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Waste to Wealth: India's case of Growing Consumption Demand for Mushrooms in Post Pandemic Era

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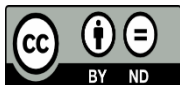


Keywords:

mushroom, consumption, behaviour, agribusiness, secondary agriculture, waste to wealth

ABSTRACT

This paper is an attempt to highlight the increasing entrepreneurship opportunities in rural India arising out of an increase in demand for mushrooms in post pandemic era. Growing mushrooms is easy, less cost intensive and economy is different from the linear economy in the sense that it has no open loops. What is the end product or waste from a process is utilized as raw material in other process, and aids in further wealth generation. The purpose of this study is to assess the potential of one of such waste to wealth generating enterprises – mushrooms. A survey of 788 households across India suggests a positive outlook for mushroom industry in India. There is a wider acceptance of mushroom and its products among population, and many treat it as a relatively cheaper source of protein. About 68% respondents expected that the demand for mushroom by their family will increase in the future. Mushroom cultivation is finding pace in states like Bihar where many migrant workers during covid-19 pandemic have taken up mushroom cultivation as an income generating enterprise. All India Coordinated Projects on Mushrooms under Indian Council of Agricultural Research have been successful in creating hundreds on mushroom enterprises across India. Value added products of mushrooms could be a good way to introduce it among the population who does not appreciate the raw product. Supply chain strengthening will certainly lead to better reach of product to potential consumers.



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1. INTRODUCTION

Mushrooms are rich in nutrients, medicinal properties and are considered as super food. Mushrooms are low calories, high protein foods that provide dietary fiber, vitamins and minerals. They have several medicinal properties [28], [13], [1], [5]. Carbohydrate content in mushrooms varies between 35-70% and the protein content ranges from 1.6-2.1 g/100g. Mushrooms are good source for unsaturated fatty acids, vitamins and minerals [4], [11]. If exposed to UV light after harvesting, mushrooms can continue to produce more

amount of vitamin D. These in fact are the only vegetarian unfortified food source that can provide a substantial amount of vitamin D in a single serve. The free amino acids composition in mushrooms varies greatly but in general they are rich in threonine and valine, and lack in sulphur containing amino acids like methionine and cysteine [15].

Mushroom cultivation is increasingly being adopted as an agri-business enterprise in rural and urban India. The committee on Doubling Farmers Income (DFI) of the Government of India identified mushroom cultivation as one of the important secondary agriculture enterprises, as it generates economic and ecological benefits, and also generates wealth from waste. The agro-wastes get completely recycled during mushroom cultivation and may further be used as manures on farm. The activity has huge scope for generating additional income and employment, not just in production, but in value addition too. Hence, mushroom cultivation is increasingly finding a bigger space in the rural areas as well as semi-urban centers. The cultivation utilizes agriculture crop residues as base material to produce protein rich food. Cultivation of mushrooms do not require productive land/soil and neither relies on direct sunlight. Besides, these small agri-businesses do not need considerable monetary investments. So, this enterprise may improve the socio-economic condition of farmers and rural youths for both the educated and uneducated youth, and particularly rural women [6]. However, as the cultivation is picking up, it is equally important to understand the scope for demand through the consumers. This study therefore is an attempt to draw conclusions from a pan-India consumer survey to understand the scope for future demand and indirectly the scope for expansion of mushroom production in India.

2. Data and Methodology

Due to ongoing Covid pandemic restrictions in the country, the study is based on online survey of consumers in India using Google Form. The survey instrument was circulated through social media and responses were collected from the consumers during August- September 2021. Apart from this, secondary source of information was also used to understand the mushroom ecosystem in India.

3. Mushroom production in India

As per National Horticulture Board, Government of India, mushroom production in India has increased from 17 thousand tonnes in 2013-14 to 487 thousand tonnes in 2017-18. However, thereafter the production dropped suddenly to 182 thousand tonnes in 2018-19, but bounced back in the following years and continues to rise. A large part of this growth is observed in the state of Bihar (Misra, 2021). Lakhs of people migrated to the state due to Covid-19 related lockdown. The reverse migration started during first lockdown and continued later as well. The jobless workers found mushroom cultivation as one of the best alternative enterprises for income generation. In North Bihar, which is more prone to recurrent floods, mushroom cultivation is getting highly popular among small and marginal farming communities. In order to promote mushroom cultivation in rural India, Indian Council of Agriculture Research (ICAR)-Indian Institute of Farming Systems Research, located at Modipuram, in Uttar Pradesh state also initiated a Technology Transfer Programme (TTP) entitled "Transfer of mushroom production technology as an entrepreneurship option to farmers, youths and unemployed workers under COVID-19 Pandemic". Demand for mushroom also increased in post-pandemic period, as high protein diet was recommended by medical practitioners to fight Coronavirus. Similar findings were recorded by Mark Lang of the University of Tampa who reported in the study that the demand of fresh mushrooms increased during the pandemic and post-pandemic period, even in the restaurants as well. A study by Allied analytics suggested that the mushroom industry is expected to reach \$53.34 billion by 2027 registering a CAGR of 9 per cent from 2021-2027. A positive outlook paints a healthy picture of growth of mushroom production in India and all over the World.

In India, Haryana is leading with annual mushroom production of 20 thousand tonnes. In fact, top 5 states together (Haryana, Odisha, Maharashtra, Himachal Pradesh, and Punjab) contribute about 55 per cent of total mushroom production in the country. The state-wise production trend is given in table 1.

Technically, mushrooms are neither plants nor animals, rather it is fungi. They don't emerge from seed but from spawns. Therefore, the sector is free from any kind of regulation like Seed Act. That is a matter of concern for the mushroom growers as they sometimes become the victim of a poor-quality spawn. Mushroom cultivation is considered as one of the best alternative enterprises to support farm incomes. Presence of natural agro-climatic conditions of India along with availability of agro/crop-wastes favors varied mushroom species production [26]. However, the cultivation is more skewed towards white button mushroom variety for its popular acceptance among consumers. At present, mushroom is cultivated all over India as small-scale non-farm enterprise.

4. Types of mushrooms

Majorly five mushroom species are under commercial cultivation in India. These are White button mushroom (*Agaricus bisporus*), Oyster mushroom (*Pleurotus* spp.), Paddy straw mushroom (*Volvariella volvacea*), Milky mushroom (*Calocybe indica*) and Shitake mushroom (*Lentinula edodes*). Even though, production technologies of most of the introduced species are standardized, the commercial markets are still ruled by *Agaricus bisporus* (white button mushroom), *Pleurotus* spp. (oyster mushroom), and *Volvariella volvacea* (paddy straw mushroom). White button mushroom leads with 85% market share followed by oyster mushroom (7%), paddy straw mushroom (6%), and milky mushroom [23], [12]. Even though, India has standardized the short period production technology for shitake mushrooms, it is observed that it's still not been exploited commercially [24].

Initially, white button mushroom used to be cultivated in temperate hilly areas of India. However, with the progress in process of composting and optimization of fruiting situations with the help of chilling system, there has been an extraordinary change in its cultivation scenario and now it is cultivated all over the country. As of now, highest cultivation of button mushroom is registered from Punjab followed by Haryana and Maharashtra. These three states account for 43% of India's white button mushrooms. Many medium to small scale mushroom producing units are situated in the states of Gujarat, Uttar Pradesh, Tamil Nadu, Himachal Pradesh, Goa and Uttarakhand. Estimated total white button mushroom produced in India is 94,676 metric tonnes (MT) from both seasonal and high-tech industrial institutions. From this, nearly 8500 MT (9%) of button mushroom is produced seasonally from the growing units located in Punjab and Haryana. Most of the producers in these areas started seasonal cultivation of white button mushroom for subsistence purpose and also as income generating enterprise. The benefits like proximity to market, presence of raw material at low cost along with the availability of good quality spawn has enhanced the mushroom production from this region and has helped these growers realize better incomes [18]. Oyster mushroom production, on the other hand is leading small scale enterprise in the North Eastern states, Uttarakhand, Chhattisgarh, and of late, is gaining popularity in Bihar too. And, the reason for rising popularity is its price and drying ability. Oyster mushrooms are ready to harvest in just 20-25 days and about 6 crop cycles may be harvested a year.

The average price of oyster mushroom is Rs 200 per Kg, while that of button mushroom and milky mushroom are Rs 150 per Kg and Rs 300 per Kg, respectively (KrishiJagran, 2021). While button mushroom farming is more input intensive as it requires compost; oyster and milky mushrooms can be grown on paddy straw. Button mushroom ready to harvest crop takes more time. Around 8-10 huts including area for compost preparation can be accommodated on an acre of land. Even though mushroom

cultivation is a low capital-intensive activity, introducing tropical and sub-tropical mushrooms in the production cycles can yield round the year mushroom production, thus increasing scales, reducing per unit costs and generating higher monetary benefits [7]. An analysis by [27] suggests a B:C ratio of 1.65 for oyster mushroom grower (250 bags, 1.5 Kg harvest/bag), 1.83 for milky mushroom grower (250 bags, 1.8 kg harvest/ bag), and 1.84 for button mushroom (250 bags, 1.5 kg harvest/ bag). These were calculated under the assumption that the grower only purchases a ready bag with spawn and their job is only to grow mushrooms. The returns that grower is able to reap come from the sale of mushrooms and also from the compost (spent) bag. The authors suggest that a mushroom grower can take all three varieties of mushroom in a year under different temperatures and make profits throughout the year. With this scale of production, the employment generated to produce 250 bags of each mushroom throughout the year (by each enterprise i.e. compost maker, spawn producer and grower) varies in the range of 90-100 mandays per annum. Hence mushroom production is less labour intensive, less costly, and high income generating enterprise.

5. Trade of mushrooms

India's part in export of mushrooms till 1993 was negligible, but for the first time in 1994, India emerged as the second largest exporter of canned mushrooms in place of Taiwan and also featured in US imports. The total exports of white button mushroom from India in 2016-17, were 105.4 tonnes in canned and frozen form valued at Rs. 7,282.26 lakhs (DGCIS, 2017). There is a lot of scope in diversified mushroom export by cultivating other mushroom species. Up gradation of skill along with technical and scientific man power on mushrooms will serve the technological requirements of the mushroom industry. Indian mushrooms are mostly exported to USA, European countries and Hong Kong in either fresh or processed form. Button mushroom has a whopping share in exports (around 95%). However, India's mushroom exports contribute less than one per cent to the global mushroom exports (INTRACEN, 2022). For Indian mushrooms, China and Poland are the biggest competitors and US and European Union is the biggest markets. Middle East countries are also emerging as potential markets for Indian mushrooms. Table 2 below is the year wise trend in export of mushroom. In last decade, there is a considerable growth in export of mushroom from India. The total value of mushroom export in the year 2009 was US\$ 17.95 million. However, there has been huge fluctuation in export value of mushroom over the years.

6. Mushroom consumption pattern

Rapidly evolving production, marketing and distribution technologies, awareness of consumers towards the health benefits of mushrooms, availability of variety of mushroom dishes by hotels and restaurants are bound to push mushroom consumption demand not just in India, worldwide too. It is expected that worldwide demand for fresh mushrooms will be more as people now a days have more preference towards non preservatives in food. Furthermore, the pandemic Covid-19 has also promoted the consumption of proteins in diet and mushroom therefore is going to gain wide popularity and acceptance among non-vegetarian population as well as among vegans too.

The global mushroom market is divided into three major categories- edible, medicinal and wild mushrooms. China is the largest producer of edible mushrooms in the world. It accounts for around 75 per cent of the global mushroom production. Not just this, per capita consumption of fungi (including mushrooms) is also highest in China, approximately to the tune of 20 Kg per person per year (Karol Kania Synowie, Poland, 2019). The European countries have on an average per capita mushroom consumption between 3-4 Kg, while that in India is less than 100 g per year [24], that shows huge market opportunity and scope for expansion in India. The United States has witnessed an increase in consumption by 240 per cent between 2013 and 2019. The US hailed mushrooms as superfood of 2019 (Karol Kania Synowie, Poland, 2019). Rising health consciousness among people for highly nutritious food is one of the key factors that will drive

the production and consumption growth in coming years. Rapidly expanding HORECA (Hotels, Restaurants, & Café) segment also fuels the demand for various types of mushrooms. Additionally, export opportunities arise from processing mushrooms into various value-added products. The investment on R&D has resulted in development of new technologies. The government support to the Micro, Small and Medium Enterprises (MSME) sector has accelerated the new entrepreneurial opportunities in the mushroom industry. An expanding production base is very likely to expand the consumer base in near future. According to the Fortune Business Insights, in 2018, the global mushroom market was 12.24 million tons and is expected to increase up to 20.84 million tons by 2025, at a CAGR of 6.41 per cent between two years. The commodity is gaining popularity due to health benefits, low production costs, and improved technologies, worldwide. The commercial units are coming up in the sector with improved logistics and distribution facilities. All this is gearing up the future demand for mushroom and paints a very positive picture for the major producing countries.

Worldwide, button mushrooms or *Agaricus bisporus* is the most widely cultivated and consumed mushroom in the world. It is also the most preferred mushroom by Indian consumers, despite of its very short shelf-life. This specific variety of mushroom requires 16⁰-18⁰C in reproductive phase and 24⁰-26⁰ C in vegetative phase [7]. In India, it contributes around 70 per cent to the total mushroom production. Other commonly grown edible mushrooms in India are Oyster mushroom, Milky mushroom, paddy straw mushroom and shitake mushroom. All these have different temperature requirements and therefore a combination of varieties may be taken throughout the year by the farmers. In terms of availability therefore, different varieties are available throughout the year. However, only oyster mushrooms can be made available throughout and others are seasonal in nature. The reason behind this is that the oyster mushroom can be dried and stored. Mushrooms are majorly consumed in clubs, hotels, Chinese food restaurant and households. Many of the restaurants have several mushroom-based recipes (like mushroom biryani, button mushroom dishes, mushroom gravy, malai mushroom curry, etc.).

Mushrooms are majorly consumed in fresh forms, and one of the major reasons behind this is its low shelf life. Under refrigerated conditions, fresh whole mushrooms can last for 7-10 days, fresh sliced for 5-7 days, cooked mushrooms last for 7-10 days. Counterintuitively, only dried mushroom can last for 2-3 years. Other forms in which mushrooms are available worldwide are dried, canned and frozen. Drying reduces the moisture content in mushrooms and enhances their shelf life. While button mushrooms are difficult to dry; oyster, shitake and a few others can be easily dried, and sold throughout the year bringing in income to the farmer/entrepreneur on one hand and fulfilling the demand by the potential mushroom consumers round the year. Dried mushrooms can either be cooked or consumed or can also be processed into flour. Mushroom powder can be utilized as supplement to raise the dietary fibers in different foods and also as a partial substitute for wheat flour in the bakery products bread, cakes, biscuits and fast-food items like cutlets, pizza and burgers etc. [10]. Several interventions have been taken by Directorate of Mushroom Research (DMR¹) for introduction of processed mushroom food items like candy, jams, chips, nuggets, ketchups and murabba. The dried mushroom slices are used directly in soups, snacks preparation, nuggets and biscuits [29], [21]. Furthermore, the mushroom extract can be exploited for preparation of mushroom wines, beers, spirits and prophylactic drinks [29]. Of late, it has been observed that the demand for convenient mushroom products has increased [3], mainly due to lifestyle changes and more working women in the workforce. Processing has also helped in enhancing global trade of mushrooms [16].

¹ICAR-DMR is Directorate of Mushroom Research is one of the research institutes under Indian Council of Agricultural Research, located at Solan in Himachal Pradesh state of India.

Processing is therefore an integral part of mushroom value chain that via value addition enhances the shelf life of the final product. Processing has also resulted in wider outreach and promotion of the commodity in the non-production areas and also among those who might not have developed a good taste for fresh mushrooms. However, only seven per cent of the mushroom is processed in India, which is very low as against developed World. The excellent work that DMR is carrying on via dissemination of appropriate technologies to process mushroom has resulted in expansion of demand for mushrooms and mushroom products. The All India Coordinated Research Projects (AICRP) on Mushrooms have further influenced the production, marketing and consumer behavior of mushroom and mushroom products in India.

7. Consumer preference for mushroom

In 2021, an online consumer survey was conducted between August and October months to understand consumption pattern, consumer demand, availability, preferences etc. The consumers from all over India belonging to different regions, states, and socio-economic strata, participated in this survey. Due to Covid-19 guidelines and restrictions, and to reach pan-India consumer base, survey was conducted in questionnaire mode via Google forms. The questionnaires were pretested and contained mainly closed ended alongside a few open-ended objective questions to let consumer express freely on issues related to availability, price and consumption pattern of mushroom at their respective households. The questions covered the information on frequency of mushroom consumption by the household, the monthly income spent on mushroom consumption, preference for varieties and forms, source of purchase, locality, family size, income etc. We also tried to understand the reasoning behind non consumption of mushrooms. A total 788 households participated in this survey. The recorded data of these 788 households/participants was exported to MS-excel and was analyzed using simple evaluation tools like frequencies, percentages etc.

8. Profile characters of the sample households

Size of the household is an important parameter to assess the consumption pattern and purchasing behavior. A general hypothesis suggests that with good regular incomes, small family experiments more with food than a relatively bigger family. Among the survey respondents (n=788), about 57 per cent reported their family size between 3-4 heads, followed by 24 per cent respondents with 5-6 heads in their family. The large families (7 heads and above) were around nine per cent.

Income and consumption are directly related variables. Annual income of the respondent's family may help us in understanding the income elasticity of demand for mushrooms. It was found that about 30 per cent respondents earned <₹3.0 lakhs, while 19 per cent earned >₹15.0 lakhs per annum at the time of survey. To understand the availability and price difference among states, the data was also recorded for the location of the respondent and it was found that 76 per cent respondents resided in urban areas (metros-11 per cent, cities-37 per cent, small towns-21 per cent, big town-8 per cent), and 24 per cent resided in rural areas (villages). Maximum respondents (40 per cent) belonged to southern states of India. The participation from eastern and northern parts of the country were almost equal (slightly more than 20 per cent). The least participation was from central India (only two per cent). A prominent reason behind this could be the production and availability in central, and in the north-east India. Due to very few production centers in this region as reflected from the data in table 3, a little number of respondents participated in online survey. That means the consumption is not widespread in this region and so is the production and that leaves lot of scope of creating awareness about production and consumption benefits of mushroom in central and north-eastern India. Even though the production is highest in northern states, the respondents were more from southern region that reflects two possibilities. Either the consumption demand and awareness for mushroom is highest in Southern India or there is an easy access to the technology down south. It shall also be noted that the number of metro cities are more in southern India than any of the other regions and these cities have

a large consumer base. Hence the consumer demand is expected to expand more in southern region. while all other regions provide a scope of expansion of consumer demand for mushroom via awareness programs and also establishment of production units.

9. Frequency of mushroom consumption

Respondents were asked about the frequency of mushroom consumption. Out of 788 respondents, 148 had never consumed mushroom, while 250 respondents rarely consume. Among rest of the respondents, 141 consume once a month, 135 once in 10-15 days, 96 weekly and only 18 respondents consume very frequently (almost thrice in a week). The frequency of consumption by the households suggests that mushroom is not regular in Indian diets and the market is very concentrated. This prompted us to evaluate the responses to next question trying to figure out reasoning behind what made some respondents to never consume mushroom. It was found that even among those who consume, majority of them consume it only rarely. This called for understanding the reasons behind consumption and non-consumption of mushrooms by the sample respondents.

10. Reasons for mushroom consumption

Through our survey, we tried to understand what makes people demand for mushrooms. More than half of the (56.40%) respondents who consume mushroom were well aware of its nutritive quality and so nutrition emerged as the strongest reasoning behind their consumption. Around 42 per cent found it an additional variety of vegetable in their plates, something different from the vegetables eaten regularly. An interesting finding was people relating it to meat. Close to 19 per cent respondents consume it as it tastes very much like meat to them. This meant that there is a vast scope of acceptance of mushrooms not only by vegetarians but also by non-vegetarians and vegans too (as a substitute to dairy products like cottage cheese). Few respondents (18 per cent) have consumed mushrooms due to a range of mushroom recipes available, and they wished to try those. The awareness on medicinal properties of mushroom seemed the lowest as only 13 per cent of the respondents consumed it for medicinal reasons. In business, the value for money play a key role for its market expansion. Mushrooms shall be promoted among the prospective consumers for two very strong reasons – one its medicinal properties and second, its nutrition content. The details of reasons for consumption of mushroom are given in figure 3.

11. Reasons for not consuming mushrooms

The survey also tried to assess the reasons for non- consumption of mushrooms. This question was responded by those who never consumed mushrooms (148). Table 5 presents the possible reasons for non-consumption of mushrooms in decreasing order of responses received during the survey. The responses varied from non -availability of mushrooms in local stores (54 per cent respondents said so), to finding them costly (by 18 per cent respondents) to their not being tasty (13.5 per cent), and also a perception that mushrooms are fungus, hence non-edible (around 7 per cent perceived so). There were responses like non-awareness about its nutritive value, recipes, etc. Nearly one fourth of the respondents said that they are unaware of nutritive value of mushrooms. Even though the respondents are educated, their lack of knowledge on mushroom nutritional information emphasizes to publish articles regularly on mushroom nutrition and medicinal properties [19]. The information about the nutrition gained from mushroom may also be labeled on the packages. As discussed earlier, mushrooms are an excellent source of protein which is also known as building blocks of our body. Indian diets lack in protein on per capita per day basis. The Indian Council of Medical Research has recommended 48 gms/day proteins, around 0.8 to 1 gm/kg of an average adult's body weight. As against it, the intake is just 0.6 gm/kg body weight. Indian diets are simple carbohydrate based, and lack in complex carbohydrates, fibres, vitamins and minerals, and proteins. Most of the protein, Indians tend to derive from cereals which are poor in quality and gluten rich or tough to digest.

Mushrooms on a 100-gram serving release only 22 calories of energy coming from 11% fat, 46 % carbs and whopping 43% proteins. The crude protein content in mushrooms is fairly high than most of the pulses making it the protein powerhouse [8]. Few respondents' perceived mushrooms could be poisonous. And 10 per cent respondents said they never had it as they find that the mushrooms available in the market are not fresh. The non-availability of mushrooms in local stores could be attributed to either non production or a poor supply chain. Logistics and supply chain strengthening is required which may address the related issues like non availability in local stores, appearance, freshness etc. Awareness programmes may help develop knowledge about edible and non-edible mushrooms. Road shows, recipe guidelines on the package, promotion through hotels and restaurants and also via medical practitioners can develop break several myths and bring in greater clarity to many who have never consumed mushrooms in their lifetime.

12. Household choice for specific variety of mushrooms

The response of the participants for the choice of variety of mushrooms showed nonsymmetrical results. Of 640 respondents who have consumed mushrooms in their lifetime, 445 preferred button mushrooms, 78 each preferred Oyster and Paddy straw mushrooms and remaining 39 respondents reserved their choices for other varieties like Shitake, Milky etc. Similar preferences for button mushrooms were also found in the USA and Mexico. A sample survey conducted in USA reported that white button mushrooms (94%) are the most preferred followed by portabella and others [19]. In a study in Mexico, it was reported that the widely consumed mushrooms (77%) are white button mushrooms [17]. This clearly reflects that the demand for button mushrooms is very high all over the World.

13. Household preference for specific form of mushrooms

The 640 respondents who have consumed mushroom in their lifetime, were further asked their preferences regarding form of mushroom they would like to consume. Around 81 per cent preferred to consume only in fresh form and again this calls for a serious development of logistics and supply chain to connect production centers to the consumption ones. Being a highly perishable product and a lesser shelf life, mushroom needs to be transported quickly under controlled temperature conditions. The preferences for value added products are very small. Mushroom soup was preferred by only 10 per cent consumers while only five per cent consumed mushroom pickles and dried mushrooms too. During the survey, it was found that the value added products prepared from mushrooms are consumed mostly by higher income earning and educated families. The details of the responses in form of mushroom consumption by the family are given in table 6.

14. Availability of fresh mushroom in the respective localities

Out of 788 participants, 635 responded to this question and the results are presented in figure 4. Even though the preference for fresh mushroom is highest, nearly fifty percent respondents informed that the availability in their locality is only during few months in a year followed by 268 (42.20%) respondents who are able to get mushrooms in their locality round the year. This could be due to good connectivity to the production units. Also availability throughout the year is an indicator of demand too, as that reflects the persistent demand throughout the year. A demand for a commodity throughout the year is also a positive sign for budding mushroom units.

15. Expected Household consumption of mushroom in near future

This question forms the backbone of future studies on mushroom markets and consumer behavior. In order to assess the potential demand in the future, respondents were asked if the demand for mushrooms at household level will change or remain the same in future. About 68% (of 640) respondents expected that the demand for mushroom by their family will increase in the future, while 31% expected that their family consumption of mushrooms will decrease in future. Increase in mushroom consumption may be due to

changing food habits and increasing health consciousness in a new normal established by Covid 19 pandemic. Doctors have recommended protein rich diets to develop an immune system that fights virus and helps in restoring good health. Preference for rich protein diets at affordable price is a reason why families expected that mushroom consumption will increase. Whereas, the decrease in consumption of mushrooms by the family may be due to some apprehensions in the minds of consumers. The details of responses for this question are given in figure 5.

Even though the country produces fewer mushrooms, 70 per cent of the total production of mushrooms from India is exported. As stated earlier, per capita consumption of mushrooms in India is very less when compared to the rest of the world. However, as per the survey the demand is expected to go up in the coming years. It was noticed that non consumption has reasons mostly related to supply chain and logistics as mushrooms are highly perishable in nature and cannot stay on the counter at room temperature. Under uncontrolled exposure, mushroom expresses discoloration and develops slimy film at the top which is an indicator of it being no more consumable. Under refrigerated conditions, mushrooms can stay for 6-7 days. An efficient cold chain may help in connecting production and consumption centers of this highly perishable and nutritive commodity. Access to the non reachable regions and of good quality product will help in creating fresh demand for mushrooms as many localities do not have a nearby availability. While the marketing, supply chain and distribution need an overhaul, there is a need to create more awareness about the health benefits of mushroom consumption including about its nutritional and medicinal importance. Health experts can play a great role in disseminating such information among people. Demonstration of recipes by chefs in fairs, malls, road shows, Anganwadi centers etc., recommendation of mushroom soup by dieticians to the patients can also play a great role in creating awareness. It can also be mandatorily included in the Mid Day Meal program in schools especially for vegetarian and vegan population. This was the rural production units will have an assured source of consumers. However, the supply and consumption need to be synchronized and there shouldn't be any delay. Inclusion in children's meal will also help develop the distinct taste at a very young age and will help in creating further awareness. Food Safety shall be taken due care and only the healthy mushrooms be included in diets. This survey was conducted to understand the future prospects for mushroom in India from the perspective of consumers and it opens door to further research on consumer behavior, elasticity, efficient supply chain model and many more. The most appealing finding of this study is that the consumers expect that demand at household level will increase in the future along with the very resolvable reasons behind non consumption by a chunk of the sample who participated in the survey. This may be looked upon as a potential agribusiness enterprise which has huge income and employment generation potential in rural India.

16. Way forward

Mushroom production is increasingly expanding due to its ability to generate income in short period. As it can be practiced in a small area, agricultural land is not a requirement to grow mushrooms, hence the enterprise finds acceptance among non agricultural population and could be a great income and employment generation activity for landless people. The Indian Council of Agriculture Research through All India Coordinated Research Project on Mushroom and Directorate of Mushroom Research, network of KVKs, State and Central Agricultural Universities all are actively engaged in training rural population to take up this lucrative entrepreneurial activity. Amid pandemic situation, several migrant workers have enrolled themselves in training programs and have started growing mushrooms. An increasing demand, and hotels and restaurants including mushroom recipes in their menu have attracted new consumers who wish to try anything other than Cottage cheese (paneer). However, the pace of acceptance of mushrooms in daily diets is slow. Not many were found consuming it more often. Lack of knowledge about its recipes and non availability of fresh ones at the nearby stores is common. A large section of vegetarian population is unable

to include mushrooms in meal plan as it finds mushroom's chewy texture close to meat. This despite the fact that mushroom is protein powerhouse and one of the most cheaper sources of protein. Hence, even though there is an increase in demand, there is huge scope of expansion in per capita consumption of mushrooms. To promote mushroom consumption, there is a need to develop taste and acceptance as a good protein source among the vegetarian population. Mushroom recipes may be included in the Mid Day Meal Programmes, value added mushroom products may be provided in Anganwadi centers, women shall be trained for value addition in mushrooms. Fortification of wheat flour may be considered by the Indian companies. A large scale consumer awareness campaign will definitely increase its consumption. Introducing mushroom and its value added products (savories and namkeens) in Mid day meal program will break the psychological barriers at right age, just the way National Egg Coordination Committee's egg inclusion program could. Additionally, the penetration of mushroom is not very wide and deep. It still is not present in many urban centers due to supply chain issues. The cold chain network needs to be strengthened so that the product can reach maximum consumers and finds place in stores. Product specific cooling chambers or customized innovative models which are cost friendly will support the sales in semi urban and urban centers. If the potential of such an enterprise is fully tapped, this indeed has a greater scope in providing agribusiness opportunity to a large chunk of population.

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Table 1: Production of mushroom in Indian states

States	Production ('000 tonnes)		Percent to Total (2020-21)
	2019-20	2020-21*	
Odisha	19.5	22.5	9.26
Maharashtra	18.4	22.0	9.06
Bihar	5.6	21.3	8.78
Haryana	20.1	19.6	8.07
Punjab	12.8	18.5	7.62
Uttar Pradesh	7.6	16.0	6.60
Himachal Pradesh	14.5	14.8	6.09
Rajasthan	1.4	14.6	6.01
Gujarat	12.0	14.5	5.97
Uttarakhand	11.7	14.0	5.76

Chhattisgarh	n.a.	13.9	5.72
Tamil Nadu	11.5	11.0	4.53
Jharkhand	1.0	7.5	3.09
West Bengal	3.0	7.0	2.88
Karnataka	1.2	4.5	1.85
Jammu & Kashmir	n.a.	3.5	1.44
Andhra Pradesh	3.7	3.0	1.24
Delhi	3.2	n.a.	0.00
Goa	4.5	n.a.	0.00
Remaining states	4.1	14.6	6.02
Total production	155.6	242.9	100.00

Source: www.indiastat.com (2019)

n.a.: information not available

*Second advance estimate

Table 2: Mushroom exports trends year wise

Year	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Export value (US\$ million)	31.33	49.52	27.87	34.31	32.44	22.15	21.51	19.49	16.84	18.82	13.89

Source: <https://connect2india.com/global/export-Mushroom-from-india>**Table 3: Family profile of the participants**

Sl.No	Criteria	Group	No. of responses	Percentage
1.	Family size	1-2	79	10
		3-4	450	57.1
		5-6	188	23.9
		7-8	39	4.9
		>8	32	4.1
2.	Family annual income	<Rs. 3.0 lakhs	238	30.2
		Rs. 3.0 -5.9 lakhs	105	13.3
		Rs. 6.0-8.9 lakhs	129	16.4
		Rs. 9.0-11.9 lakhs	96	12.2
		Rs.12.0-14.9 lakhs	72	9.1
	>Rs. 15.0 lakhs	148	18.8	
3.	Residing	Village (rural area)	185	23.5
		Small town	165	20.9
		Big town	61	7.7
		City	289	36.7
		Metro	88	11.2
4.	State	Northern states	158	20.1
		Southern states	316	40
		Western states		
		Eastern states	92	11.7
		Central states	162	20.6
		North-East states	15	1.9
		40	5	

Note: Northern states included Punjab, Haryana, Delhi, Himachal Pradesh, Jammu & Kashmir, Uttarakhand, and Uttar Pradesh; Southern states included Andhra Pradesh, Karnataka, Kerala, Puducherry, Telangana, and Tamil Nadu; Western states included Gujarat, Maharashtra, and Rajasthan; Eastern states included

Bihar, Jharkhand, Odisha, and West Bengal; Central states included Chhattisgarh and Madhya Pradesh; North-East states included Arunachal Pradesh, Assam, Nagaland, Mizoram, Manipur, Sikkim, and Tripura.

Table 4: Frequency of mushroom consumption by participants

Sl. No	Frequency	No. of responses
1.	Frequently	18 (2.30)
2.	Weekly	96 (12.20)
3.	Once in 10-15 days	135 (17.10)
4.	Once in a month	141 (17.90)
5.	Rarely	250 (31.70)
6.	Never	148 (18.80)
	Total	788 (100.00)

Note: Figures within parenthesis are in percentages to total.

Table 5: Reasons for not consumption of mushrooms

Sl.No	Reason	No. of responses
1.	Not available in local stores	80 (54.1)
2.	Don't know how to make a recipe	49 (33.1)
3.	It is costly	26 (17.6)
4.	Unaware of nutritive value of mushrooms	23 (15.5)
5.	Doesn't look good	21 (14.2)
6.	Mushrooms are not tasty	20 (13.5)
7.	Have a doubt that it may be poisonous	17 (11.5)
8.	Mushrooms available in the market are not fresh	15 (10.1)
9.	It is a fungus, not edible	10 (6.8)

Note: Figures in parenthesis are percentages to Total consumers who never consumed mushrooms (148)

Table 6: Form of mushroom consumption by the family

Sl.No	Mushroom form	No. of responses
1.	Only fresh mushroom	521 (81.4)
2.	Mushroom pickles	34 (5.3)
3.	Dried mushrooms	33 (5.2)
4.	Mushroom powder	12 (1.9)
5.	Canned mushroom	23 (3.6)
6.	Mushroom cookies & biscuits	13 (2)
7.	Mushroom soup	63 (9.8)
8.	Others	96 (15)

Note: Figures in parenthesis are percentages to total (640 respondents) who have consumed mushroom in their lifetime

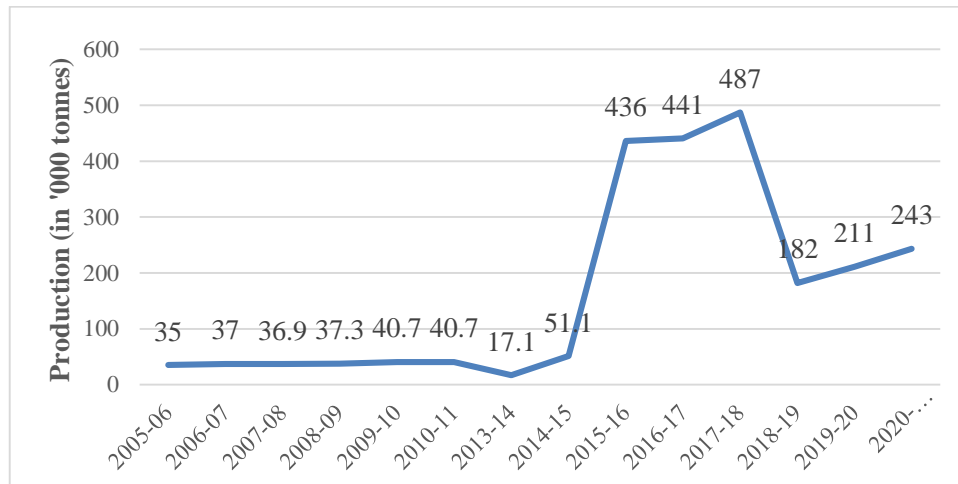
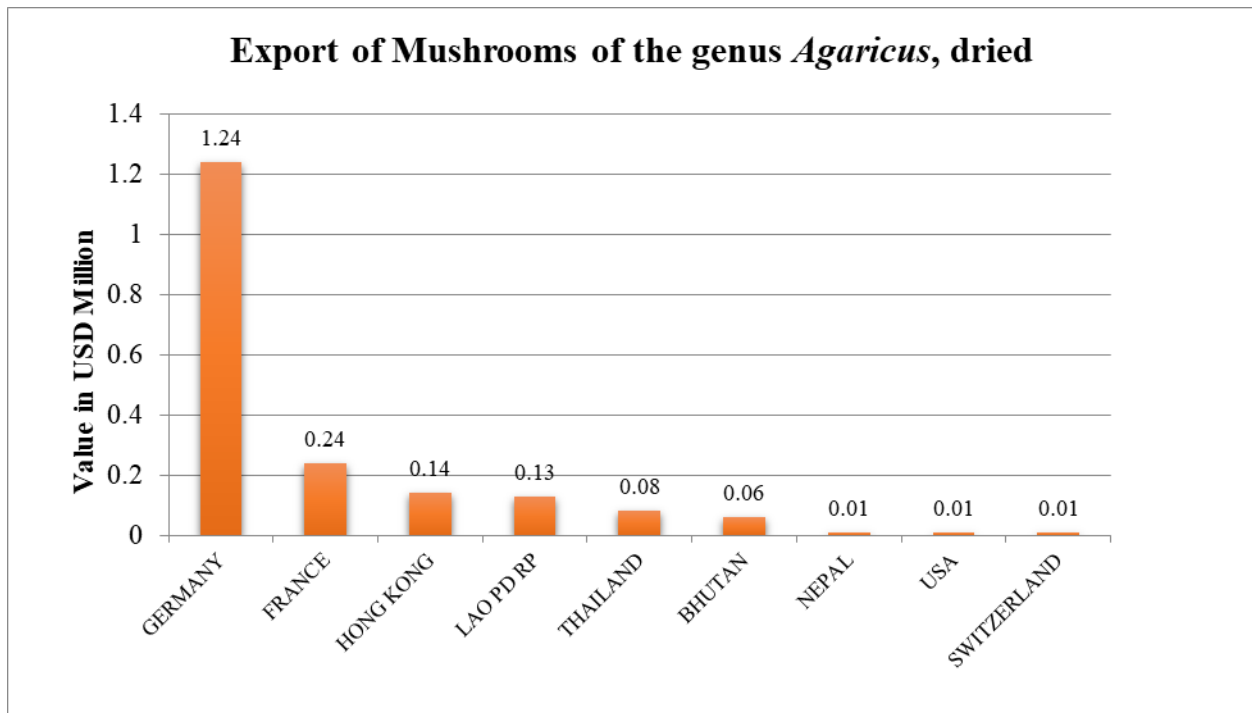


Figure 1. Mushroom production trend in India



Source: DGCIS Annual Export

Figure 2: Country wise trends in mushroom export

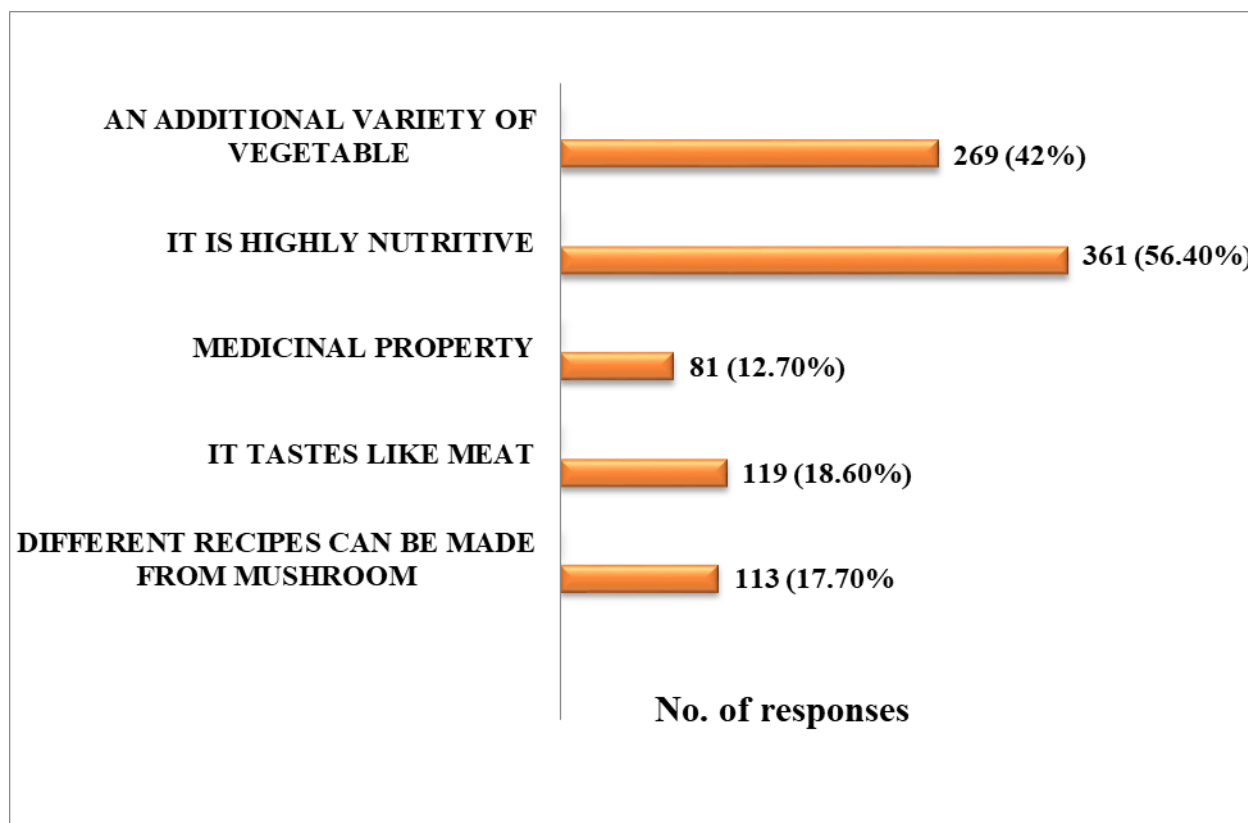


Figure 3. Reason for consumption of mushroom

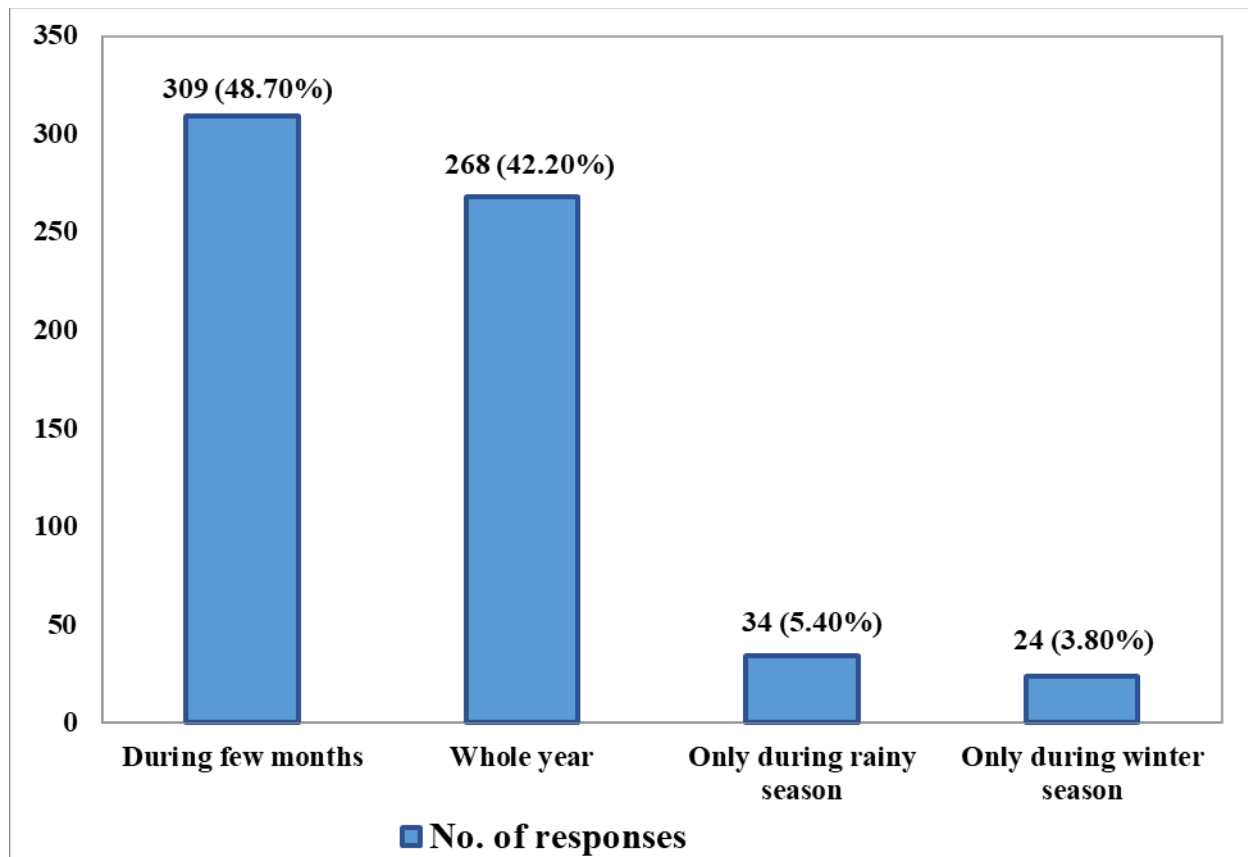


Figure 4. Availability of fresh mushroom in their locality

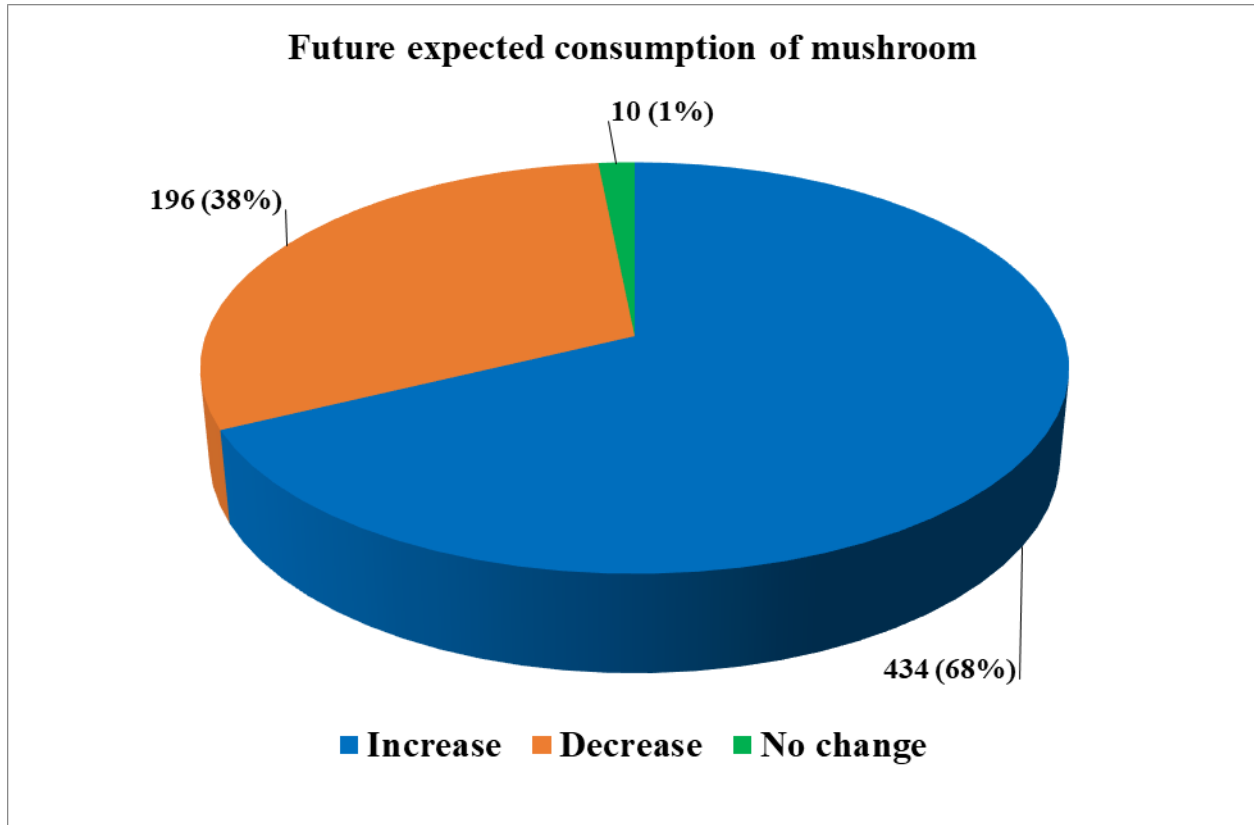


Figure 5. Future expected consumption of mushroom