Critical dimensions of entrepreneurship and entrepreneurial behaviour among mushroom growers: Investigation through Principal Component Analysis

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ABSTRACT

Mushroom cultivation is often promoted as profitable and income generating agri-business activity, while there is a very high rate of attrition in mushroom entrepreneurship. Performance of mushroom enterprise as a physical attribute and the entrepreneurial behaviour of mushroom growing farmers as a psychological attribute plays an important role in the success of the mushroom entrepreneurship. Both these variables are in turn influenced by several dimensions rendering it difficult to comprehend the nature of variability observed in them. Therefore, the principal component analysis (PCA) of these two variables was done for variable reduction and to understand their influence on mushroom entrepreneurship. The results of PCA ascertain the relative importance of different dimensions on the variables through Eigen weightages. Based on the findings, suitable strategies and necessary policy interventions are identified to make the mushroom entrepreneurship as a potential agri-business to augment farmers' income.

Key words: Entrepreneurship, Index, Mushroom, Principal component analysis, Performance.

INTRODUCTION

The growth in the global mushroom industry is backed by the performance of western countries in the past and recently from China with annual production of 32 million tonnes (Royse 2014, Zhang *et al*. 2014, Wang *et al*. 2015). The production of fresh mushrooms is just over 120,000 tonnes in India (Singh and Shirur 2016). In China, mushroom is the 5th most important crop giving jobs to more than 20 million people either directly or indirectly (Wang *et al*. 2015) while the number of Indians engaged in mushroom entrepreneurship is abysmally low- though, not estimated precisely. This huge gulf between India and China in terms of quantity of mushroom production and employment creation indicates our inability to explore mushroom entrepreneurship as potential agribusiness activity.

Many farmers and entrepreneurs embracing mushroom cultivation find it difficult to sustain this agri-business activity and hence, the rate of attrition is very high in this entrepreneurship (Shirur *et al*. 2017). Besides the lack of policy support, huge initial investment, high cost of inputs and raw materials, nonavailability of quality spawn, inconsistent demand for mushrooms in the market, *etc*. are the constraints identified in mushroom entrepreneurship (Singh *et al*. 2008, Kangotra and Chauhan 2014, Shirur *et al*. 2016). Performance of mushroom enterprise as a physical attribute and the entrepreneurial behaviour of mushroom growing farmers as a psychological attribute play an important role in the success of the mushroom entrepreneurship. Both the 'performance' and the 'entrepreneurial behaviour' in turn are influenced by several other variables.

There is always a risk of presence of multicollinearity in the model when we use ordinary least square where the validity of results become questionable. Although the correlation coefficients of independent variables taken in this study were not very high (Shirur *et al*. 2017) yet according to Gujarati (1988) the Condition Index (CI) is a more reliable test of multicollinearity detection. The CI text is based on Eigen values and hence, the Principal Component Analysis (PCA) was carried out to assess performance of mushroom enterprises and the entrepreneurial behaviour of mushroom growing entrepreneurs. PCA summarizes the variation present in correlated multivariate variables in the form of non-correlated component, each of which is a linear combination of several of the original variables. The extracted non-correlated component are known as Principal Component (PC) and are estimated from the eigen vectors of the covariance matrix of the original variables (Hotelling, 1933). To this effect, the present study was carried out to identify

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the dimensions of higher impact contributing to the success of entrepreneurship and entrepreneurial behaviour of mushroom growers.

MATERIALS AND METHODS

The study was conducted in Southern Indian State-Karnataka. The entrepreneurs growing any edible variety of mushroom, with an experience of taking at least one commercial mushroom crop, were selected for the study. The ICAR- Indian Institute of Horticulture Research, State Department of Horticulture and private spawn laboratories were contacted for data collection about the mushroom producing entrepreneurs in the State. The snowballing technique was employed to identify the mushroom growers in the state.

Data on the performance of the mushroom growing entrepreneurs was collected with the scale developed by Shirur *et al*. (2018). The 'Performance Index' was operationally defined as the combination of existing infrastructural, social capital, economic and efficiency dimensions of the mushroom unit and their incremental expansion or growth with the passage of time.

The entrepreneurial behaviour was measured using the scale developed by Shirur *et al*. (2015). Entrepreneurial behaviour is operationalised as the combination of various socio-psychological, cognitive, affective and skill attributes of an individual entrepreneur to operate his mushroom enterprises successfully. The dimensions selected for measuring the entrepreneurial behaviour are; Innovativeness, Achievement motivation, Risk bearing ability, Technical competency, Decision making ability, Economic motivation, Marketing strategy, Scientific orientation, Management orientation, Leadership ability and Information seeking behaviour.

The Principal Component Analysis is used to reduce the dimensionality of several underlying variables to enable better visualization and analysis of the data. The principal component, their standard deviations and the loading of each variable or dimension on the principal component were generated in the analysis. Scores for each component were calculated using the formula given below.

$$Ci = bi1(X_1) + bi2(X_2) + ... bip(X_p)$$

Where,

Ci = the subject's score on principal component i (i component extracted)

bip = the regression coefficient (or weight) for observed variable p, as used in creating principal component i.

$X_1 - X_p$ = the subject's score on observed variable 1 to p.

Condition Index (CI) was used as the test of multicollinearity in the model with the following specifications:

$$CI = \sqrt{\frac{EV_{Hi}}{EV_{Lo}}}$$

Where *EV*=Eigen Values; *Hi*=the highest and *Lo*=the lowest Data was analysed using the SPSS (16.0 version) software.

RESULTS AND DISCUSSION

The results of the PCA are discussed separately for the entrepreneurial behaviour and performance index.

Principal component analysis of entrepreneurial behaviour: The results of principal component analysis for dimensions of entrepreneurial behaviour and its component matrix are presented in Table 1 and 2. The Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy of 0.858 can be termed as 'meritorious' (Kaiser and Rice 1974) indicating the suitability of data for variable reduction. In other words, all the variables can be reduced into fewer number of variables. Since, the variables were the outcome of behavioural faculties, many were acting linearly on the entrepreneurial behaviour. Only two principal component with Eigen value of more than 1 accounted for more than 60 per cent of the cumulative variability. The first component accounted for nearly 50 per cent of the cumulative variability observed in all the dimensions of entrepreneurial behaviour.

The Eigen vectors/ principal component loadings are the coefficients of the principal component obtained. The

Table 1: Principal component analysis of dimensions of entre preneurial behaviour and its component matrix.

Component	Initial Eigenvalues		
	Total	% of Variance	Cumulative %
1	**5.416**	**49.238**	**49.238**
2	**1.201**	**10.918**	**60.156**
3	.984	8.946	69.102
4	.729	6.626	75.727
5	.697	6.332	82.060
6	.472	4.289	86.349
7	.418	3.803	90.151
8	.349	3.174	93.325
9	.284	2.578	95.903
10	.233	2.115	98.018
11	.218	1.982	100.000

Extraction Method: Principal Component Analysis.
Kaiser-Meyer-Olkin Measure of Sampling Adequacy: 0.858

Table 2: Component matrix showing the Eigen weightages for different dimensions of entrepreneurial behaviour.

Dimensions	Component	
	1	2
Innovativeness	.762	-.193
Achievement motivation	.770	.100
Economic motivation	.646	.583
Technical competency	.842	-.040
Decision making ability	.736	-.283
Risk bearing ability	.703	-.312
Information seeking behaviour	.564	.419
Scientific orientation	.781	-.134
Leadership ability	.652	-.152
Management orientation	.624	.535
Marketing orientation	.581	-.364

Extraction Method: Principal Component Analysis.

Eigen vectors or the loadings provide an expedient summary of the influence of the original variables on the principal component and thus a useful basis for data interpretation.

The Eigen vectors presented in the component matrix (Table 2) shows the higher influence of almost all the dimensions in forming the first principal component. A close look at the loadings of the component 1 suggests significant importance of technical competency than rest of the variables in the entrepreneurial behaviour of mushroom growing entrepreneur. Further, the scientific orientation and innovativeness getting higher loadings underscores the relatedness of these variables and their importance for mushroom growing entrepreneur. Besides technical competency, scientific orientation and innovativeness-achievement motivation and decision making ability are also getting higher loadings in the first component. Hence, the first component can be summed up as sound professional knowledge about the mushroom enterprises.

The entrepreneurs need to have knowledge about several areas of activity relevant to their domain of enterprise (Senthil kumar *et al*, 2012). Such knowledge helps him plan his strategy and use his skills effectively. Knowledge about environment, industry and technology is considered important (Pareek and Nadakarni 1978). Technical competency or knowledge about the enterprise also lead to better decisions making in the farm. Joshi and Kapoor (1973) emphasised the managing a farm as a continuous process of decision making. Entrepreneurs are seen as making judgments based on their superior information and knowledge (Ucbasaran 2004).

Understandably, knowledge on the entrepreneurship forms an important basis for making the correct decisions in the farm. Mushroom cultivation as an agri-business requires better understanding of technical aspects related to insulation, air conditioning, air flow, control of humidity, temperature, carbon dioxide, hygiene, etc. and also the production of quality spawn. Many of these aspects of mushroom cultivation demands a better education status and hence, an educated entrepreneur can fare better in mushroom entrepreneurship (Singh and Shirur 2016).

The second component showed higher eigen vector values for economic motivation and management orientation. Further, because of higher loadings for information seeking and marketing orientation, this component can be construed as the entrepreneurs' interest for 'commercial profitability' of the enterprise. Since, the commercial profit is the primary objective of any agribusiness activity, this result is on the expected line.

The economic motivation of a mushroom entrepreneur is important behavioural character in ensuring success in his enterprise. His economic motivation aided by sound marketing strategies and processing activities will bring the commercial success in mushroom entrepreneurship (Shirur *et al*. 2015). This also necessitates the popularization of farmer friendly cultivation models of tropical mushroom varieties like *Pleurotus*, sp., *Calocybe* sp. and *Volvariella* sp. which are easy to cultivate involving very low to modest investment. Investments for such models under Indian conditions may range from Rs. 1 to 5 lakh. The commercial scale production of *Agaricus* sp. under most of the Indian conditions requires environment modulation, involving expenditure on infrastructure setup and heavy recurring cost on electricity and maintenance.

Principal component analysis for dimensions of performance index: The results of principal component analysis for six dimensions of performance index and its component matrix are presented in Table 3 and 4. It was observed that, the KMO measure of sampling adequacy of 0.819 (meritorious) indicated the suitability of data for variable reduction. Only two principal component with Eigen value of more than 1 accounted for more than 73 per cent of the cumulative variability. The first component accounted over 55 per cent of the cumulative variability observed in all the dimensions of performance index.

The Eigen vectors of all the dimensions except efficiency shows very high correlation with the first component matrix (Table 4). The dimensions of social capital, scale, infrastructure, GMCPs (Good mushroom cultivation practices) and incremental growth all relate to the "size and scale" of the enterprises. Higher social capital

Table 3: Principal component analysis of dimensions of performance index and its component matrix.

Component	Initial Eigen values		
	Total	% of Variance	Cumulative %
1	**3.304**	**55.067**	**55.067**
2	**1.110**	**18.505**	**73.572**
3	.594	9.898	83.470
4	.356	5.930	89.400
5	.333	5.548	94.947
6	.303	5.053	100.000

Extraction Method: Principal Component Analysis.
Kaiser-Meyer-Olkin Measure of Sampling Adequacy: 0.819.

Table 4: Component matrix showing the Eigen weightages for different dimensions of performance index.

	Component	
Dimensions	**1**	**2**
Scale	.846	-.017
Infrastructure	.783	.175
Social capital	.850	.205
Efficiency	**.198**	**.919**
GMCPs	.759	-.335
Incremental	.798	-.283

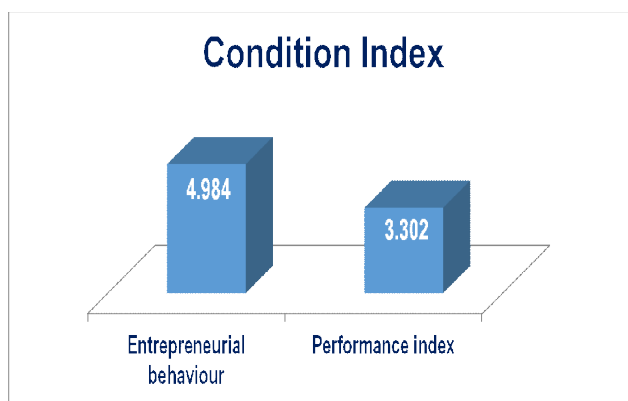Extraction Method: Principal Component Analysis.

Fig 1: Condition Index values for entrepreneurial behaviour and performance index as test of multicollinearity.

is the result of expanded production and marketing linkages. The size of the unit and number of machinery and type of infrastructure in the mushroom unit will have direct bearing on the quantum of mushroom produced. Hence, the first component can be identified as 'scale and size' of the mushroom production and it has distinct role for success in mushroom entrepreneurship.

The relationship between human capital and various outcomes associated with entrepreneurship may be mediated by entrepreneurial behaviour (Baron and Kenny 1986, Cohen 2003). Social capital leads to enhanced commercialization and results in improving farmer's business skills (Roseline *et al*. 2016). Often the smaller and medium mushroom growing units were reported to be unsustainable on commercial level because of lack of scale of economy.

The second component showed higher Eigen vector values for efficiency essentially reflecting "efficiency" as another important component in the performance analysis of mushroom entrepreneurship. The second component accounting for more than 18 per cent of cumulative variability and the Eigen vector value of 0.919 for efficiency in second component underlines the importance of efficiency as a stand-alone factor in contributing to the performance index of mushroom entrepreneurs. Hence, the second component-efficiency of the mushroom growing enterprises in terms of physical productivity of (quantity of mushroom per kg of compost/ weight of dry substrate), marketability of fresh mushrooms, quality of mushrooms according to grades and financial productivity in terms of the breakeven of the unit assuming highest value is logical as it ensures the commercial success of the unit.

With diminishing land area it would be more prudent to focus on improving productivity (Roseline *et al*. 2016). Yield and productivity of mushroom considerably varies with the substrate quality, methods of cultivation, organic supplementation, *etc*. (El-Kattan and Salama 1996, Philippoussis 2001, Biswas and Layak 2014). Hence, to

achieve efficiency and to produce more per unit area and per unit time, the mushroom breeding programmes must focus on developing high yielding strains of different mushroom varieties suitable to Indian conditions under natural growing conditions as well as environment controlled units. Besides, the quality of the mushrooms must be enhanced in terms of their shelf life, nutritional status and amenability for post-harvest treatments for storage and processing.

Condition Index (CI) as test of multicollinearity: Condition index has been considered one of most reliable methods for detection of multicollinearity in the regression model as there is no other method to perfectly estimate it (Gujarati 1988). As a widely accepted thumb rule; if CI is between 10-30 then it confirms presence of moderate multicollinearity in the model while beyond 30 its presence is severe. Any value of CI of less than 10 confirms the absence of multicollinearity in regression model. Fig 1 clearly depicts absence of multicollinearity in this study both for entrepreneurial behaviour (CI=4.984) and performance index (CI=3.302) of mushroom enterprises in the study area validating authenticity of all findings of this study.

CONCLUSION

In an agrarian country like India, farmers and agripreneurs can reap the benefits of globalisation only with vibrant agribusiness enterprises. Mushroom entrepreneurship, a grossly untapped agri-business opportunity, besides augmenting farmers' income has the potential to address many of the problems plaguing rural India *viz.* malnutrition, decreasing land holdings, declining soil fertility, lack of employment and low income generation leading to widespread poverty (Verma 2014). Mushroom is one of the rare crops which don't compete for scarce cultivable land resources. Hence, potential of this crop in mitigating food and nutritional insecurity is much larger than crops grown on land.

The results of the study emphasise the role of entrepreneurial behaviour in contributing to the performance index of their units and importance of both variables together to succeed in mushroom entrepreneurship. The principal component analysis further elucidates the relative weightages of dimensions on each of these variables. The training, capacity development and policy support must be posited to give due importance to the critical dimensions of both the variables in promoting the growth of mushroom entrepreneurship in India. The technical competency and associated key attributes of entrepreneurship must be imparted through trainings and capacity development programmes. The social capital, scale and size of the enterprise and efficiency of the firm must be given due importance to make the mushroom unit technically and economically viable and sustainable. The mushroom industry has grown more than 25-fold during the last 35 years with annual mushroom production of about 27 billion kg in 2012

(Royse 2014). India has failed to seize the opportunity to cater to the global demand for fresh mushrooms and seize this lucrative export opportunity. Based upon FAOSTAT (2016) triennium ending 2013 data, the annual average per capita mushroom production in India and China was 33.2 g and 2.5 kg, respectively. However, with the advantages of diverse climate, huge quantity of agricultural residues and abundant labour force, Indian mushroom industry has much higher potential to grow. The success in mushroom enterprise can be ensured when the holistic approach is adopted to give due importance to both the entrepreneurial behaviour of the mushroom growing entrepreneurs as well as critical dimensions of their mushroom units. The growth in mushroom industry in India can directly contribute to the nutritional security and the employment generation for educated rural youth.

REFERENCES

Baron, R. M. and Kenny, D. A. (1986). Moderator-Mediator distinction in social psychological research: Conceptual, strategic and statistical considerations. *Journal of Personality and Social Psychology.* **51**: 1173-1182.

Biswas, M. K. and Layak, M. (2014). Techniques for increasing biological efficiency of paddy straw mushroom (*Volvariellavolvacea*) in Eastern India. *Food Science and Technology.* **2**(4): 52-57.

Cohen, J. (2003). Applied Multiple Regression/Correlation Analysis for the Behavioural Social Sciences. Third Edition. Lawrence Erlbaum Associates. Mahwah, NJ.

El-Kattan, M. H. and Salama Gad, E. M. (1996). Production of oyster mushroom using simplified technology. *Acta Horticulturae.* **434**: 393-400.

FAOSTAT. (2016). Mushrooms and truffles. Rome: Food and Agriculture Organization of the United Nations. http://faostat3.fao.org/ (accessed during February 2016).

Gujarati, D. N. (1988). Basic Econometrics. Second Edition, McGraw-Hill Book Co. Singapore: 298-307.

Hotelling, H. (1933). Analysis of a complex of statistical variables into principal components. *Journal of Educational Psychology.* **24**: 417-441.

Joshi, S.S. and Kapoor, T. R. (1973). Fundamentals of farm business management, Kalyani publishes, New Delhi.

Kaiser, H.F. and Rice, J. (1974). Little Jiffy, Mark IV. *Educational and psychological measurement.* **34**: 111-117.

Kangotra, A. and Chauhan, S. K. (2014). Economic viability of button mushroom cultivation in himachal pradesh, India. *Indian J. Agric. Res.* **48**(2): 134-139.

Pareek, U. and Nadakarni, M. (1978). Development of entrepreneurship: A conceptual model. In RaoTV and Pareek U (Eds), Developing entrepreneurship: A handbook, Learning system, New Delhi.

Philippoussis, A., Zervakis, G., Diamantopoulou, P. (2001). Bioconversion of agricultural lignocellulosic wastes through the cultivation of the edible mushrooms Agrocybeaegerita, Volvariellavolvacea and Pleurotus spp. *World Journal of Microbiology and Biotechnology.* **17**(2): 191-200.

Roseline, J. A., Olubunmi, L. B., Adekemi, A.O. (2016). Commercialization of urban vegetable farming. *International Journal of Vegetable Science.* **22**(1): 24-34.

Royse, D. J. (2014). A global perspective on the high five: Agaricus, Pleurotus, Lentinula, Auricularia & Flammulina. In key note address, VIII International conference on mushroom biology and mushroom products, New Delhi. **1**: 1-5.

Senthil kumar, R., Ramkumar., Babu, D., Vijai Babu, D., Jaishridhar, P. (2012). Socio-economic analysis and its correlates with entrepreneurial behavior among dairy farmers in Tamil Nadu. *J. Dairying, Foods & H.S.* **31**(2): 108-111

Shirur, M., Shivalingegowda, N.S., Chandregowda, M.J., Rana Rajesh, K. (2018). Performance analysis of South-Indian mushroom units: Imperative policy implications for their preparedness for global competitiveness, *Current Science.* **115** (11) December 2018: 2141-2146.

Shirur, M., Shivalingegowda, N. S., Chandregowda, M. J., Rajkumar, B. J. (2015). Mushroom entrepreneurial behaviour: Dimensions and measurement. *International Journal of Agricultural and Statistical Sciences.* **11**(1): 61-68.

Shirur, M., Shivalingegowda, N. S., Chandregowda, M. J., Rana Rajesh, K. (2016). Technological adoption and constraint analysis of mushroom entrepreneurship in Karnataka. *Economic Affairs.* **61**(3): 427-436.

Shirur, M., Shivalingegowda, N. S., Chandregowda, M. J., Rana Rajesh, K. (2017). Socio economic analysis of entrepreneurial behaviour ofmushroom growers in Karnataka. *Indian Journal of Agricultural Sciences.* **87**(6): 840-845.

Singh, M. and Shirur, M. (2016). Mushroom Production: A Viable and Profitable Avocation for Educated Youth In*:* Doubling the farmers income through horticulture. [Eds: Chadha KL, Singh SK, Kalia P, Dhillon WS, Behera TK and Prakash Jai]. Published by Daya Publishing House, New Delhi. **2:**847-852.

Singh, N., Mehta, S., Godara, A. K., Yadav, V. P. (2008). Constraints in mushroom production technology in haryana. *Agric. Sci. Digest.* **28**(2): 118-120

Ucbasaran, A.D. (2004). Business ownership experience, entrepreneurial behaviour and performance: novice, habitual, serial and portfolio entrepreneurs. *Ph.D. thesis* submitted to the University of Nottingham, UK.

Verma, R. N. (2014). India on the threshold of non-green revolution. In: The Proceedings of 8th International Conference on Mushroom Biology and Mushroom Products, Delhi. **2**: 19-22.

Wang, J., Li, J., Wei, S., Liu, L. (2015). China mushroom processing industry - current situation and development trends. *Mushroom times.* **5**: 4-7.

Zhang, Y., Geng, W., Shen, Y., Wang, Y., Dai, Y.C. (2014). Edible mushroom cultivation for food security and rural development in China: bio-innovation technological dissemination and marketing. *Sustainability.* **6**: 2961-2973.