

Status of mushroom production: Global and national scenario

Shweta Bijla* and V.P. Sharma

ICAR-Directorate of Mushroom Research, Solan (H.P) – 173213

**Corresponding author; E-mail: shwetabijla2@gmail.com*

ABSTRACT

Mushroom cultivation has the potential to be a very lucrative agribusiness venture which addresses several present-day concerns such as resource utilization, circular economy, job creation, sustainability, unpredictable weather, and nutritional security. In India, since majority of the farmers are small-scale and marginal landowners with limited capital, mushroom production is a boon as it uses agricultural waste for growing medium and requires less land, water, and finance. Growing the production of mushrooms would increase their availability throughout the country, which will further help to reduce nutritional insecurity and also raise the income of small and marginal growers. Mushrooms have immense potential for medical and nutraceutical purposes. However, our nation has recently begun to produce and consume mushrooms. Many obstacles faced by mushroom growers including a lack of technical knowledge, inadequate infrastructure, an unorganized market, expensive inputs, etc., still need to be addressed with sufficient research and additional legislative solutions tailored to the requirements of Indian mushroom growers. The paper will describe the growth of mushroom economy globally and in India as well. Some challenges and opportunities are also discussed at the end.

Keywords: Mushroom, agribusiness, small and marginal growers, mushroom economy

Mushroom cultivation began in Asia (China) around 600 AD, Europe (France) in the 17th century, and the United States (America) in the 1900s. In general mushroom uses can be categorized into four categories: medicinal, edible, poisonous, and other (El Sheikh and Hu, 2018). Multi-functional mushrooms had also been documented in existing works (Cheung, 2010). Worldwide, mushrooms have been utilized as food, medication, and decoction due to their high nutritional content. It has very few calories, carbs, or fat and a high concentration of crude fibre, protein, and several essential vitamins and minerals. In many underdeveloped countries, like our own, where there is a significant reliance on diets based primarily on cereals, mushrooms can serve as a source of high-quality protein. Thus, it can be categorized as a

potential commodity which can resuscitate global as well as Indian economy holistically. Below, we confer the significance of mushroom cultivation in the world and Indian economy in details along with the challenges faced by Indian mushroom growers.

A. Global scenario

Mushrooms have been recommended by Food and Agriculture Organization (FAO) as protein food specially for developing nations which mainly depend on cereals to meet their protein requirement (Marshall and Nair, 2009). Contrary to cereals, mushrooms do not require large land for cultivation as it is vertical farming in racks indoors. Systematically followed mushroom cultivation can support the livelihood of

STATUS OF MUSHROOM PRODUCTION

small and marginal farmers economically as well as nutritionally as it is a short duration crop with numerous health and economic benefits (Marshall and Nair, 2009). Global mushroom production has grown at 8.26% compound growth rate per annum (CAGR) over the last 20 years. This CAGR is highest for Asian continent (8.97%) followed by Africa (6.31%) continent (Table 1).

Mushroom production in the world has increased more than five times since 2000 and presently, it stands at as 44 million tonnes (FAOSTAT, 2023) with

Asian continent as the major producer with 95% share in production after that European (3%), and American continent (1%). As far as country-wise production is concerned, presently, the leading countries in terms of fresh mushroom production shown in table 2 are China (93%), Japan (0.01%), and Poland (0.01%). India stands at number six with around 0.24 million tonnes production. (FAO, 2023). Although, as per its domestic data updates, it has reached 0.31 million tonnes. Interestingly, the CAGR of fresh mushroom production of China (9.23%) and India (8.58%) is comparable for the last 20 years despite of the

Table 1. Global mushroom production trend & CAGR: continent-wise (1970-2021) (in million tonnes)

Year	World	Africa	America	Asia	Europe	Oceania
2000	8.781	0.011	0.464	7.196	1.066	0.045
2001	10.022	0.011	0.463	8.384	1.116	0.048
2002	10.980	0.011	0.452	9.342	1.123	0.052
2003	12.650	0.012	0.476	10.984	1.130	0.048
2004	13.849	0.013	0.472	12.174	1.135	0.055
2005	15.573	0.013	0.467	13.942	1.094	0.057
2006	16.943	0.013	0.472	15.335	1.071	0.052
2007	19.056	0.015	0.443	17.467	1.080	0.051
2008	20.887	0.016	0.485	18.960	1.372	0.055
2009	23.176	0.016	0.486	20.900	1.723	0.050
2010	24.977	0.017	0.474	22.761	1.678	0.047
2011	28.934	0.018	0.513	26.467	1.881	0.054
2012	31.780	0.020	0.528	29.016	2.166	0.050
2013	34.284	0.022	0.528	32.428	1.253	0.052
2014	35.368	0.025	0.554	33.458	1.271	0.061
2015	37.480	0.026	0.536	35.511	1.364	0.044
2016	38.661	0.025	0.547	36.730	1.307	0.052
2017	39.811	0.026	0.544	37.875	1.319	0.048
2018	40.583	0.028	0.542	38.726	1.235	0.053
2019	41.739	0.032	0.516	39.863	1.279	0.050
2020	42.923	0.034	0.503	40.929	1.406	0.051
2021	44.207	0.037	0.482	42.143	1.501	0.044
CAGR (2000-21)	8.26	6.31	0.77	8.97	1.29	-0.09

Source: FAO, 2023

Table 2. Production trend & CAGR of Top 10 countries for fresh mushrooms in the world (2000-2021) (million tonnes)

Year	China	Japan	Poland	USA	Netherlands	India	Spain	Canada	Russia	France
2000	6.644	0.424	0.109	0.384	0.265	0.024	0.063	0.080	0.006	0.204
2001	7.828	0.427	0.110	0.377	0.275	0.030	0.110	0.086	0.006	0.196
2002	8.774	0.430	0.120	0.377	0.270	0.040	0.135	0.075	0.007	0.175
2003	10.396	0.434	0.135	0.388	0.263	0.040	0.129	0.088	0.006	0.170
2004	11.610	0.406	0.150	0.388	0.260	0.040	0.139	0.085	0.006	0.165
2005	13.360	0.420	0.160	0.387	0.245	0.040	0.138	0.080	0.005	0.139
2006	14.749	0.430	0.169	0.383	0.235	0.035	0.135	0.089	0.006	0.116
2007	16.829	0.440	0.180	0.360	0.240	0.037	0.132	0.083	0.006	0.132
2008	18.278	0.450	0.185	0.369	0.255	0.037	0.134	0.116	0.006	0.139
2009	20.214	0.460	0.207	0.372	0.230	0.037	0.131	0.114	0.006	0.114
2010	22.020	0.470	0.230	0.359	0.266	0.041	0.133	0.115	0.005	0.119
2011	25.726	0.470	0.220	0.391	0.304	0.041	0.146	0.122	0.004	0.116
2012	28.289	0.460	0.230	0.403	0.307	0.030	0.147	0.125	0.005	0.117
2013	31.705	0.460	0.249	0.408	0.323	0.017	0.150	0.120	0.008	0.104
2014	32.708	0.460	0.263	0.432	0.310	0.028	0.150	0.122	0.008	0.109
2015	34.772	0.450	0.269	0.421	0.310	0.051	0.219	0.115	0.009	0.101
2016	35.979	0.460	0.280	0.428	0.300	0.076	0.148	0.119	0.010	0.100
2017	37.130	0.459	0.291	0.423	0.300	0.102	0.159	0.120	0.016	0.086
2018	37.901	0.467	0.200	0.416	0.300	0.134	0.166	0.126	0.031	0.083
2019	38.981	0.470	0.235	0.384	0.270	0.182	0.170	0.132	0.048	0.088
2020	40.008	0.471	0.320	0.370	0.260	0.211	0.166	0.133	0.086	0.080
2021	41.127	0.469	0.379	0.344	0.260	0.243	0.164	0.138	0.111	0.099
CAGR	9.23	0.57	5.04	0.22	0.63	8.58	2.54	2.81	11.70	-3.91

Source: FAOSTAT, 2023

substantive advancements in China, presenting encouraging growth of Indian mushroom industry vis-a-vis global leader.

In nations like European and USA, white button mushroom is grown majorly on commercial basis, while in Asian countries like China the situation is different and other species are also taken up for commercial production. Majorly six mushrooms dominate the global production and market viz. shiitake mushroom (26%), oyster mushroom (21%), black ear

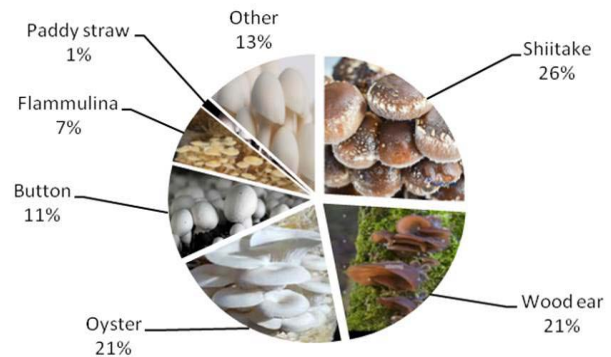


Fig. 1. Species wise share of mushrooms in global production

STATUS OF MUSHROOM PRODUCTION

mushroom (21%), button (11%), *Flammulina* (7%), paddy straw mushroom(1%), and others mushrooms (13%) (Fig 1).

Table 3 shows the production scenario for various processed mushroom products. China leads the world in mushroom canning output with 83%, followed by the Netherlands with 6% and India with 3%. Despite the large differences in output and market share, India leads the globe in the CAGR of canned mushrooms, at 24%, surpassing both China and the rest of the world combined at 21%. It exhibits the noteworthy expansion of canning within the Indian mushroom sector. This also holds true for the manufacturing of dried mushrooms. Its current production is estimated

to be 4 million tonnes, with China accounting for 97% of it, Japan for 1%, and India for 1%.

B. Indian scenario

Although the mushroom production and consumption is on the rise, India has a tepid response to it. Indian mushroom industry is majorly focused on few labour and capital intensive mushrooms. With abundant agro-residue resources, cheap labour and wide range of suitable climatic conditions, we have enormous scope of producing mushrooms at cheap rates. As vertical and indoor space is utilized for mushroom production, comparatively less land and capital are required. Markedly, the average operating

Table 3. Production trend & CAGR of major countries for canned mushrooms in the world (2010-21)

Year	World	China	Netherlands	India	Poland	Spain
Canned mushrooms (million tonnes)						
2010	0.74	0.33	0.15	0.02	0.02	0.03
2011	0.86	0.39	0.16	0.02	0.02	0.04
2012	1.09	0.45	0.21	0.01	0.03	0.04
2013	0.97	0.49	0.23	0.01	0.03	0.04
2014	0.96	0.53	0.26	0.01	0.04	0.04
2015	1.06	0.55	0.28	0.02	0.06	0.06
2016	0.99	0.53	0.21	0.04	0.08	0.04
2017	1.01	0.56	0.19	0.05	0.07	0.04
2018	1.07	0.58	0.21	0.06	0.07	0.05
2019	3.19	2.67	0.21	0.08	0.07	0.05
2020	3.32	2.74	0.26	0.10	0.06	0.05
2021	3.39	2.82	0.20	0.11	0.08	0.05
CAGR (2010-21)	13.80	20.96	2.13	24.41	11.95	3.07
Year	World	China	Japan	India	Poland	Netherlands
Dried mushrooms (million tonnes)						
2010	0.55	0.45	0.06	0.00	0.01	0.00
2011	0.64	0.53	0.06	0.00	0.01	0.00
2012	0.72	0.61	0.06	0.00	0.00	0.00
2013	0.76	0.66	0.06	0.00	0.01	0.00
2014	0.75	0.71	0.01	0.00	0.01	0.01
2015	0.78	0.74	0.01	0.00	0.00	0.01
2016	0.77	0.73	0.01	0.01	0.01	0.01
2017	0.81	0.76	0.01	0.01	0.01	0.01
2018	0.90	0.80	0.06	0.01	0.00	0.01
2019	3.77	3.66	0.06	0.02	0.00	0.01
2020	3.88	3.75	0.06	0.02	0.01	0.02
2021	3.99	3.86	0.06	0.02	0.01	0.01
CAGR (2010-21)	19.41	21.15	-0.03	25.00	-3.24	16.39

Source: FAO, 2023

holding size in India has declined to 1.08 hectares (GoI (a), 2020). With an average land holding size of 0.50 ha, the majority of farming population belong to small and marginal category (GoI, 2023). A minimum viable controlled unit of white button mushroom needs an area that is even less than 0.1 hectares. For other mushrooms like oyster grown on locally available agricultural and agro-industrial wastes, no sophisticated infrastructure is required which makes the operational cost as low as Rs. 30-40 per kg of mushroom. Thus, with such minimum requirements, mushroom farming can be considered as a diversification tool for land and capital-constrained farmers.

1. Growth of mushroom production

While mushroom growing has a long history worldwide, it wasn't until the 1960s that it initiated in India (Sharma *et al.*, 2020). China leads the world in mushroom output, which now exceeds 40 MT globally. There is considerable growth in Indian mushroom production in recent years. Twenty years from now, we produced mere 44000 metric tonnes of mushrooms, but at present, India is producing 0.31 million tonnes of mushrooms with position in the top 5 countries in the world. Over the past ten years, the production has grown at a Compound Annual Growth Rate (CAGR) of about 8%, going from 0.03 MT to 0.3 MT; in contrast, China's CAGR is only 3.81% (2012–2021). Additionally, between 1970 and 2022,

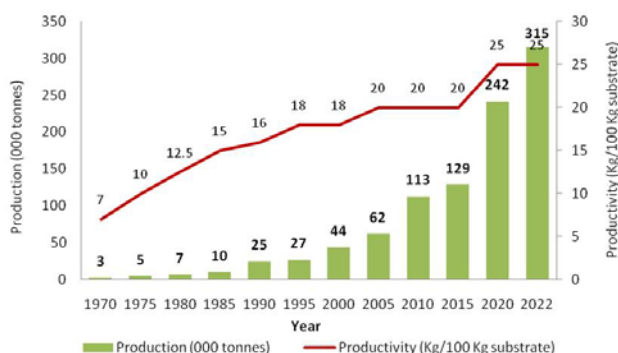


Fig. 2. Mushroom production and productivity trend in India (1970-2022)

the productivity of Indian mushrooms increased from a meagre 7% to 25% (Fig 2) due to improved strains of commercial edible mushrooms, improved cultural practices etc.

2. Relative share of different mushroom species

In our country, 5 major mushroom species are cultivated commercially *i.e.* button mushroom (*Agaricus bisporus*), oyster mushroom (*Pleurotus spp.*), tropical mushrooms *viz.* paddy straw mushroom (*Volvariella volvacea*), milky mushroom (*Calocybe indica*), and shiitake (*Lentinula edodes*). The relative contribution of each type of mushroom to the overall production is shown in Fig 3. As is clear, India's production situation does not exhibit particularly significant variation but still the diversification is in nascent stage. Button mushroom grabs the first space with major (70%) share followed by oyster mushroom (17%), paddy straw mushroom (9%), milky mushroom (3%), and others (shiitake, *Hericium*, *Ganoderma*). By using a year-round culture model, it is possible to grow a variety of mushrooms in a range of temperatures and in a low-cost system, based on the specific temperature requirements at different periods of the year.

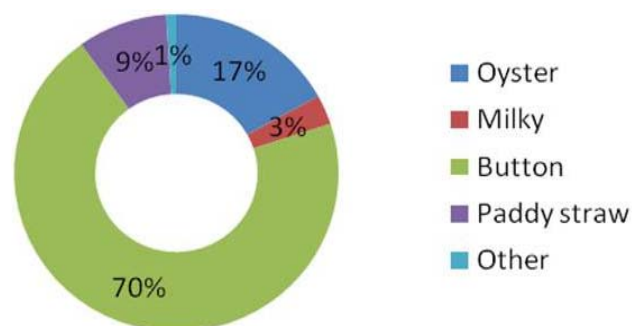


Fig. 3. Relative shares of different species in Indian mushroom production

3. State-wise mushroom production

In terms of states, Bihar is the number 1 mushroom producing state with a production of around 35.6 thousand tonnes and 11% share in total production

STATUS OF MUSHROOM PRODUCTION

figure. Second to that is Odisha with around 34.5 thousand tonnes of production followed by Maharashtra (32.5 thousand tonnes), Uttar Pradesh (23.4 thousand tonnes), and Uttarakhand (22.4 thousand tonnes) (Fig 4).

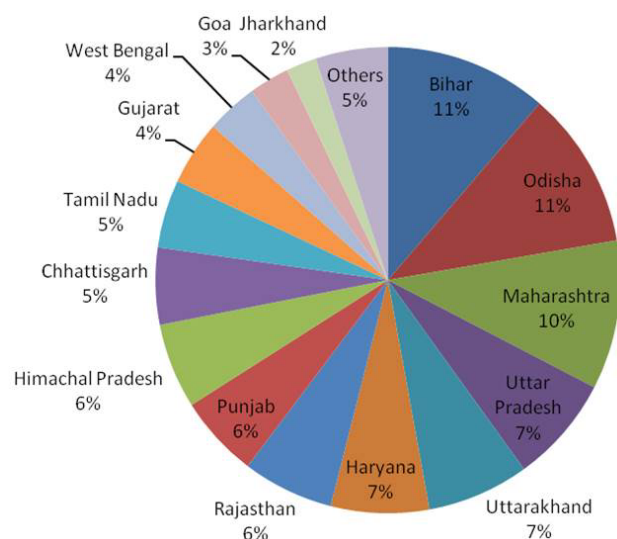


Fig. 4. Statewise share in mushroom production

The Northern states of Punjab, Haryana, and Himachal are majorly focused on button mushroom. Haryana and Punjab becomes the hub of compost preparation and seasonal button mushroom cultivation during the months of September to Mid-March. Milky mushroom is a kind of native to tropical states *i.e.* Southern India, while Paddy straw mushroom is

mainly grown in Odisha and Chhattisgarh due to abundant availability of paddy straw as a substrate material. Various promising, short duration and improved strains of other mushrooms such as shiitake, *Hericium*, *Ganoderma* have been developed, but their adoption is still in nascent stage in the country and is not yet adapted to their full potential. Such mushrooms present minimum land investment requirements along with medicinal value and good returns and medicinal value, hence should be promoted and adopted to reduce poverty and strengthen nutritional security in India (Bijla and Sharma, 2023).

C. Global mushroom trade scenario

Table 4 portrays the key trade destinations and import sources of Indian mushroom growers. In 2020, India earned a total of 8.65 million USD from the export of mushrooms. The major destinations are France (42%) and Germany (21%), followed by Switzerland (8%), Nepal (4%) and Hong Kong (3%).

D. Challenges and opportunities of mushroom production in India

As mushroom is a unique crop, mushroom growers also have several unique challenges. It is non-traditional in a number of respects such as it is primarily cultivated indoors rather than on open field,

Table 4. Major trade export destinations and import sources with value (Million USD)

S. No.	Trade destinations/ sources	Export value (Million USD)	% share
1	France	3.66	42
2	Germany	1.79	21
3	Switzerland	0.66	8
4	Nepal	0.34	4
5	Hong Kong	0.26	3
6	Others	1.94	22
Import value (Million USD)			
1	China	0.99	78
2	Thailand	0.17	13
3	Nepal	0.07	6
4	Sri Lanka	0.04	3

Source:GoI(b), 2020

and it needs agricultural leftovers as a growth substrate rather than soil. It also demands technical know-how and a deeper understanding of marketing non-traditional crops. As a result, growers may have difficulties with marketing, capital supplies, practical knowledge, etc.

Mushroom production is highly technical in nature, It requires sophisticated infrastructure, machineries etc. India as a country lacks hugely in development of adequate infrastructure in terms of quality and standardized spawn production units, compost preparation facility, post-harvest infrastructure such as cold chains, processing facilities etc. Inadequate networking and collaboration, blind-spot in backward and forward market linkages are some challenges faced by Indian mushroom growers.

Apart from this, the major marketing bottleneck is lack of awareness about different mushroom species and mushrooms in general. Mushrooms are generally not included in the traditional diets of Indians. It can be attributed to various factors such as lack of familiarity with the taste, lack of knowledge on nutritional and medicinal benefits, limited promotion and marketing from public as well as private sector. It is an important challenge to overcome cultural biases and reach urban customers where the demand might be high while not ignoring the rural areas where the reach of bio-fortified and functional foods is limited.

With 5th rank in production worldwide, we are yet not a major player in global mushroom trade. Maintaining consistent standard and quality is a key factor in international trade. We must ensure good quality spawn, hygienic substrate preparation, good cultivation practices, effective disease and pest management, sanitary post-harvest handling of the produce etc. to comply to international standards.

Various varieties, strains, spawn and compost-related technologies have been developed and commercialized, yet the gap persists in terms of

research collaborations, adoption, and higher returns in any area of mushroom cultivation. Mushroom industry is a promising field for Indian government, yet it suffers from supportive and targeted policies in the part of policy making agencies.

E. Way forward

With its vast population, plentiful biodiversity, diverse climate, and affordable access to agricultural resources and labour, India has the immense potential to develop into a nucleus for the mushroom industry as a whole. However, it is the obligation on part of both the public sector and the related stakeholders in the mushroom industry to consider above-mentioned issues by continuous backing in terms of increasing investments in R&D, raising awareness, expanding market access, fortifying value chains and connections, entrepreneurship, policy reforms etc. These positive alterations will act as pivot in growth and sustainability of Indian mushroom industry.

REFERENCES

1. Bijla, S., and V.P. Sharma. 2023. Economic analysis of shiitake mushroom cultivation as an agribusiness enterprise in India. *Economic Affairs* **68(2)**: 1101-1106.
2. Cheung, P.C. 2010. The nutritional and health benefits of mushrooms. *Nutrition Bulletin* **35(4)**: 292-299.
3. El Sheikha, A. F., and D.M. Hu. 2018. How to trace the geographic origin of mushrooms? *Trends in Food Science & Technology* **78**: 292-303.
4. Food and Agriculture Organization. 2023. *FAOSTAT Statistics database 2023*. Food and Agriculture Organization of the United Nations.
5. GoI. 2020a. *All India Report on Agriculture Census 2015-16*. Ministry of Agriculture & Farmers' Welfare. Department of Agriculture, Cooperation & Farmers' Welfare. New Delhi.

STATUS OF MUSHROOM PRODUCTION

- Available at https://agcensus.nic.in/document/agcen1516/ac_1516_report_final-220221.pdf
6. GoI. 2020b. *World Trade Analytics. Ministry of Commerce and Industry*. Directorate General of Commercial Intelligence and Statistics.
 7. GoI. 2023. *Annual Report 2022-23*. Department of Agriculture, Cooperation & Farmers' Welfare. Ministry of Agriculture & Farmers' Welfare, New Delhi.
 8. Marshall, E., and N.G. Nair. 2009. *Make money by growing mushrooms*. Food and Agriculture Organization of the United Nations (FAO).
 9. Sharma, V.P., M. Shirur, R.C. Shakywar, S.K. Annepu, S. Kamal and M. Singh. 2020. Status and scope of mushroom farming in Arunachal Pradesh. In *Perspective plan for resurgent agriculture and allied sector in Arunachal Pradesh*. Chintala, G.R., Mani, G. and Gupta, H. (eds.). pp97-111. NABARD.