Holistic review on mushroom: A perspective on production, economics, marketing and constraints in India

Abstract

Mushroom cultivation offers humongous potential to improve socio-economical condition of farmers and strengthen food security of world since it serves as utilization of agricultural wastes and offering mushroom and manure from used substrate. It becomes important part at global level due to increasing demand of mushroom. It provides livelihood to most of small and marginal farmers of Bihar, Maharashtra, Odisha and other temperate region of country. For Mushroom cultivation require labor on the daily basis so it provide employment in rural area and it is providing typical management and economical advantages over other allied sector in agriculture. This article provides a chronological study of different research articles published from the year 2013-2024. The present article provides a theme and pattern on which research was conducted and it can be classified into five categories that is socio-economic conditions of growers, production, economic analysis, marketing scenario& value chain and constraints face by growers. The finding indicates that mushroom entrepreneurship is to great extent a metropolitan or semi-metropolitan undertaking. Post-harvest losses can be reduced by providing training and adopting different value addition methods at production level. It requires concentration on various marketing strategies for spread awareness about nutrition content and increasing in demand. Thus, value addition and marketing strategies can help in export of mushroom to earn foreign revenue.

Highlights

- *Mushroom cultivation requires small land, less time and make more profit than other agriculture sector.*
- *Major constraints faced by producers are low technical knowledge, credit facilities, technology, disease pest attack and transportation facilities.*
- *Post-harvest technologies can be useful for enhancing profitability.*

Keywords- Mushroom production, Socio-economic, Constraints, Post-harvest technology, Foreign revenue

Introduction:

Man started cultivation of crops around 10,000 years ago so mushroom is a relatively new idea for them. Mushrooms have been picked and consumed in several parts of the world, but commercial cultivation started after World War II [28]. India has long history with mushroom. The ancient religious texts like ‘Rig veda’ and ‘Atharva veda’, describe juice of mushroom as ‘Soma Ras’ but the commercial Cultivation of mushroom is a recent origin in India. it started in 1961. After that mushroom development project was launched under U.N.D.P. Then numbers of R & D activities in Button and various other mushrooms and mushroom production progressed [6].

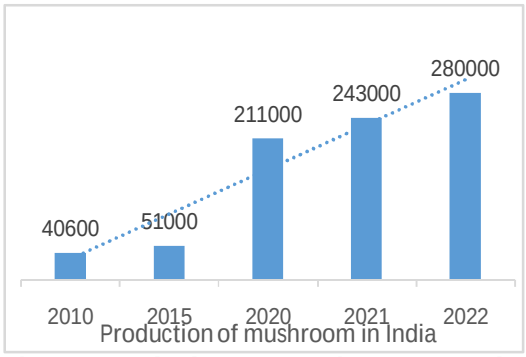
India's FDI (Foreign Direct Investment) policy aims to attract investment in technology to development and production of vegetables and mushrooms under controlled conditions (Annual report 2017-2018). Efforts are being made by the Indian government to improve mushroom research and development and to encourage mushroom growers to develop advanced Research & Development technologies and policies. The Research & Development and biotechnology laboratories play a vital role in the mushroom breeding process and the optimization of the cultivation environment for better yield. Such technological advancements and favourable government initiatives promise ample growth opportunities for the industry participants and mushroom researchers.The fresh mushroom contains about 85-90 percent moisture, 3 percent protein, 4 percent carbohydrates, 3-4

percent fats and 1 percent minerals and vitamins as well as some medicinal properties like lowering blood cholesterol levels, defence against cancer and invigorating hair growth, due to nutritional value it becomes focal point and increase awareness among Indian people.

India has a wide range of agro-climatic conditions and largely an agricultural country with a cultivated area of about 4.37 percent, generating about 620 million tons of agro-waste annually so Mushroom cultivation not only helps in recycling agro-wastes but also contribute the nutritional gap prevalent among a huge population of India [23].

Figure 1.Graphical representation of Indian mushroom production scenario

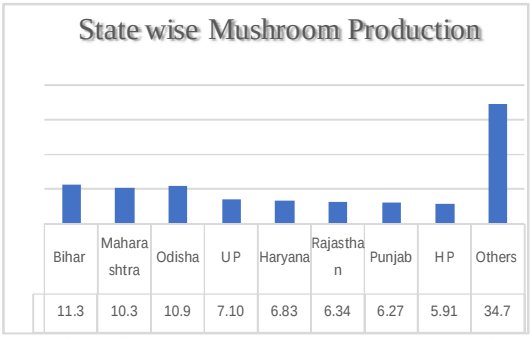
In 2022, the total mushroom production in India is around 2,80,000 metric tonnes. From 2010



to 2022, the mushroom industry in India has increased at compound annual growth rate of nearly 17.45 percent per annum [4]. It shows an overall upward trajectory in mushroom production in the country. It is important to producers get good quality spawn to produce good quality mushrooms. In India, the demand for good quality spawn is high but supply is low. [16].

Figure 2. State wise mushroom production in India

Various types of Mushrooms are produced in our country. Bihar, Maharashtra, Orissa, Haryana and Uttarakhand are the leading mushroom producing states in India. Approximately 50



percent of production is contributed by six states namely, Bihar, Maharashtra, Odisha, Uttar-Pradesh, Haryana and Rajasthan. Bihar is the leading state in mushroom production and contributes 11.31 percent in total production. Whereas Gujarat stands at 9th position with 4.46 percent of the total share [2].

Research Methodology

Either a qualitative or quantitative literature review done well gives appropriate information about the many researchers' work. Overview of Literature condenses, synthesizes and defends the work of others. A chronological and systematic study review was done to analyze various aspects of mushroom cultivation including its production scenario, economics of production, value chain analysis, recent trends in industries, constraints and marketing. From 2013 to 2024, 31 research publications were reviewed to identify patterns, problems and common themes. The results were

classified into five categories: socioeconomic background of grower, production, economics, value chain and marketing, and constraints.

Result and Discussion

Socio-economic background

A study on socio-economic profile revealed that the majority of mushroom growers had land holding less than 2 hector (70%) and Only 3.3 percent were large farmers with more than 10 hector land [25].Most of the participants were from urban and non-agricultural background with nuclear family. Few (12%) had a gross monthly income of more than Rs 10,000[17].Maximum number of the respondents belong to middle age ;32-48 years group (54.2 %), having education up to 10^{th} SSC (30%) and 12^{th} HSC (20%) [17,31]. As mushroom farming enterprise does not require arable land so the respondents from marginal land holding and landless category wanted to adopt this enterprise to augment their family income and 72 percent of women mushroom growers had improved their occupation followed by improvement in standard of living (64%), better saving (60%), knowledge and attitude (52%) and social status (24%) [9,1].

Production of mushroom

A study on mushroom cultivation revealed that used a scientific method provide more assurance to increasing productivity and profitability. Six steps make up the standard mushroom growing method: spawning, substrate preparation, bedding, casing & pinning, harvesting, processing & marketing.For mushroom producers, growing mushrooms can yield a relatively higher percentage of income (37.74%) than crop production on average [27]. Features of the Cultivation site also play an important role. It needs to be kept in the shaded or protected from the direct sunlight. The majority of Mushrooms are grown in low temperature, high humidity, darkness and require sterilized spawn, highly nutritive substrate (which varies depending on the species), good casing-bedding material and frequent inspection of beds.

Since it needs a low temperature to grow, it is primarily grown on hills; however, with the advent of modern cultivation technology, it is now possible to cultivate this mushroom seasonally under controlled conditions and throughout the year. As a result, Technology has directly influenced production and accelerated the adoption of mushroom farming in India [6].

Table 1. Suitable temperature for various mushroom spices

Mushroom species	Suitable Temperature	
	For spawn (C^0)	For cropping (C^0)
1)Button Mushroom	25-28	18-23
2) Oyster Mushroom	25-30	20-25
3) Milky Mushroom	25-30	30-35
4) Paddy straw Mushroom	30-35	28-32

The estimated demand for mushroom spawn is 8000-10000 tonnes in 2018. Mushroom growers seek spawns that are both inexpensive and of high quality. Public sector such as KVK, SAU and government training centers are the first choice for purchasing spawn. Major private spawn

producing labs are located in high production states like Bihar, Maharashtra, Odisha and there is huge global demand for Indian spawn because it has high quality and low price [16]. Farmers use various crop straws as substrate material like wheat, paddy, sorghum, maize, pseudo stem of banana and cotton. Many marginal farmers prepare crop straw compost as replacement of farm yard manure. A study on using cotton compost as mushroom substrate revealed that farmer can save more than 2 times money by using cotton compost as compared to farm yard manure and use of banana pseudo stem waste as substrate is also beneficial [10,15]. Roy et al. (2024)[19] revealed that, out of three subtracts namely, paddy, wheat and paddy+wheat, the oyster mushroom grow on wheat straw performed best. They further revealed that blanching has increased the shelf-life of mushroom up to 96 hours after its harvesting.

Limbule *et al.* (2021) [14] found that proportion of components in subtract preparation played a major role in disease and pest infection. They added that sciarid fly, phorid fly and staphylinid beetle were attacking at different stages of mushroom production.

The mushroom production and consumption are on the rise in rest of the world, India witnesses a lukewarm response in its growth because before independence awareness level about mushroom was low. Nowadays farmers are more attracting toward mushroom farming because of its' higher farm benefit cost ratio. Out of the total mushroom produced the share of white button mushroom was 73 percent followed by oyster mushroom (16%), paddy straw mushroom (7%) and milky mushroom (3%), during 2018. Many wild species are also edible, grown largely in temperate areas and have good nutrition value but urban people consider it to be poisonous so they do not prefer to consume. Compared to other vegetables; per capita consumption of mushrooms in India is meagre and data indicates it is less than 100 grams per year. In 2016-2017, Indian mushroom industry generated revenue of 7282.26 lakhs by exporting 1054 quintals of white button mushroom in canned and frozen form [17].

Economics of Mushroom Production

Dhiman *et al.* (2022) [3] found that average total establishment cost for (150-300 bags) mushroom production unit was around Rs. 83481.74 which varies with unit size. Production cost was increase with unit size. Net return was highest in big production units which led to concluded that growers need to increase their production unit size to get maximum profit and minimize cost. Average total cost of unit (150-300 bags) was Rs. 47774.10 and generated net return was Rs. 24225. Mushroom production per bag was around 2.134 kg and net income was Rs. 14.15/kg.

Koundal and Kumar (2024)[11]also revealed that per 100 square feet the cost of cultivation for mushroom was higher for small farmers (Rs. 3179.20) followed by medium (Rs. 2735.13) and large farmers (Rs. 2666.02). While cost A1, A2 and C was grater for small farmers compared to medium and large farmers. These further revealed that cost of production decreases as unit size increase while the benefit-cost ratio was higher for larger farmers (2.9) flowed by medium (2.7) and small (2.1) farmers. Horo and Singh (2023) [7] also analysed cost- return of mushroom enterprise and concluded that cost of production was Rs. 447.46/sq.m. for Punjab and Rs. 470.86/sq.m. for Haryana and net return was Rs. 30.50/kg and Rs. 29.76/kg respectively.

Break-even output varied from 279 kg to 147 kg mushroom production on small (less than 100 bags) and large unit (more than 100 bags) and benefit-cost ratio was observed average 1.87 for all farm situation [22]. Moreover, analysis of variable cost shows that the purchasing bags have the highest share and the lowest in water change [10].

Marketing and value chain of Mushroom

A study revealed that Mushrooms are marketed as fresh, dried and preserved. Market for mushrooms is growing rapidly because of their nice aroma, subtle flavour, nutritious values and

special taste. Kumar *et al.* (2023) [27] observed that very small units mostly sell their produce to consumers and retailers; whereas very big units depend mostly on wholesalers for selling their produce.

Production of mushroom in India is based on season as well as high tech system industry. The favourable natural agro-climate conditions of India combine with the availability of agro-wastes favours diversified mushroom species cultivation [24].

Mushroom is a highly perishable commodity. Value addition plays an important role in increasing shelf life and market value. Producers can prepare many value- dded products like ketchup, noodles, nuggets, pickles, chips, cookies and many other recipes. Most of mushroom growers sell their products without value addition that's why the marketing channel is short and the export of mushrooms is low. Value addition of mushroom obtained highest net return followed by banana cultivation [8].Benefit cost ratio of value-added mushroom (5.21) was very much higher than fresh mushroom (1.75-2.00) [3].

The main four mushroom marketing channels can be summarized as follows.

Channel 1: Producer - Commission agent/ Wholesaler - Retailer-Consumer
Channel 2: Producer - Retailer - Consumer
Channel 3: Producer - Wholesaler – Consumer
Channel 4: Producer - Consumer

Marketing cost was higher in channel-1 & 3. While marketing efficiency was higher in channel 4. Whereas the price spread was increasing from channel 4 to channel 1 and producers share was highest in channel 1. As the length of marketing channel increases, marketing cost also increases [24,20,30].

Price fluctuation occurs in summer season and price increases extremely therefore processing can help to generate more revenue in off season [12]. The market of mushrooms in India is not yet organized. In other countries, 10 per cent of the total cost is earmarked for marketing. Due to the lack of a marketing system, farmers are unable to get remunerative price. Sometimes farmers needed cash after the threshold the crop and supposed to be forced sale of their produce and get an uneconomic minimum market price. Therefore, profitable transactions and a fair and suitable marketing system are needed in the country. The United States of America, the United Kingdom, Germany are top importers and Poland, Netherland, China are major exporters countries [4].

Constraints faced by growers

Mushroom enterprise can be generating a good amount of side income and play an important role in the upliftment of lifestyle. However, adoption among some farmers has been less due to certain constraints such as growers should take as much care of mushrooms as a grown-up baby. Researchers revealed that unavailability or low quality of spawn, uncontrolled price structure and storage facilities were the main constraints in recent years. Good quality of spawn is essential for getting the best quality of mushroom. State agricultural universities and the privet sector are providing mushroom spawns but the most trusted source is state agricultural universities or grower can also prepare spawn by their selves. It is the most remunerative enterprise but price fluctuation is also a major problem. It gets aggravated during peak production months, also because there is no minimum support price from the Govt. even in states with a good number of mushroom farmers [13,5,26]. Many other constraints are there like a complicated loan procedure, lack of government initiative, lack of awareness about nutritive value, lack of adequate technical guidance, irregular fluctuating production, perishable nature, lack of knowledge about improved cultivation technology, lack of transport to the nearest town, lengthy and non-scientific method of compost preparation, limited post-harvest processing options and lack of regulated market [29,31].

Conclusion

India has enormous potential to become a hub for global business but in few parts of India, people have been considered mushroom as non-vegetarian food and avoid to consume. So, spreading awareness to overcome these beliefs and highlight the nutrition composition and health benefit is a need of hour. Mushroom production is majorly urban and semi-urban activity, nevertheless, promoting it in rural regions will result in various benefits such as livelihood security, economic development among rural people, job creation and treating malnutrition through greater mushroom consumption in rural peoples. Majority of mushroom cultivators were young and educated entrepreneurs and the benefits of mushroom growing spread through word-of-mouth. The high Benefit-cost ratio attracts entrepreneurs and encourages them toward mushroom production. Part-time mushroom ventures also possible for generating additional income. Nowadays, Growers become more aware about value addition and marketing. These two factors drastically impact on increasing profitability and reduce risk of quality loss. Mushroom enterprise requires high capital therefore government should give some importance on this sector and provide credit, marketing and knowledgebased facilities to growers and provide minimum support price to overcome price fluctuation.

Scope of future research

It is now abundantly obvious that mushroom growing has the potential to be extremely important for rural people's food and economic stability, especially for landless, small and marginal farmers. It is having high demand in in developed countries and India stands on 5^{th} rank in world production provides opportunity for researchers to find ways to increase productivity as well as market demand so that the cultivators and other players involved in it and can get maximum benefits. Various studies have been conducted on scientific mushroom production and spawn preparation methods but still there is scope for future study in this field. At the end, it can be suggested that different species of mushroom could produce in different state as per their climate condition still production contribution was too low. So, there is need of research to expand it's cultivation in various parts of India.

Conflict of interest

The authors declare that they have no conflict of interest.

Disclaimer (Artificial Intelligent)

Author(s) hereby declares that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of manuscripts.

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