Economic Affairs
Citation: EA: 61(3): 427-436, September 2016

Technological adoption and constraint analysis of mushroom entrepreneurship in Karnataka

Mahantesh Shirur[1*], N.S. Shivalingegowda[2], M.J. Chandregowda[3] and Rajesh K. Rana[4]

[1]*ICAR-Directorate of Mushroom Research, Solan-173 213, HP, India*
[2]*Department of Agricultural Extension, UAS, GKVK, Bengaluru-560 065, India*
[3]*ICAR-Agricultural Technology Application Research Institute, Zone-VII, Hebbal, Bengaluru-560 024, India*
[4]*ICAR-National Institute of Agricultural Economics and Policy Research, DPS Marg, Pusa, New Delhi-110 012, India*

ABSTRACT

Mushroom cultivation is a remunerative agribusiness. However, consumption of mushrooms to ameliorate nutrition deficiency is often underemphasized in India. Mushroom entrepreneurship being technologically intensive agribusiness, its success in a country like India is contingent upon the technological and institutional support available to it. Present study was carried out to assess component wise technology adoption and constraint analysis of enterprises in order to suggest precise policy interventions for bringing the mushroom industry to health and vibrancy. The research was conducted among the mushroom entrepreneurs in Karnataka State. The constraint analysis reveals that, non-availability of spawn, lack of technical information and exploitation by consultants are major constraints. The increasing labour wages calls for adoption of mechanization in various activities of mushroom cultivation. The higher cost on electricity has rendered the cultivation of button mushroom less profitable in the State. For mushroom cultivation to pick up the pace, there is need for capacity building of KVK staff about improved low cost cultivation technology for disseminating the same among the farmers and supply of quality spawn by State departments.

Keywords: Constraint analysis, mushroom entrepreneurship, policy implications, technology adoption

The vast cultivable area (123100 km^2) and diverse agro climatic conditions of Karnataka State allows the cultivation of different types of field crops and plantation crops yielding huge amount of crop residues. Despite the extensive use of these residues in the social sector; the total surplus crop residue (residue left after usage in social sector like fodder, fuel and other purposes) in the state is to the tune of 168.65 lakh t/ year (Pandey *et al.*, 2011). Even 1% of this surplus residue if used for mushroom cultivation, the State has the potential to produce more than 80,000 t mushroom/ year (with 50%

Access this article online	
Publisher	Website: http://www.ndpublisher.in
	DOI: 10.5958/0976-4666.2016.00054.1

Address for correspondence
ICAR-Directorate of Mushroom Research, Solan, India
E-mail: mahanteshshirur@gmail.com

Biological Efficiency). Contrary to the huge potential, the actual production of mushrooms in Karnataka is miserably small. Pandey *et al.* (2011) estimated annual production in the State as 84 t; whereas the authors of this paper estimated the annual production to be around 895 t in 2015 out of which nearly 750 t is of *Agaricus bisporus*- a temperate mushroom and around 145 t is from *Pleurotus* sp. and *Calocybe* sp –two tropical mushroom varieties.

The food consumption pattern in Karnataka is predominantly cereals and millets based with lesser amount of protective foods. Growth retardation has been observed in a vast majority of children in the country including Karnataka (Bhavani *et al*., 2008; Kesavan, 2015; Naveena *et al.*, 2016). Protein energy malnutrition, vitamin A deficiency and B-complex deficiencies are the major nutritional deficiencies among pre-school children, while anaemia remains a major health problem in women (Sheela, 1999). WHO estimated that malnourished children numbered 181.9 million (32%) in developing countries (ICDS, 1983). Protein energy malnutrition (PEM) is a potentially fatal body depletion disorder. In India, the proportion of children with PEM was 46 % in 2005-2006 and in Karnataka it is 41 per cent (NFHS-3). However, the potential of mushroom to ameliorate this malady has not received commensurate attention it merits. Further, mushroom cultivation as an agri-business creates lot of employment and income generation opportunities especially for weaker sections of the society (Singh *et al*., 2015).

For any entrepreneurship to prosper, besides market dynamics, the technological adoption and institutional support plays an important role. Technical aspects of mushroom entrepreneurship thrives only with adequate institutional support. Though mushroom entrepreneurship figures in the training and demonstration activities of many research and training institutions, analysing its inadequacies helps in suggesting suitable policy measures. Mushroom entrepreneurship being technologically intensive agribusiness, its success in a country like India is contingent upon the technological and institutional support available to it. Hence, the present study was carried out in order to assess component wise technology adoption and constraint analysis of enterprises to suggest precise policy interventions for bringing the mushroom industry to health and vibrancy.

Methodology

The research was conducted among the mushroom entrepreneurs in Karnataka State. Sixty respondents growing mushroom for a year or more were interviewed and data was collected through a pre-tested schedule. The technological adoption on mushroom cultivation for the purpose of this study was limited to seven important and common aspects required for all types of mushrooms such as project preparation, training, straw, spawn, labour, bagging and packaging. The data were collected with respect to their source, cost/ price, overhead cost (for straw and spawn), distance and quality.

Different constraints were listed based on review of literature and discussion with the experts. These identified constraints were categorized under different headings and the respondents were asked to indicate their response on a three point continuum of 'no constraint', 'minor constraint' and 'major constraint'. Constraint score (C score) was calculated through arithmetic mean by assigning different weightage based on the extent of constraint perceived by the entrepreneurs. A score of zero, one and two were assigned to no, minor and major constraint respectively. Based on the mean cumulative constraint score, the ranks were given for constraints. For understanding the nature of problems of two different types of mushroom varieties (Temperate and Tropical mushroom varieties), they were presented separately in Table 1.

To analyse the institutional support, the data was collected from two representative institutes; ICAR-Indian Institute of Horticulture Research, Bengaluru and Biocentre, State Department of Horticulture. Descriptive statistical tools were employed to analyse the results.

Results and Discussion

Technological adoption and constraints for mushroom cultivation

Among seven technological factors, the spawn and

Table 1: Summary of technological support for mushroom growers

		Button mushroom (n=8)			Oyster mushroom (n=52)			All growers (n=60)		
Input/Service	**Statistic**	**Min**	**Max**	**Mean**	**Min**	**Max**	**Mean**	**Min**	**Max**	**Mean**
Project preparation	Cost (₹)	4000	20000	11500	5000	5000	5000	4000	20000	10571[@]
	Distance (km)	80	2800	1610	20	20	20	20	2800	1383
	Quality (1-5)	3	4	3.67	2	2	2	2	4	3.67
Training	Fees (₹)	100	5000	3417[@]	100	5000	457[@]	100	5000	960[@]
	Distance (km)	100	2800	2044[@]	20	2800	129[@]	20	2800	454[@]
	Duration (Days)	1	10	7.11	1	5	1.81	1	10	2.71
	Quality (1-5)	4	5	4.11	2	5	3.56	2	5	3.66
Straw	Cost (₹)	2.5	7	4.75	1	20	6.71	1	20	6.49
	Overhead cost (₹)	1	2	1.5	0	5	1.51	0	5	1.51
	Total cost (₹)	3.5	9	6.25	1	25	8.22	1	25	8.00
	Distance (km)	10	800	237[@]	1	300	50[@]	1	800	71[@]
	Quality (1-5)	4	5	4.5	3	5	4.19	3	5	4.23
Spawn	Cost (₹)	60	90	72	40	120	63.4	40	120	64.18
	Overhead cost (₹)	10	20	18	2	100	18.58	2	100	18.53
	Total cost (₹)	80	100	90	45	200	81.98	45	200	82.71
	Distance (km)	90	400	248	6	500	139.32	6	500	149[@]
	Quality (1-5)	2	4	3.2	2	5	3.88	2	5	3.82
Wages (₹)	Men	200	400	308[@]	180	400	281[@]	180	400	286[@]
	Women	150	300	225	100	300	199[@]	100	300	204
Bagging	Price* (₹)	145	165	156[@]	110	300	176[@]	110	300	174[@]
	Distance (km)	20	150	73[@]	5	450	56[@]	5	450	58[@]
	Quality (1-5)	4	5	4.67	4	5	4.49	4	5	4.51
Packaging	Price# (₹)	2	8	5.83	1	4	1.88	1	8	2.54
	Distance (km)	20	2400	890	7	400	40[@]	7	2400	182[@]
	Quality (1-5)	3	5	4.67	3	5	4.5	3	5	4.53

** Per kg of bagging material # Cost calculated for packing a kg of mushroom @ rounded off to nearest whole number*

straw are two critical inputs deciding the success of the mushroom entrepreneurship. The project preparation is important mostly for button mushroom growers as they go for financing from the banks because of heavy investment on the infrastructure. Training is considered essential for mushroom cultivation because of its non-traditional method of cultivation using pasteurised compost and the environment controlled indoor rooms or thatched huts as per the weather conditions. Singh *et al*. (2015) pointed that, in the opinion of mushroom growers in Haryana, two technical aspects of mushroom cultivation-the compost preparation and casing soil preparation require elaborate training.

The technological factors are discussed below:

Project preparation

Among the eight button mushroom growers, seven availed the project preparation services; whereas, only one out of the 52 tropical mushroom growers opted to

prepare the project appraisal report. Lot of variation was observed in the cost incurred on project preparation and distance travelled to avail the expertise. The only one to prepare the project among the tropical mushroom growers did it locally by paying ₹ 5000 (Table 1). The experts and entrepreneurs must adopt e-mail as a way of communication to overcome the barrier of distance for project reports. The service providing institutions and financing agencies must also consider the same to support the mushroom growers. This might save the cost and time of the entrepreneurs and lead to improvement in the delivery of quality services.

The tropical mushroom growers do not get the proper project report because, tropical mushroom growers mostly with limited investment capacity take up mushroom cultivation as cottage agriculture activity. They find it too costly and do not appreciate the returns on its investment. Further, it also suggests that, the loan and subsidy are availed only by the white button mushroom growers who require the project report for the appraisal. This calls for inclusiveness of small and marginal mushroom growers, growing tropical mushroom varieties for financial and subsidy facilities extended by the State.

The constraint analysis reveals that, lack of technical information and exploitation by consultants are major constraints (II rank for white button mushroom growers with a C-Score of 1.88 and III rank for tropical and overall mushroom growers with a C-Score of 1.33 and 1.40 respectively). It highlights the importance of offering institutional support on project preparation which address both the constraints faced by the growers. The quality of project preparation will also meet the need of technical knowledge of mushroom growers. The deficiencies in the training (especially the poor rating from oyster mushroom growers) can be largely addressed with the improvement in quality project preparation.

Straw for substrate and compost preparation

The average cost incurred on straw was ₹ 4.75/- per kg for button mushroom growers and ₹ 6.71 for tropical mushroom growers with a maximum going up to ₹ 20. This shows that, the agriculture residues such as wheat straw, paddy straw or sugarcane bagasse have become costly commodity and the overhead cost in the form of transportation, handling charges etc. add to the total cost of straw. The high cost of straw will have major implications on the costing of mushrooms and subsequently the profitability and economic feasibility of mushroom entrepreneurship. Besides the cost and distance of straw availability the growers' decision is also influenced by the quality of straw. The quality of the straw influence the quality of the compost and subsequently the mushroom productivity. The overall quality rating of 4.23 can be considered as better for mushroom cultivation.

Straw is getting costlier in recent times because of shortage and demand for the same by other sectors like dairy, manuring, fuel and energy production. However, solid fermentation of straw to convert the biowaste into quality protein food through mushroom cultivation throws several opportunities. This is a boon especially where agriculture residue is available in plenty at cheaper price. The spent mushroom substrate (SMS) can again be used as compost and manure for many agriculture and horticulture crops.

The constraint on straw or residue is perceived more by the white button mushroom growers (C-Score of 1.38 on both huge cost of inputs and non-availability of straw) compared to the tropical mushroom growers. This is on account of large quantity requirement for white button mushroom growers compared to oyster mushroom growers.

Spawn

Spawn in mushroom cultivation is akin to the seed in other crop enterprises. Spawn is the most critical input influencing the success or failure of mushroom entrepreneurship. The availability, cost, quality and handling of spawn together are affecting the prospect of mushroom entrepreneurship. Since, the units producing white button mushroom were large commercial units, their spawn requirement was also high. Hence, most of them have their own spawn production facility at their unit. Hence, the non-availability of spawn is a lesser

constraint for them compared to tropical mushroom growers. Non-availability of spawn is the biggest constraint for tropical mushroom growers.

The cost of spawn is varying depending on the type of supplier. The commercial growers charge different rates depending on the demand. The overhead cost of the spawn because of transportation and handling adds to the total cost of spawn. In some cases it is as high as Rs. 100/-, which is more than the cost of the spawn itself. The distance from which the spawn is bought indicates the lack of supply of most critical input for mushroom cultivation in all parts of the state. Spawn in very few places preclude willing entrepreneurs to adopt the mushroom entrepreneurship for their livelihood or as an agri-business. The rating of the quality of spawn among the mushroom growers is also not satisfactory. The deterioration in the quality of spawn due to contamination, aging, immaturity, improper colonization of fungus, etc. shows the need for skill and competence enhancement among the spawn producers. The lack of any controlling authority or the legislation on spawn standards have added to the problems on spawn quality. The same can be seen in different constraints listed under situational and technological constraints (Spawn standards).

Labour wages

A large difference was observed in the wage rates between maximum and minimum and also among the men and women labours. The wages were not dependent on type of mushroom though, they were decided by other factors such as nearness to urban areas or the skills of the labours in carrying out certain operations. It was observed that, average wage given to men and women labour by white button mushroom growers was ₹ 308.33 and ₹ 225 respectively. The oyster mushroom growers offered an average of ₹ 280.83 and ₹ 198.75 respectively for men and women. The average wages for overall mushroom enterprises were ₹ 286.33 and ₹ 204 respectively for men and women.

The wages are usually found to be higher for labours employed in mushroom units than other agri-related activities. Since, most of the tropical mushroom growers are depending on the family labour or hired labour in small numbers, they perceive it as a minor constraint compared to white button mushroom growers. The high labour wages calls for adoption of mechanization in compost mixing, turning, filling, etc.

Bagging for compost and packaging of fresh mushrooms

The polythene for bagging comes in different thickness. Most of the farmers use above 140 GSM thickness for compost filling. The variation observed in the price can be ascribed mostly to the thickness of the bags. The quality of bags was rated as very good.

The packaging cost was calculated for per kg of fresh mushroom packaged to overcome the problem of using different packaging material by mushroom growers of different varieties. The results show that, the button mushroom growers spend higher amount on packaging of mushroom than the growers of tropical mushrooms.

The results reveal that, the cost of per kg packing of button mushroom and tropical mushroom was ₹ 5.83 and ₹ 1.88 respectively. This is because of the high quality packing material and the branding cost incurred by most of the white button mushroom growers. The button mushroom growers get the packaging materials of desired quality from far off places such as Varanasi, Chandigarh, Delhi and other places. Whereas, the tropical mushroom growers mostly depend on locally available polythene of 140 to 170 GSM thickness. The button mushroom growers use the punnets for packaging mushrooms. A kg of punnet (numbering around 80-90 punnets to hold 200 gm. of fresh mushrooms) costs between ₹ 120-140.

It also comes with a microfilm for wrapping around the punnets which helps in extending the shelf life of mushrooms by exchange of air. The normal polythene costs ₹ 160-170 per kg of packaging material. Around 500-550 polythene bags each holding 200 g of fresh mushrooms. The average cost for packing a kg of mushroom comes around ₹ 1.25 to ₹ 2.00. The difference in the rating for quality of packaging material is also not much indicating the satisfaction among the entrepreneurs growing all type of mushrooms.

Additional constraints and implications

Besides the technological and input factors, a perusal at Table 2 suggests that, huge cost of electricity is seen as the major constraint by all the white button mushroom growers. Insufficient electricity supply, lack of technical information, exploitation by consultants and long gestation period with a constraint score of 1.88 were seen as next major constraints. The electricity as the major constraint for white button mushroom unit is reported not only from India (Anon., 2005) but even in United States (Pollack, 1995). The problem of electricity in India is twofold. First is its availability itself and the second is the high cost of electricity. Further, reducing the high temperature to 16-18^{0}C will consume large amount of electricity. While, the agriculture and horticulture continue to enjoy either free or subsidized electricity in many States, the mushroom entrepreneurship does not enjoy any such largess from the Governments.

Verma (1999) averred that, Indian mushroom industry is in urgent remedial need of improving its production, consumption and trade. In order to increase mushroom production for international trade, the revival of closed and abandoned export oriented units (EOU) and construction of new units supported by government initiatives and subsidies covering energy costs, interest rates and canning/ packaging are desperately needed.

Lack of skilled labour, spawn standards and problems by pests and diseases were third ranked problems with similar score. They were followed by huge investment, lack of working capital and lack of quality water as other major problems. Exploitation by the middlemen in the market is listed as fifth ranked constraint. Michael *et al*. (2008) mentioned the time lag to obtain a return on investment, lack of funds, insufficient production and marketing information as the major constraints in mushroom production in US. They further observed that, people are prevented from starting a shiitake mushroom business because of lack of information about funding sources, production and marketing. Based on the constraint analysis in this study, comparable situation is witnessed in India. Singh *et al*. (2015) emphasised the importance of group approach in marketing to succeed in mushroom cultivation.

The constraints faced by the growers growing tropical mushroom varieties needs further emphasis here. As has been discussed, the major constraint was non-availability of spawn. Singh and Suresh (2007) concluded in their study that, lack of availability of quality spawn and high price of spawn along with pest and disease infection were major problems in mushroom production.

Exploitation by the middlemen in the market was second biggest constraint. The growers are offered very low price by the middlemen even as the prices of mushroom in the local market is fairly good. According to Michael *et al*. (2008), the major problem faced by mushroom industry was how to sell more mushroom than how to grow more mushrooms. Exploitation by the consultants, high cost of land acquisition and spawn standards follow next in the order. Similar constraints were reported as reasons for loss in mushroom entrepreneurship by Michael *et al.* (2008) and Celik and Peker (2009).

Shirur and Shivalingegowda (2015) found that the difference in the price realised by the growers while selling directly to consumers and retailers was varying between ₹ 27.4-40/kg for different varieties with an average of ₹ 29.6/ kg (17.79 %). The same while selling directly to consumers and wholesalers for different mushrooms was varying around ₹ 50/kg for all the varieties with an average difference of ₹ 46.8 (34.21 %).

The difference in the price paid by consumers at farm gate and at market is different for different mushrooms. This difference was ₹ 13.88/kg (7.47 %) for button, ₹ 34.2 (19.35 %) for oyster and ₹ 45.02/kg (28.21 %) for milky mushroom with an average difference of ₹ 38.67/ kg (23.24 %). Though, it is not an objective to do away with the market intermediaries, the growers must be protected from being exploited from middlemen who makes higher profit than the growers in a brief period of time (Shirur and Shivalingegowda 2015).

Huge cost of inputs is also seen as next major constraint suggesting that, the straw, the spawn, the polythene, chemicals and other raw materials are costly for the tropical mushroom growers. Such constraints were also suggested to deter farmers from cultivating shiitake mushroom in United States (Michael *et al*., 2008). Fresh and processed button mushrooms constituted 95 per cent

Table 2: Constraint analysis for mushroom growers (n=60)

Sl. No.		Button mushroom (n=8)		Tropical mushroom (n=52)		All mushroom (n=60)	
	Financial constraints	**C_Score**	**Rank**	**C_Score**	**Rank**	**C_Score**	**Rank**
1	Huge investment on infrastructure	1.63	IV	1.04	X	1.12	IX
2	Lack of working capital	1.63	IV	0.98	XII	1.07	X
3	Huge cost of inputs	1.38	VI	1.23	V	1.25	VII
4	Huge cost of electricity	2.00	**I**	0.46	XXII	0.67	XX
5	High cost of labour	1.38	VI	0.92	XIV	0.98	XIII
6	High cost of land acquisition	1.38	VI	1.31	IV	1.32	V
	Situational constraints						
7	Unsuitable climate for mushroom cultivation	0.63	XI	0.94	XIII	0.90	XV
8	Non availability of spawn	1.25	VII	1.52	**I**	1.48	**I**
9	Non availability of poultry manure	1.50	V	0.33	XXIV	0.48	XXII
10	Non availability of straw/ bagasse	1.38	VI	0.71	IXX	0.80	XVII
11	Non availability of gypsum and other chemicals	1.00	IX	0.23	XXV	0.33	XXIII
12	Insufficient electricity supply	1.88	**II**	0.42	XXIII	0.62	XXI
13	Lack of skilled labour	1.75	**III**	0.85	XVI	0.97	XIV
14	Lack of good quality ground water	1.63	IV	0.46	XXI	0.62	XXI
15	Contamination in spawn	1.25	VII	0.83	XVII	0.88	XVI
16	Maturity of spawn	1.00	IX	0.71	XVIII	0.75	IXX
	Technological constraints						
17	Lack of technical information	1.88	**II**	1.17	VI	1.27	VI
18	Exploitation by consultants	1.88	**II**	1.33	**III**	1.40	**III**
19	Long gestation period	1.88	**II**	0.85	XVI	0.98	XIII
20	Spawn standards	1.75	**III**	1.31	IV	1.37	IV
21	Pest and disease problem	1.75	**III**	1.15	VII	1.23	VIII
	Marketing constraints						
22	Lack of market information	0.63	XI	1.06	IX	1.03	XI
23	Market accessibility	1.25	VII	1.04	X	1.07	X
24	Lack of transport	1.25	VII	0.69	XX	0.77	XVIII
25	Lack of storage facility	1.00	IX	1.02	XI	1.02	XII
26	No good price for mushrooms	1.13	VIII	0.87	XV	0.90	XV
27	Exploitation by middlemen	1.50	V	1.44	**II**	1.45	**II**
28	Quality standards	0.75	X	1.08	VIII	1.03	XI

Table 3: Details of institutional support to mushroom entrepreneurship in Karnataka

Sl. No	Institutional support	IIHR, Bengaluru			Biocenter, Hulimavu		
		2012	2013	2014	2012	2013	2014
1	No of trainings on mushroom cultivation	3*	3*	3*	20#	20#	20#
2	No of trainees for training on mushroom cultivation	31	35	40	600	575	950
3	No of trainings on spawn production technology	3	3	3	—	—	—
4	No of trainees for training on spawn production technology	23	21	33	—	—	—
5	Quantity of spawn supplied (in kgs)	25414	28117	34000@	5000	5100	5250
6	Number of RTF bags supplied	—	—	2100	—	—	1000

** Training duration is five days* *# Training duration is one day only* *@ Extrapolated based on 10 months data*

of the export market for India. In view of the increasing international demand for fresh mushrooms, India must focus on creating the necessary infrastructure, cold chain transport of fresh chilled mushrooms to its western customers (Verma, 1999).

A keen look at the constraints of temperate and tropical mushroom growers presented in Table 2 suggest that, they experience different constraints which affect the prospects of their entrepreneurship. This merits the attention of the policy makers to devise separate policies for separate mushroom growers. A blanket solution to both category of respondents will be of little significance to either of the category of growers.

The data in the Table indicates that, Biocentre trains majority of the people on mushroom cultivation whereas, ICAR-IIHR, Bengaluru is the principal supplier of the spawn among the mushroom growers. Patil and Kokate (2011) assessed that, 71.67 per cent of the scientists working in KVKs expressed the need for training on mushroom cultivation aspects which suggests the need for capacity building of Subject Matter Specialists working in KVKs. The state agency though trains large number of interested participants through adequate number of trainings, the training duration is of only one day. Considering the technical operations involved in preparing selective compost, spawn and crop management through the manipulation of temperature and relative humidity in the cropping environment, trainings of longer duration are recommended. Further, the State Department must initiate the training on spawn production aspect as it potentially empowers trainees to take up spawn production as an agri-enterprises and also reduces the cost on spawn procurement.

The increasing trend observed in the quantity of spawn supplied and number of trainees suggests either increasing number of people embracing mushroom cultivation as their avocation or surge in the production capacity of mushroom growers. This indicates rising demand for mushrooms in the market.

The overall results for technological support suggests that, spawn followed by straw have been major cause of concern for mushroom growers. The results of project preparation also suggests that, the oyster mushroom and milky mushroom growers are not given any favourable situation by the state department or the financial institutions. This needs immediate attention from the policy makers to help many new and emerging entrepreneurs which comes out best under natural climatic conditions.

Institutional support available for mushroom entrepreneurship

The research organisations, State Agriculture Universities, Krishi Vigyan Kendras (KVKs) and State department of Horticulture support the mushroom entrepreneurship in many ways like, imparting training, research on its cultivation, processing, consumption, etc. The data on trainings and extension services from the identified organizations were used as the basis to draw conclusions. The details of these institutional support analysed for three years from 2012-2014 are presented in Table 3.

Since 2014, both these organisations have started giving ready to fruit (RTF) spawned compost bags in small scale among the small mushroom growers for domestic consumption and marketing in small quantity. This intervention found favour with the public as it came as a means to promote mushroom consumption among the public and spread the cultivation technology of mushrooms among the beginners and willing entrepreneurs.

Michael *et al.* (2008) observed that, grants and general support offered for small farms and direct marketing were mentioned among the policies that help establish a shiitake mushroom business in US. Hence, the sale and distribution of RTF among the small mushroom growers might herald a similar success under Indian conditions.

Conclusion

Notwithstanding the importance of mushroom as health food and its cultivation as a remunerative agribusiness, it is yet to find desired importance in India. The regular supply of quality spawn is the single most important intervention that needs to be addressed for mushroom entrepreneurship to flourish.

The commercial button mushroom projects must be encouraged to concentrate on exports demand. Such units must be enabled to receive financial support, subsidized electricity and cold chain facility to avoid the post-harvest losses. Under Indian conditions and more particularly in rural areas, awareness on mushroom consumption needs to be heightened for reaching the larger mass. The institutional mechanism for training, capacity building must be emphasized at regular intervals. National Horticulture Mission has received appreciation for its support to horticultural sector in Karnataka, however, it appears to be the right time for NHM to focus more on developing mushroom industry in the state (Gowda and Kar, 2015).

References

Anonymous. 2005. Proposal for establishment of mushroom spawn production laboratory under State Horticulture Mission submitted to National Horticulture Mission, GOI, New Delhi.

Bhavani, V.B., Anuradha, G., Gopinath, R. and Velan, A.S. 2008. Report of the State of the Food Insecurity in Rural India. M. S. Swaminathan Research Foundation and World Food Progamme, FAO, MSSRF Report-27, pp. 39-42.

Celik, Y. and Peker, K. 2009. Benefit/ Cost Analysis of Mushroom Production for Diversification of Income in Developing Countries. *Bulgarian J. Agric. Sci.* **15**(3): 228-237.

Gowda, Sathish C.S. and Kar, A. 2015. National Horticulture Mission (NHM): A Game Changer for Horticultural Economy of Karnataka. *Economic Affairs* **60**(4): 633-636.

ICDS. 1983. Central Technical Committee on Health and Nutrition. All India Institute of Medical Sciences, New Delhi.

Kesavan, P.C. 2015. Shaping science as the prime mover of sustainable agriculture for food and nutrition security in an era of environmental degradation and climate change. *Currrent Science* **109**(3): 488-501.

Michael, A. Gold., Mihaela, M. Cernusca. and Larry, D. Godsey. 2008. A Competitive Market Analysis of the United States Shiitake Mushroom Marketplace. *Hortitechnology.* **18**(3): 489-499.

Naveena, K.P., Mouzam, S.M. and Bellundagi, V. 2016. Economic importance and consumer preferences for neglected and underutilized crop species in Karnataka. *Economic Affairs* **61**(1): 135-140.

NFHS-3. 2006. National Family Health Survey-3, 2005-2006. Ministry of Health and Family Welfare, Govt. of India, International Institute for Population Sciences Deonar, Mumbai. Available at http://www.indiahealthstat.com

Pandey, M., Khandekar, N. and Veena, S.S. 2011. Status and problems of mushroom industry in Karnataa – A Few case studies. *Diversity and Production of Edible Mushrooms*. Kannaiyan S., Marimuthu T and Lenin K (Eds). Associated Publishing Company, New Delhi.

Patil, S.S. and Kokate, K.D. 2011. Training Need Assessment of Subject Matter Specialists of Krishi Vigyan Kendras. *Indian Res. J. Extn. Edu.* **11**(1): 18-22.

Pollack, Susan. 1995. Mushrooms: An Economic Assessment of the Feasibility of Providing Multiple-Peril Crop Insurance. Report Prepared by the Economic Research Service, USDA,

for the Office of Risk Management, Consolidated Farm Service Agency.

Sheela, K. 1999. Nutrition scenario in Karnataka, a state in southern India. *Asia Pac. J. Clin. Nutr*. **8**(2): 167-74.

Shirur, M. and Shivalingegowda, N.S. 2015. Mushroom marketing channels and consumer behaviour: A critical analysis. *Mysore J. Agric. Sci*. **49**(2): 390-393.

Singh, J., Chahal, V.P., Rathee, A. and Singh, K. 2015. Economic Empowerment of Scheduled Caste Landless Rural Women through Mushroom Cultivation: A Case Study. *Economic Affairs* **60**(4): 591-594.

Singh, R. and Suresh, R. 2007. Cost-benefit analysis of mushroom cultivation. *Indian J. Agric. Res*. **41**(4): 256-261.

Verma, R.N. 1999. National and International Scenario of Mushroom Production and Trade. *Proceedings of the Conference on the Mushroom Industry in India – A Decade of Achievements and Future Prospective*, 5 December, pp. 5-8.