

**Dossier of the Project “Mushroom Training and Production Centre at three villages of Block, Thouldhar.Distt. Tehri Uttarakhand.**

<b>Sl. No.</b>	<b>Description</b>	<b>Details</b>	<b>Remarks if any</b>
<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>
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8.	Location/Area of operation of the Project	Village Inder Kaleth and Hadagi of Block Thouldhar, Tehri	
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10.	Targeted Group	Villagers of Three Village of Block Thouldhar,	
11.	Number of people benefitted from the project	25 Farmer of Three Village of Block Thouldhar	
12.	Quantification of benefit accrued from the project, as derived from the Impact Assessment Report/evaluation report by independent agency. If any	Departmentally	
13.	Documentary proof like Photo\video\news items etc. If any	As Detailed Below	

# RURAL LIVELIHOOD ENHANCEMENT THROUGH DEVELOPMENT OF MUSHROOM CULTIVATION TRAINING

## AND PRODUCTION CLUSTER

(Thauldhar Block, Tehri Garhwal)

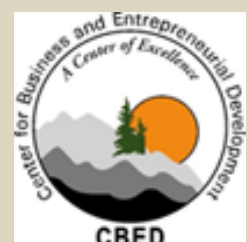
*Submitted to*



## SEWA THDC



**Submitted by :**  
**Center for Business and Entrepreneurial  
Development (CBED)**  
**(195/1, Vasant Vihar, Dehradun)**



<b>Title of the Study</b>	:	<b>Rural livelihood enhancement through development of mushroom cultivation training and production cluster in Thauldhar block, Tehri Garhwal, Uttarakhand.</b>
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# Contents

<b>INTRODUCTION .....</b>	<b>1</b>
<b>1.1 Objectives.....</b>	<b>2</b>
<b>PROJECT AREA.....</b>	<b>3</b>
<b>KEY ACTIVITIES OF THE PROJECT.....</b>	<b>6</b>
<b>AWARENESS MEETING .....</b>	<b>7</b>
<b>IDENTIFICATION OF BENEFICIARIES.....</b>	<b>9</b>
<b>FORMATION OF GROUP .....</b>	<b>11</b>
<b>Training aspects on Mushroom Cultivation.....</b>	<b>14</b>
<b>CULTIVATION TECHNIQUES OF MUSHROOMS.....</b>	<b>14</b>
<b>TRAINING AND DISTRIBUTION OF QUALITY SPAWN ON MUSHROOM CULTIVATION</b>	<b>19</b>
<b>YIELD OF OYSTER AND GANODERMA MUSHROOM.....</b>	<b>26</b>
<b>CONCLUSION.....</b>	<b>35</b>

# INTRODUCTION

Mushrooms constitute a group of higher fungi which are objects of much curiosity and speculation since time immemorial. Mushrooms with their flavor, texture, nutritional value and high productivity per unit area have been identified as an excellent food source to alleviate malnutrition in developing countries. Being a good source of vitamins, minerals and proteins it is considered to be a distinct food. A large group of mushrooms are known for their delicacy; they are consumed by the people and are part of their diet. The demand for the mushrooms has increased with increasing population and the food demand, on the other hand has also increased with advances of the time. Mushrooms contain 20– 35% of protein (dry weight), are low in lipids and contain all the nine essential amino acids. Mushroom has been widely cultivated since the 1700's and presently more than 30 unknown species are cultivated as foods. Mushrooms are increasingly gaining acceptance in different Cuisines and in everyday consumption.

Oyster mushroom (*Pleurotus spp.*), commonly known as “Dhingri” in India, is a lignocellulose loving fungus growing in nature on living or dead tree trunks/stumps or bark. They are easily recognized in nature due to their peculiar morphology with an eccentric short stem or stipe. The Oyster mushroom has been found to be ideal for people suffering from anemia, hyperacidity, and constipation. *Pleurotus* species (oyster fungus) is an edible mushroom having excellent flavour and taste. The oyster mushrooms are nutritious vegetarian delicacy consumed worldwide. These are rich in vitamins and minerals but low in sugar and fats. It is easy to cultivate with a low budget. It can be successfully grown within a temperature range of 20-30oC and relative humidity of 55-75%. In the processed form usually dried mushrooms are sold.

*G. lucidum* is a medicinal mushroom widely used in traditional medicine. Among the medicinal mushrooms, *G. lucidum* is considered as a king. There is a huge requirement of this medicinal mushroom across the world; however, the production is limited to few countries such as China, Japan and Malaysia. Traditionally this mushroom is used for nourishing, supplementing, toning, removing toxins, and dispersing accumulation. It is indicated for neurasthenia, nervousness, dizziness, insomnia, high blood pressure, high cholesterol, chronic hepatitis, cancer, AIDS/ARC, nephritis, bronchial asthma, allergies, pneumonia, stomach disease, coronary heart disease, diabetes, angina, mushroom poisoning, fatigue, and for enhancing longevity. This mushroom has been cultivated in Indian condition by the technology standardized by Dr. NSK Harsh (Retd. Scientist) Forest Research Institute, Dehradun. He has disseminated the package and practices of this medicinal mushroom in the villages of Dehradun and Rudraprayag districts of

Uttarakhand. In these areas, the farmers have begun and are cultivating this valuable mushroom. This mushroom is highly valuable in the international market and can fetch the price around Rs. 3500/kg.

The present project provides the right set of package of practice for production, harvesting and marketing. Mushroom cultivation is not much affected by weather changes thus enhancing resilience of people. Through the present project, the income from mushrooms is generated and thereby supplement cash flow, provides either a safety net during critical times, preventing people falling into greater poverty; a gap- filling activity which can help spread income and a stepping stone activity to help make people less poor. The project provides Livelihood Options and Employment Generation for enhancement of economic activities to the beneficiaries of the village. In order to develop the employment to the rural poor in the villages, cultivation of edible as well as medicinal mushroom with integrated approaches seems to be feasible in this region. The present project focuses upon the livelihood options and employment generation among the selected beneficiaries; the project is a collaborative effort of **SEWA THDC** and **Center for Business and Entrepreneurial Development (CBED)**.

### 1.1 Objectives

Keeping in view above discussed facts, the following specific objectives have been addressed in the present study:

- a. Provide reliable techniques for commercial cultivation of Oyster and Ganoderma Mushrooms.
- b. Awareness generation, motivation and involvement of beneficiaries in cultivation of mushroom
- c. Diversify income generation activities of 25 local farmers through adoption of best practices for commercial production of mushroom.
- d. To institutionalize a sustainable enterprise through the formation of mushroom producer company.

## PROJECT AREA

Uttarakhand, a hilly state referred as the Devbhumi (land of gods) is known for its natural beauty of the Himalaya, the Bhabhar and the Terai. The state extends between 28°43' to 31°28' N and 77°34'' to 81°03' E and covering an area of 53,483 km<sup>2</sup> with an elevation ranging from 210-7,817amsl (ISFR, 2011). The State borders Himachal Pradesh in the north-west and Uttar Pradesh in the south, and international borders with the two countries viz., China (north) and Nepal (east). Topography of the Uttarakhand implicates the terrain and the landforms, which results in varying vegetation in the region. The region spreads from foot-hills in the south (Siwaliks) to the Tibetan plateau in the north (trans-Himalaya). The vital rivers flowing through state are Bhagirathi, Alaknanda, Mandakini, Pindar, Tons, Yamuna, Kali, Bhilangana, Sarayu and Ramganga. The climate of the State is temperate, marked by seasonal variations but also affected by tropical monsoons.

The temperature in the State varies from sub-zero to 43°C in summer. The average rainfall is 1,550 mm. Being one of the most fragile and complex ecosystem on earth communities inhabiting in the Himalayas mainly depend on forest and its products for their livelihood. Communities obtain innumerable products for their livelihood needs and benefit from different types of forest and alpine pasture lands. As per the Census of India, 2011 the total population of the state was 10,086,292 person (5,137,773 males and 4,948,519 females). The majority of the state's human population (69.8%) resides in rural areas. The state's population density is 189 per sq. km, and it registered a decadal growth rate of 18.81% during 2001–2011. Scheduled Castes (SCs) and Scheduled Tribes (STs) form about 19% and 3%, respectively, of the state's population. Uttarakhand is divided into two divisions – Garhwal and Kumaon –with a total of 13 districts and 95 blocks.

Tehri Garhwal, Uttarakhand, India situated in the Himalaya and distributed between 30° 3'' to 30° 53'' N Latitude and 77° 56'' to 79° 04'' E Longitude with total geographical area of 3642 km<sup>2</sup> (FSI, 2015). The climate of the region is sub-temperate to temperate on higher elevations with well marked seasons. The winter season is from mid-November to February and temperature even falls up to 0°C with snowfall characterization during last December to early February. The temperature during the summer ranges between 18°C and 30°C. The area receives heavy rains (1500 mm<sup>3</sup>) in July due to summer monsoon. During rainy season, the climate is very cool and full of greeneries. Cultivable waste is 16 percent, with only 14 percent land is irrigated. According to the 2011 census, population of the district is 0.62 million (87 percent rural) and 1078 male per thousands

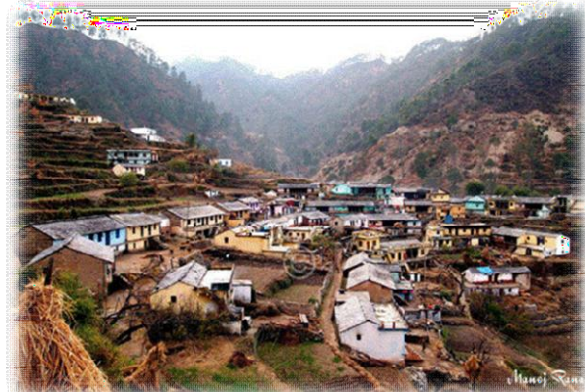
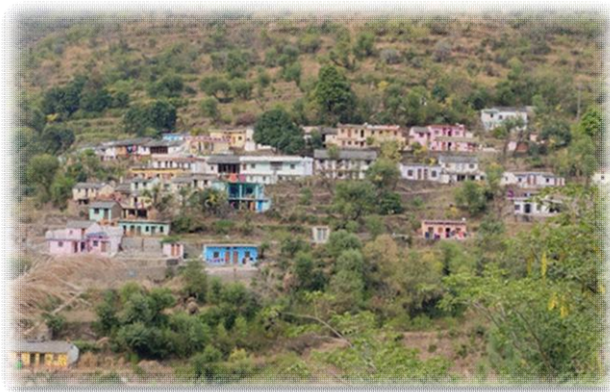
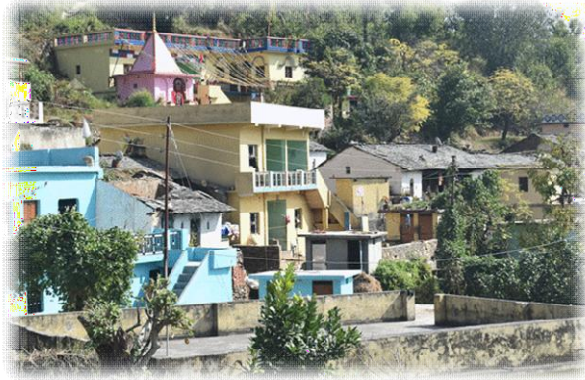
female with 1.93 percent growth rate and 169 population density; and 75 percent literacy rate. Agriculture is the primary profession and wage labour accounts as the secondary profession of the population. The share of marginal and small farmers is 91 percent among the total 81,079 farmers. Villagers rear cattle for milk supply for self consumption and for dung for manure.

The present project has been implemented in the two villages viz., **Inder, Sunar and Hadagi villages of Thauldhar Block, Tehri Garhwal**. In this section, socio-economic and bio-physical characteristics of each village have been elaborated. The village is located in block of Tehri Garhwal district lies between 30° 23' 39'' N to 78° 24' 01'' E. The project area is surrounded by Pratapnagar block towards East, New Tehri block towards South, Chamba block towards South, and Chinyalisaur block towards North. Nearest town of the villages is Chamba and distance from project area to Chamba is 30 km. District head quarter of the village is New Tehri which is 40 km away. Based on the data provided by Census of India, 2011, the largest category of communities in the study area is General Category followed by other categories include Schedule Caste and Schedule Tribe categories.

**Table 1:** Bio-physical and socio economic characteristics of the villages

VILLAGE NAME	INDAR	HADAGI	SUNAR
<b>GEOGRAPHICAL CHARACTERISTICS</b>			
<b>Geographical Area</b>	85.78 Hectares	53.58 Hectares	43.80 Hectares
<b>Latitude</b>	30° 25' 30'' N	30° 23' 39'' N	30° 26' 11'' N
<b>Longitude</b>	78° 24' 30'' E	78° 26' 18'' E	78° 24' 01'' E
<b>Topography</b>	Hilly	Hilly	Hilly
<b>Block/District</b>	Thauldhar Block, Tehri Garhwal	Thauldhar Block, Tehri Garhwal	Thauldhar Block, Tehri Garhwal
<b>Gram Panchayat</b>	Indar	Hadagi	Hadagi
<b>DEMOGRAPHIC FEATURES</b>			
<b>Number of households</b>	84	29	19
<b>Total Population</b>	282	139	84
<b>Major Caste present</b>	General (86 %)	General (62 %)	General (94 %)
<b>Total Schedule Caste</b>	14 %	38%	6 %
<b>Total Schedule Tribes</b>	Nil	Nil	Nil





**Figure: Pictures representing location and settlements in the Project Area.**

## KEY ACTIVITIES OF THE PROJECT

1. **Awareness Meeting:** A series of awareness campaign were done in the villages so as to sensitize the rural families about the project and mushroom cultivation. This includes discussions, lectures by experts, documentary and exposure visits.
2. **Identification of beneficiaries:** While selecting beneficiaries“ priority were given to families those were extremely poor and their income mainly depend on agriculture. Preference was given to women farmers while selecting the beneficiaries.
3. **Formation and Orientation of the Groups:** The identified members from all the villages were grouped together to form a self reliant cooperative. All the members of the cooperative were trained on all aspects of mushroom production. Project staff motivated the members to work collectively in order to improve their income.
4. **Training on aspects of Mushroom Cultivation:** Mushroom basics, room preparation for cultivation of mushroom, quality spawn for mushroom cultivation, disease and pest control, value addition of the cultivated product through grading, packaging of the harvested mushroom.
5. **Distribution of Quality Spawn:** 100 mushroom bags (both species) were provided to the beneficiaries for mushroom production.

## AWARENESS MEETING

A series of awareness meeting and training programme at the project site were organized to develop the capabilities of rural and marginal farmers so as to improve their livelihood status through trainings on mushroom cultivation. Out of the selected beneficiaries, one member was selected as a community mobilizer to provide time to time support throughout the process of mushroom cultivation. Following resource persons visited the site to motivate the beneficiaries to cultivate Oyster and Ganoderma mushrooms-

1. Mr. Arvind Verma (Nodal Officer, SEWA-THDC)
2. Mr. M S Rana (Senior Environment Officer, SEWA-THDC)
3. Ms. Nandini Maithani (Project Manager, CBED)

Mr. Arvind Verma elaborated that mushroom cultivation can be a suitable alternate as it offers sustainable income along with several other advantages. Further he said, mushrooms have been valued throughout the world as both food and medicine for thousands of years. They are a rich source of nutrition and form a major chunk of health foods. Mr. M S Rana talked with the beneficiaries in their local language (Garhwali), so as to connect them with their culture. It was told by Mr. Rana that the important component of the project is to help the rural people of Uttarakhand in the cultivation of medicinally important mushroom namely Ganoderma lucidum which has vast pharmaceutical potential.

Some of the beneficiaries were having some queries about cultivation technologies of Ganoderma and forward market linkages as well. Expert from CBED, Mr. Pramod Chaurasia satisfactorily replied against each queries. Mr. Chaurasia elaborated about the market linkages at two levels viz., local and regional as per scale of production available in the community. Less dependence on agriculture will improve their adaptability, concluded by Ms. Nandini Maithani. Mushroom cultivation is not much affected by weather changes thus enhancing resilience of people. Further she explained, income from mushrooms can supplement cash flow, providing either a safety net during critical times, preventing people falling into greater poverty; a gap-filling activity which can help spread income and generally make poverty more bearable through improved nutrition and higher income; and a stepping stone activity to help make people less poor, or even permanently lift them out of poverty. After the successful orientation session, the team from SEWA THDC and CBED Organization visited the rooms of each selected beneficiary.



**Figure: Orientation and awareness generation meetings were organized at the project area.**

## IDENTIFICATION OF BENEFICIARIES

The beneficiary selection was done after conducting a series of awareness generation campaigns in the villages, so as to sensitize the rural families about the project and advantages of mushroom cultivation. While selecting beneficiary, priority was given to families that are extremely poor and whose income was mainly depend on agriculture. After the mobilization process, the interested farmer list was collected from the group and thereafter rooms/ hut availability for mushroom growing were noted. 25 beneficiaries were selected for the cultivation on the basis of set indicators. The CBED team members visited houses of the beneficiaries, selected the rooms for cultivation and allocate each room as a specific mushroom unit.

**Table 2 :** List of the selected beneficiaries

S. No.	Beneficiary Name	Father's Name	Contact No.
<b>INDER VILLAGE</b>			
1.	Sandeep Chauhan	Beer Singh Chauhan	9634469933
2.	Surjeet Singh	Sh. Dharam Singh	9997587979
3.	Pankaj Chauhan	Sh. Jagat Singh Chauhan	8126099228
4.	Ankit Panwar	Sh. Roshan Panwar	9759121097
5.	Beerendra Singh	Ilam Singh	9759056799
6.	Rajendra Singh	Sher Singh	8448258770
7.	Sukhri Devi	Lt. Bhopal Singh	9997587979
8.	Aarti Meher	Sh. Mohan Singh	9720781363
9.	Nathi Singh	Sundar Singh	9758202852
10.	Jai Singh	Jabbar Singh	-
11.	Roshan Singh Panwar	Shiv Singh	8171680122
12.	Harish Singh	Sohan Lal	9536395052
13.	Guddi Devi	Rajendra Singh	-
<b>HADAGI AND SUNAR VILLAGE</b>			
14.	Darshan Lal Dobhal	Sh. Sundar Lal Dobhal	9410790484
15.	Premdutt Dobhal	Sh. Taradal Dobhal	8393021568
16.	Totaram Dobhal	Sh. Taradal Dobhal	7060358620
17.	Subhash Chandra Dobhal	Sh. Surendra Lal Dobhal	-
18.	Mastan Lal	Sh. Jwalpu Lal	9557306197
19.	Govind Lal Dobhal	Sh. Artilal Dobhal	9758936435
20.	Taj Ram	Sh. Gopeswar Dutt	7055914304
21.	Suvit Lal	Sh. Prem Lal	9711522395
22.	Buddu Ram	Sh. Shiv Ram	9568627706
23.	Shyam Lal	Sh. Jhura Lal	9627946324
24.	Kuran Lal	Sh. Rajesh Lal	9411511504
25.	Sita Ram	Sh. Charan Lal	9547956713



**Figure: Identification of beneficiaries in the Project Area.**

## FORMATION OF GROUP

The identified members from the villages were grouped together and after conducting meetings, a self reliant cooperative under Uttarakhand Self Reliant Cooperative Act, 2003 was formed at the project area named as **NAGRAJA SWAYAT SEHKARITA** which aimed at social well-being and livelihood security. All the members of the cooperative were trained on the technical aspects of mushroom cultivation and production. The documents pertaining to the cooperative formation had been attached below. The following table represents the members of the cooperative

S. No.	Name	Father's/Husband's Name	Position
1.	Darshan Lal Dobhal	Sundar Lal Dobhal	President
2.	Shivani Devi	Sandeep Singh	Secretary
3.	Pushpa Devi	Subhash Chandra	Treasurer
4.	Pooja Devi	Shyam Lal	Member
5.	Sona Devi	Govind Lal	Member
6.	Kushla Devi	Mastan Lal	Member
7.	Pooja Devi	Veerendra Sigh	Member
8.	Madhani Devi	Jai Singh Chauhan	Member
9.	Kusum Devi	Harish	Member
10.	Guddi Devi	Rajendra Singh	Member
11.	Sona Devi	Nathi Singh	Member





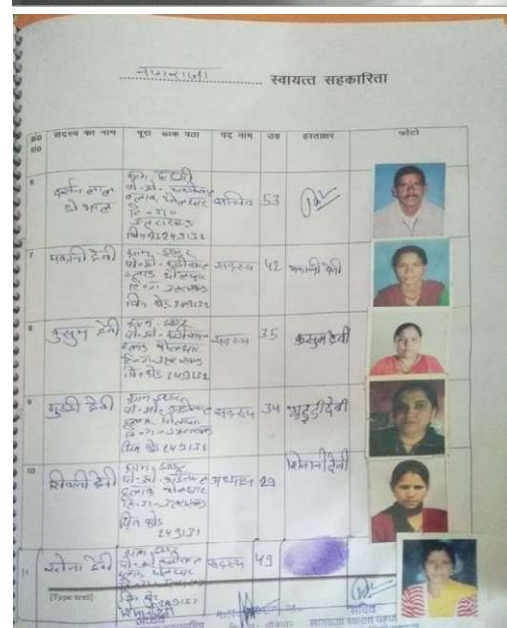
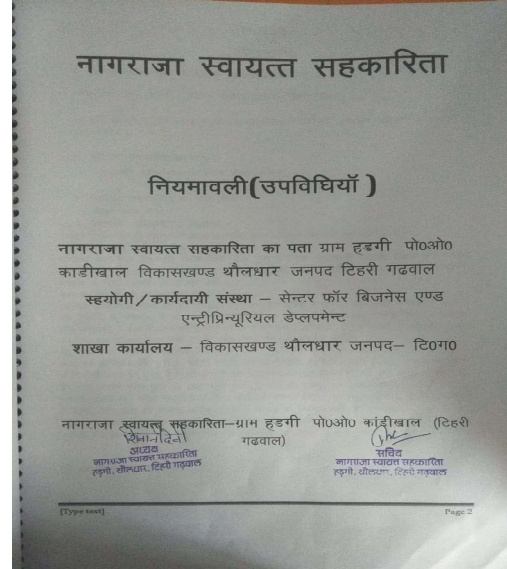
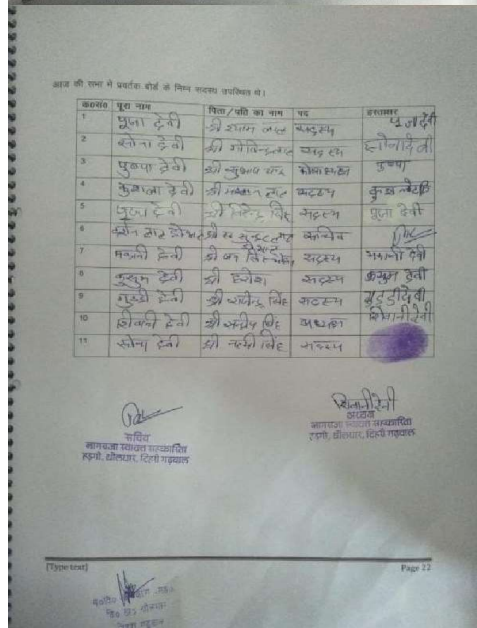
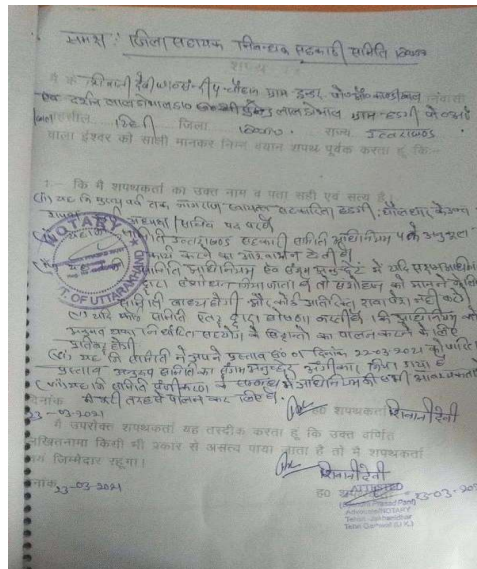
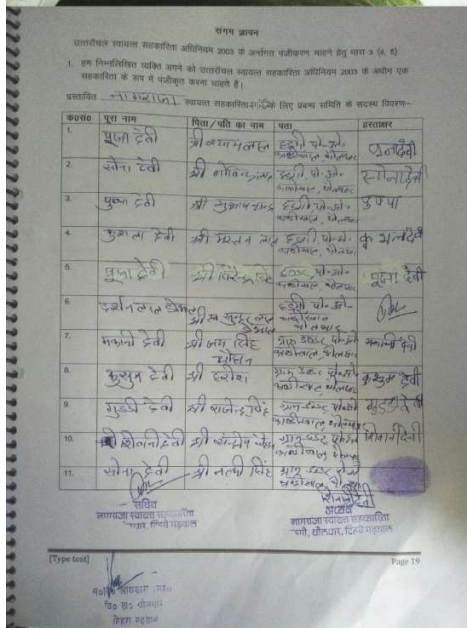
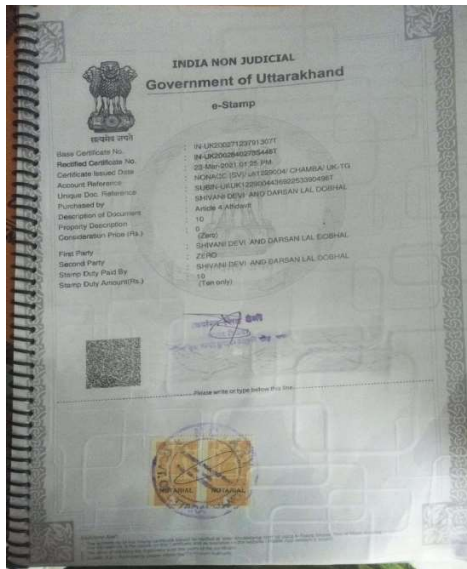


Figure: Documents of Nagraja Swayat Sehkarita

# CULTIVATION TECHNIQUES OF MUSHROOMS

## Training aspects on Mushroom Cultivation

- ✚ Basic information on mushrooms.
- ✚ Room preparation for the cultivation process. Selection of quality spawn.
- ✚ Disease and pest control.
- ✚ Packaging of harvested mushroom.
- ✚ Cultivation systems and production cycles.
- ✚ Various value chain processes of mushroom, and how to enhance the shelf life of mushroom.
- ✚ Value addition.
- ✚ Marketing and its channel aspects.

### 1. Cultivation technique of Oyster (*Pleurotus florida*) Mushroom

The Oyster Mushroom is mostly called as „Pleurotus“ or „Dhingri“ in India. It is a rich source of proteins, minerals, and vitamins. Cultivation of Oyster mushroom has increased tremendously throughout the world because of their abilities to grow at a wide range of temperature and utilizing various agro-based residues. It requires a short growth time line in comparison to other edible mushrooms. The fruiting part of this mushroom is viewed with distinct shell, fan or spatula shaped and different shades of white, cream, grey, yellow, pink and light brown.

#### **Climatic requirement**

Oyster mushroom can be grown within a temperature range of 16°C-30°C for its optimum growth. The favorable growing seasons are during Feb./Mar-Oct/Nov in the hills and Sep/Oct-Mar/Apr in the plains.

Material requirements-

1. Paddy straw
2. Perforated Poly bags (18"x12")
3. Mushroom spawn
4. Room with bamboo racks
5. Equipments like chaff cutter and boiling drum
6. Buckets and sprayers.

## **Buildings and Other Facilities**

Most ordinary buildings are not suitable for mushrooms. Oyster mushrooms have some basic requirements for the environment.

- a) Temperature of 15°-20°C and humidity of 80-90%. Both temperature and humidity should be kept as constant as possible as any rapid changes in temperature will cause disastrous changes in humidity.
- b) Good ventilation:- It is needed for healthy mushroom and health of the growers. Ventilation removes CO<sub>2</sub> formed by mushrooms.
- c) Light:- Light also helps in the growth of mushrooms. However natural daylight does not work well.

The production of the oyster mushroom can be conveniently summarized into a number of stages which are to be strictly followed in order to achieve higher biological efficiencies (B.E). The stages are as follows:

1. Mushroom growing house disinfection
2. Substrate preparation
3. Straw sterilization
4. Spawning
5. Maturation
6. Harvesting

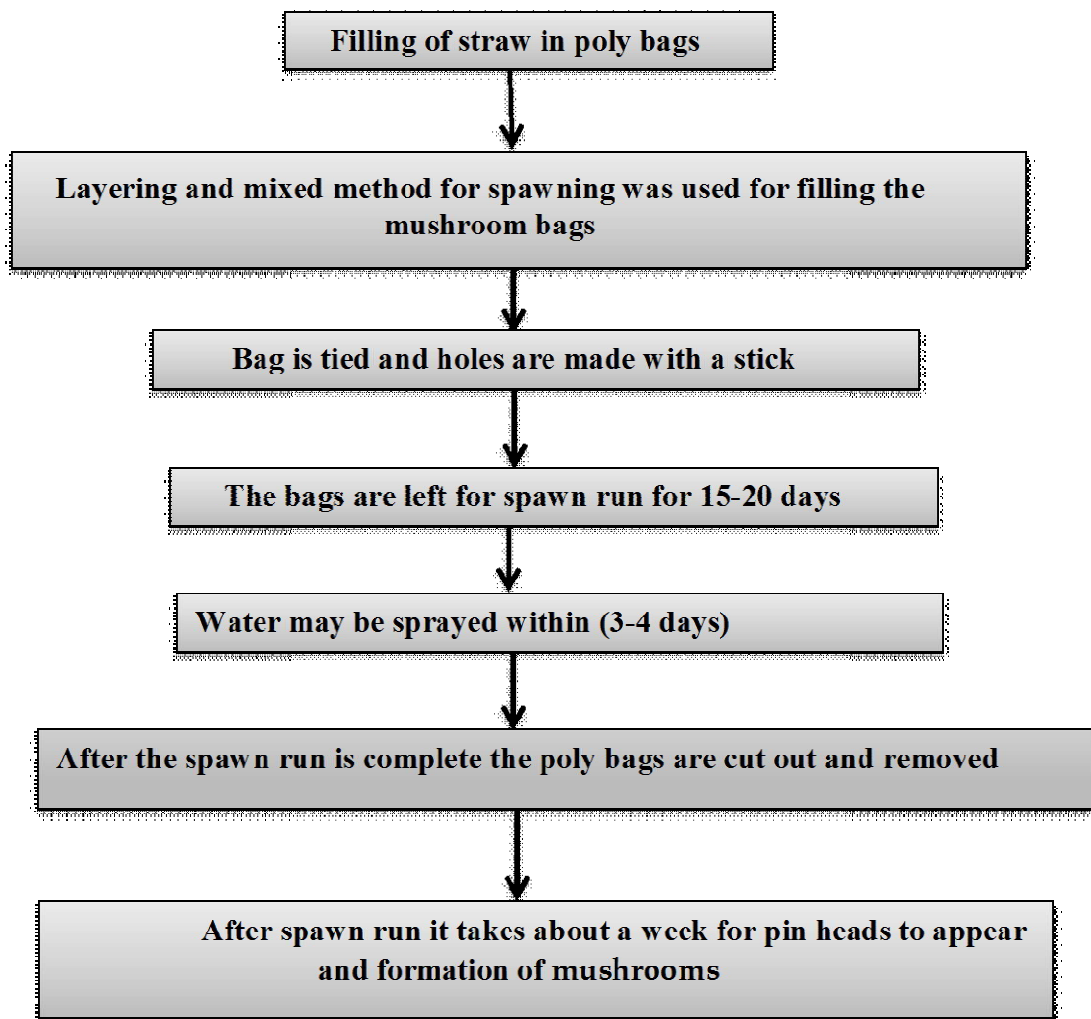
### **Mushroom Growing House (MGH) disinfection**

The MGH is a very selective environment for the growing of the oyster mushroom. This means that it must not give chance for the growing of other competitor organisms which will compete for nutrients with our mushrooms e.g. bacteria, other fungi, viruses and pests- flies, rodents etc. Since chemicals are not encouraged to practice organic farming which involves the non chemical production of mushrooms by using biological control methods. However, chemicals like hypo chloride, Dettol, formaldehyde or hydrogen peroxide can be used for initially disinfecting the MGH or between cycles.

### **Preparation of substrate**

Wheat straw was soaked in water for about 8 hours to get wet and achieved 65-70% of moisture content. All these wet substrate were separated from water and excess water was removed properly and then boiled the contents for 1 hour. After cooling, the substrate was ready for filling and spawning, at this stage substrate moisture content should be about 70 %. Polythene bags or polypropylene bags were used for its

cultivation. 200-250 gm spawn was used for 10-12 kg wet straw. Spawning can be done through layering method and mixed (through) method. In the case of layer spawning, substrate was filled in bag, pressed to a depth of 8-10 cm and broadcasted with a handful of spawn above it. Similarly, 2nd and 3rd layers of substrate were put and simultaneously after spawning, the bags were closed. After that it was gently pressed, and the bags were sealed for spawn running (development). Spawned bags were placed through hanging method in neat and clean place with the help of rope. It took 15-20 days when bags were fully covered with white mycelium, respectively.



**Figure: Cultivation Technique of Oyster Mushroom.**

## 2. Billet Method for Cultivation of Ganoderma (*Ganoderma lucidum*) Mushroom

Wood or sawdust is mainly used as substratum for cultivation of *G. lucidum*; wooden blocks commonly called as “billets” mainly made of Populus tree wood were used in this technique. Initially, the wooden blocks or billets having dimension about 12 to 15 cm long and 5 to 8 cm in diameter were arranged or prepared. The bark of these billets was removed (debarked) and then debarked billets were submerged in 2% malt solution made from corn flour for about 24 hours. Subsequently, the billets were removed from malt solution and sun dried properly. The dried billets were placed in polypropylene bags (three billets in each bag) and kept inside autoclave for about 121°C and 15 psi pressure for 3 hours. The main purpose for keeping billets in autoclave was to completely sterilize and to make billets free from contamination without any micro-organism for future use.

Afterward, the billets were taken out from autoclave and cooled to room temperature and the spawn of *G. lucidum* was inoculated by opening the mouth of polypropylene bag containing three billets in each bag under laminar air flow. The spawn was used at the rate of 5 grams per billet or about 15 grams for three billets in each bag containing *G. lucidum* spawn. The spawn was prepared on wheat grains by inoculating 8-day old young growing pure culture *G. lucidum*. The pure culture was obtained from the tissues of a matured healthy fruiting body grown on a potato dextrose agar medium. While preparing the spawn, we also added lime @ 10 gm/kg and gypsum @ 0.5 gm./kg of sterilized wheat grains. Lime and gypsum were added to balance pH of spawn. These inoculated billets were then sealed air tight and transferred to cropping room where, at temperature of 27-32°C was maintained for the entire fruiting period. The fresh fruiting bodies after harvesting were sun dried and kept for the storage and sale.

### Soil Preparation

Primarily, garden soil was filtered through metal wire mesh and mixed with sand in the ratio of 4:1 (soil and sand). The role of mixing sand was to improve the drainage of the soil. Further, lime @ of 0.5% of soil weight was mixed to maintain the soil pH. Later, the soil was covered with tarpaulin sheet and exposed to sunlight for solarization for at least a day so that harmful organisms (insects, worms etc) present in the soil may be destroyed. The soil was now ready and filled in polybags of 30 cm × 20 cm dimensions. The billets were then installed in these filled polybags of soil and kept in empty house/shed under dark light. In subsequent day, the installed billets were watered and kept in dark having proper ventilation until the pinheads of mushrooms started to appear.

### **Different stages of *G. lucidum***

Matured healthy fruiting bodies of *G. lucidum* growing naturally on a live plant and decaying poplar woods were collected and used for preparation of pure culture. The pure culture of *G. lucidum* was obtained from the inner tissues of upper surface of the matured healthy fruit body after surface sterilization. However, lower surface of the fruiting body was pale yellow colour had porous tubes. The surface sterilized bits were then placed on a potato dextrose agar medium and sub cultured till the pure culture was obtained. The pure culture of *G. lucidum* was then maintained in refrigerator at 4°C and used for making wheat grain based spawn used for inoculation of wooden block called „billet“ made of poplar soft wood. These billets before inoculation were submerged in 2% malt solution, removed, dried, placed in the polypropylene bags and autoclaved. These billets were then inoculated with wheat grain based spawn in a laminar flow by opening the mouth of the pp bags. About 15 days after inoculation (it depends on temperature, humidity etc.), these billets were completely impregnated or properly colonized with white mycelial growth of *G. lucidum*. At this stage, these ready to install billets transferred to cropping room in the laboratory and were also given to the farmers for further fructification and yield. These billets were then installed in soil, nevertheless, it was important to prepare the soil before installation of billets for physical support of the fruiting bodies as they are heavier in weight.

About 14-15 days after installation of billets, small pinheads (Primordia) of *G. lucidum* started to appear on the upper surface of billets. These pinheads were small cream coloured which slowly turned into yellow in colour with elongated stipe (Fig. 15). The appearance of pinhead on one billets varied from one to seven in number. After 5 to 7 days of emergence of primordia, the upper part of primordia became round, umbrella shaped and pale white in colour and the stage called cap formation stage. This umbrella shaped caps grew further and started turning yellow to brown from centre towards periphery with white outer margin of fruiting body. After about 14 to 17 days of emergence of pinheads, fruiting bodies turned into shiny, dark golden red colour. At this stage, this Ganoderma mushrooms got fully developed and margins of the fruiting body also turned to red colour. These fruiting bodies are harvested after the shedding of its spores.

In this method, on an average 2-3 fruiting bodies per billet weighing about 20-25 grams (fresh weight) each were harvested from 140g of dry billet in 2-3 flushes with an average biological efficiency of 9 percent (dry weight basis) within the cropping period of about 130-145 days.

## TRAINING AND DISTRIBUTION OF QUALITY SPAWN ON MUSHROOM CULTIVATION

Onsite training was done in Inder, Hadagi and Sunar village, a low cost techniques for commercial cultivation of Mushroom was transferred to the selected beneficiaries to pave the way for developing reliable production and marketing of Oyster Mushroom (*Pleurotus sp.*) and Ganoderma a medicinal mushroom (*Ganoderma lucidum*). Mushrooms with their flavor, texture, nutritional value and high productivity have been identified as an excellent food source to alleviate malnutrition and poverty.

Awareness and training on mushroom production helped in income generation, nutrient supplement, and profitable marketing of beneficiaries. Exposure training was also conducted at Centre for Business and Entrepreneurial Development, Dhulkot Dehradun for the selected beneficiaries on 17-02-2020 to 18-02-2020 to understand the cultivation techniques of Oyster and Ganoderma Mushroom. Nutritional importance of mushroom, types of mushrooms, raw material, mushroom spawn, method of cultivation, watering, required temperature and humidity for fruiting, harvesting methodology, preservation techniques, pest and disease control and about marketing channels were elaborated during exposure visit. Practical knowledge was disseminated to the beneficiaries for better understanding of the cultivation, so that in future they can establish their venture independently. The beneficiaries succeeded in acquiring knowledge after exposure training on mushroom production, exposure to training had increased the knowledge of beneficiaries regarding all the sub-components of mushroom production.



**Figure: Onsite training on cultivation technique of Oyster Mushroom.**





**Figure: Preparation of quality bags at project villages.**



**Figure: Distribution of quality bags by SEWA THDC and CBED team members**



**Figure: Exposure visit and practical training on Mushroom Cultivation.**





**Figure: Oyster mushroom bag installation.**



**Figure: Training on Ganoderma lucidum**

## YIELD OF OYSTER AND GANODERMA MUSHROOM

Oyster mushroom units were established during the project and approximately 12 quintal of wheat straw and 120 kg spawn (mushroom seeds) was used to make the 1000 (approximate) mushroom bags. First spawning was done in the month of December 2019 and the subsequent bags in the succeeding month, so that continuous adequate production of mushroom can be obtained and regular income should be achieved by the beneficiaries. The mushroom from the each bag was harvested and weighed properly. The yield of oyster mushroom during the project period is mentioned below. Due to National Pandemic COVID-19, our mushroom expert suggested the beneficiaries to sundry the fresh fruiting of Oyster Mushroom as beneficiaries were facing marketing issues. Further, the organization bought the dried mushroom from the beneficiaries. It was noted that till now, beneficiaries has dried approximate 5 kg of Oyster mushroom which roughly cost Rs. 2000.

### PRODUCTION DATA - INDER VILLAGE

Total Number of bags installed = 400 on 02/12/2019

Name of Beneficiary	Number of bags provided	Mushroom Yield till March, 2019	Total mushroom sold till March, 2019
Surjeet Singh	72	13 kg 990 grams	Rs. 1585
Ankit Panwar	76	11 kg 230 grams	Rs. 1240
Sandeep Chauhan	69	12 kg 250 grams	Rs. 1600
Roshan Singh	75	8 kg 900 grams	Rs. 1090
Sukhri Devi	58	5 kg 270 grams	Rs. 660
Arti Meher	50	6 kg 80 grams	Rs. 820

## PRODUCTION DATA - HADAGI VILLAGE

Total Number of bags installed = 500 (approximate) on 21/02/2020

Name of Beneficiary	Mushroom Unit	Number of bags provided	Mushroom Yield till July, 2020	Total mushroom sold till July, 2020
Darshan Lal Dobhal (Community Mobilizer)	Unit No 1	50	25 kg 800 grams	Rs. 3800
Premdutt Dobhal	Unit No 2	50	17 kg 750 grams	Rs.3060
Tejram	Unit No 3	50	15 kg 250 grams	Rs. 2700
Subhash Chandra Dobhal	Unit No 4	50	15 kg 150 grams	Rs.2400
Mastan Lal	Unit No 5	50	16 kg 900 grams	Rs. 2880
Sampat Lal	Unit No 6	50	15 kg 80 grams	Rs. 2250
Puni Devi	Unit No 7	50	13 kg 800 grams	Rs. 2180
Suvid Lal	Unit No 9	50	14 kg 400 grams	Rs. 2075
Buddu Ram	Unit No 9	50	18 kg 900 grams	Rs. 3060
Shyam Lal	Unit No 10	50	17 kg 700 grams	Rs. 2985

Out of the total mushroom yield, approximately 75 % was sold by the beneficiaries to the local market and among village communities. Only 10 % subsidiary income was generated by the beneficiaries apart from their traditional agricultural practices. Whereas, approximate 25 % fresh mushroom was consumed by the beneficiaries, which reflects that the protein, lipid, fiber, and carbohydrate content were added in their daily food habits, which helped the communities to overcome protein-energy malnutrition problem. The nutritional value of mushrooms is generally explained in terms of their availability of protein content in their fleshy edible fruiting bodies. As compared to plant proteins, the mushroom protein is ranked to have higher nutritional quality (FAO, 1991). Generally, mushrooms being good source of protein the contents ranging from 19 to 35 % on dry weight basis.

**Cost Benefit Analysis for Oyster Mushroom as an economically sustainable enterprise.**

- The economies of *Pleurotus spp.* has been estimated using its production statistics and cost of the main product *i.e.* edible fruiting body of the mushroom. The production cost from 100 bags of Oyster includes the growing cost *i.e.* cost of raw material (wheat straw, spawn, polypropylene bags, chemical used), energy consumption, financial and man power cost, etc. was calculated.
- The input cost required for the production of one complete bag which is at the final stage of installation was calculated around Rs. 70. Cost of 100 bags adds upto Rs. 7,000.
- One bag weighs 3 kg produce approximately 1.5 kg fruiting body in four flushes. Total production from the 100 bags would come out to be 150 kg within a period of 90 days.
- Common market value of 1 kg of Oyster mushroom varies from Rs. 120 to 200.
- Total of Rs. 2,000 was deducted from the obtained cost as local transportation charges incurred during distribution of mushroom to local markets.
- Net profit from the 100 bags would be comes around Rs. 15,000 within 90 days.

Profit incurred from 100 Oyster mushroom bags	
<b>Total cost of one complete bag</b>	= Rs. 70
<b>Cost of 100 bags</b>	= Rs. 7,000
<b>Production per bag</b>	= 1.5 kg
<b>Production from 100 bags</b>	= 150 kg
<b>Selling Price per kg</b>	= Rs. 120 to 200
<b>Net Profit</b>	= Selling Price-Transportation charges Rs. 15,000, Growing duration 90 days





**Figure: Fresh fruiting of Oyster Mushroom cultivated at Project Area.**



**Figure: Fresh fruiting of Oyster Mushroom cultivated at Project Area.**



**Figure: Dried Oyster Mushroom Production at Hadagi Village.**

***Ganoderma lucidum*** is highly valuable mushroom being used for numerous purposes, mainly in pharmaceutical companies, food and cosmetic companies. Ling-zhi products made from cultivated Ling-zhi fungi are consumed worldwide and have a significant market value, an estimated annual global turnover of more than 2.5 billion US dollars. It is used after manufacturing by pharmaceutical companies in the form of powder, capsule, syrup, oil capsule or mushroom slices. Its spore powder is also being sold in the form of spore powder capsule and spore powder oil capsule. It is also used as a base material in manufacturing of many cosmetic products such as face cream, face wash, moisturizing cream, soap, shampoo, massage oil, baby oil, body lotion, face mask, anti- ageing cream etc. It is also utilized as an ingredient in many food products and beverages like tea, coffee, biscuit, cookies, cake etc and also popular among many bakery products.

In India, almost all industries manufacturing products based on *G. lucidum* are importing its raw material from China, Japan, Malaysia and Korea. China alone produces and consumes most of the *Ganoderma* products worldwide. Many international companies are in business of manufacturing and marketing of *G. lucidum* based products worldwide. Also, various international companies are marketing *Ganoderma* based products to India but the Indian companies are yet to work for its national and international marketing. With the passage of time, people are getting aware about the products of *G. lucidum* and its marketing in India. However, it is still limited to laboratories and now scientific institutions are trying its expansion for cultivation and marketing to the mushroom growers and farm community.

#### **Economics for cultivation of *Ganoderma lucidum***

The economics of *G. lucidum* cultivation has been estimated using its production statistics and cost of the main product i.e. fruiting body of the mushroom. The production cost includes the growing cost i.e. cost of raw material (billets), energy consumption, financial and man power cost, etc. calculated for the production of 1 Kg (dry weight) of *G. lucidum* fruiting bodies.

-The input cost incurred for the production of 1 Kg dry *G. lucidum* fruiting bodies is Rs. 1446 (comprising, Rs 546 for billet preparation including cost of Billets, Polypropylene bags, charges of Autoclaving @ Rs 7/ complete billet + Rs. 900 for man power, energy, land charges, sand, soil etc), i.e. Rs. 900 + Rs. 546 = Rs. 1446.

-For production of 1 Kg dry *G. lucidum*, an average 78 bags containing 1 billet in each bag (total 78 billets) required which can be accommodated in 1 x 2 m<sup>2</sup> area.

-Billet size dimensions varied 12 to 15 cm long and 5 to 8 diameter.

**Cropping cycle:** In 1<sup>st</sup> flush, from 78 bags in 70-75 days, one can get 80-85 fruiting bodies (1st crop). In 2<sup>nd</sup> flush, from the same 78 bags in next 30-35 days, 52-56 fruiting bodies can be harvested (2nd crop). In 3<sup>rd</sup> flush, in the next 30-35 days, 30-32 fruiting bodies can be harvested (3rd crop).

-A total of 162-173 fruiting bodies can be harvested (Average 168 fruiting bodies) from 78 bags or billets in 130 to 145 days.

-Dry weight of each fruiting body = 6 gm (Average)

-Dry weight of 168 fruiting body =  $168 \times 6 = 1008$  gm (approx. 1000 gm or 1 kg)

In 130-145 days, approx. 1000 gm of dried *G. lucidum* can be produced from 2 x 1 m<sup>2</sup> area.

**Output cost:**

Common market value of 1 Kg. *G. lucidum* fruiting body= Rs. 4000.

Total profit = Output cost - Input cost

= Rs. 4000-1446 = Rs. 2554 /Kg

It can be said that from one square meter one can earn about two thousand five hundred rupees in 130-145 days.

Although, this cost benefit analysis is suitable if one is selling the raw fruiting bodies directly to the consumer without any transportation and storage cost. Farmers/growers can earn a handsome amount of profit if they sell the processed products after the value addition of its fruiting bodies.

In the project villages, 50 billets of *Ganoderma lucidum* were distributed to each beneficiary to assess the feasibility of the mushroom production at the project site. Approximately, 2 Kg of *Ganoderma lucidum* is harvested by the beneficiaries at project site and the *Ganoderma* dried fruiting body were buy-backed by the implementing organization, CBED for further processing of the fruiting part to make that in powder form.



**Figure: Fruiting of Ganoderma Mushroom**

## CONCLUSION

The project findings shows that majority of the farmers agreed that mushroom production can improve farmers' livelihood and the cultivation of mushroom as secondary occupation will increase farmers' source of income. The perceived benefits derived from mushroom production shows that mushroom served as improvement of strong bone formation, substitute for meat and reduction of diseases. Training and demonstration were the integral part of the project cycle. The beneficiaries were inspired greatly by the easy method of mushroom production. The mushrooms were included in their daily diet and supplemented additional nutrition to them. The perception levels of the respondents about mushroom and its production after the training have changed. The reason behind the satisfactory change in perception level is due to well educational background, keen interest of participants and methods followed for technology transfer to the trainees.

The generation of additional employment opportunities would be able to ease the unemployment situation, may be in whatever smaller degree. With this in mind, the mushroom cultivation was introduced, initially the beneficiaries were interested but the growth rate of adoption of this activity did not touch the desired level due to the COVID- 19 situation as the beneficiaries did not get proper market channel to buy their fruiting bodies in adverse conditions of the pandemic prevailing in the country. Still, beneficiaries increase their subsidiary income by 1 % through adoption of mushroom cultivation as a secondary occupation.