NA	NA	NA	NA
	iii) Humidity	%	80-85	70	75	72.5	+15.15	+9.09	+12.12
2.	**Environmental Conditions from day ten onwards**								
	i) Temperature	^{o}C	14-18	12.5	19	15.75	+21.88	-18.75	+1.59
	ii) CO_2concentration	ppm	8,000	NA	NA	NA	NA	NA	NA
	iii) Humidity	%	80-90	93	87	89	-9.41	-2.35	-4.71
3.	Foot dip	No.	60	10	25	18	+52.38	+35.90	+41.67
4.	Double door	No.	60	4	15	19	+80.95	+61.54	+68.33
5.	Surface cleaning by formalin	%	2	NA	NA	NA	NA	NA	
6.	Storage temperature	^{o}C	4	9.5	9.5	9.5	-57.89	-57.89	-57.89
7.	Cap/button size at harvesting stage	Dia(cm)	3-4 cm	4	3.8	3.9	-14.29	-8.57	-11.43

Note: (+) means less use and (-) means more use

Table 7.Problems and constraints faced by mushroom growers on sample farms **(per cent)**

Sr. No.	Particulars	Farm size		
		Small	Large	Overall
1.	**Production problems**			
	i) Non-availability of spawned compost bags	51	20	30.85
	ii) Insect-pest attack and incidence of disease	33	60	50.55
	iii) Non availability of labour	27	13	17.9
	iv) Lack of awareness	13	20	17.55
2.	**Related to market**			
	i) High charges of transportation	24	29	27.75
	ii) Lack of market information	20	27	24.55
	iii) Inadequate arrangements for grading and storage	18	33	27.25
3.	**Institutional problems**			
	i) Training facilities not adequate	33	20	24.55
	ii) Package of practices not available	20	47	37.55
4.	**Social problems**			
	i) Lack of interest in mushroom of family members	40	27	31.55
	ii) Inadequate space for cultivation	11	7	8.40

Conclusion

The ever increasing population, shrinking agricultural land, degrading environment, water scarcity and demand for quality foods are emerging vital issues need to be addressed in the times to come. Mushroom is an economically viable and potential supplementary enterprise for gainfully employing small and marginal farmers in Himachal Pradesh. Economic analysis of mushroom production revealed that break-even output was worked out at 193 kg mushroom production on overall category of farms. In physical terms the break-even output was attained at 60 compost bags on overall mushroom farms. Therefore, the mushroom growers must keep at least 60 compost bags on their farms to meet total cost of production. The study of the problems revealed that attack of insect-pest and incidence of diseases was high and about 50.55 per cent of the respondents reported these problems.The maximum technological gap on small, large and overall farms was present in respect of lack of double door mushroom houses. It is evident from the above analysis that for increasing income and employing the growers gainfully the mushroom farming needs to be promoted.

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