VALUE CHAIN STUDY OF MUSHROOM IN MANIPUR

A DETAILED STUDY OF THE MUSHROOM VALUE CHAIN IN MANIPUR COVERING FARMERS, TRADERS AND CONSUMERS

A STUDY CARRIED OUT BY THE MAOLKEKI FOUNDATION

With support from the National Bank for Agriculture and Rural Development (NABARD)

02 02 2020

Imphal, Manipur, INDIA

MaolKeki Foundation

NABARD

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Abstract

This NABARD-funded study carried out by a team from the MaolKeki Foundation interviewed over 300 farmers, traders and consumers of different types of mushroom in Manipur between September 2019 and January 2020. The interviews were conducted using a defined set of questionnaires in both the valley and hill areas of Manipur.

The findings show that mushroom cultivation is a recent phenomenon which has only really taken off in the last three to six years. Most farmers are the educated male youth of Manipur while traders are primarily middle-aged women educated up to primary school level. The farmers also use existing infrastructure and available tools to grow mushroom at a relatively lower cost than a dedicated mushroom facility. Though this saves cost delivering margins ranging from 59% for Oyster and 68% for Paddy Straw farmers, it limits productivity and year-round production capacity with most production coming in after the peak demand had subsided. A farm economic model was created based on an existing farm and it showed that an average farmer needs an upfront investment of Rs2.3 lakhs to establish a new mushroom farm capable of producing 1,000kg of oyster mushroom a year with an IRR of 17% and BCR of 1.01. For Paddy Straw mushroom production, the upfront investment is Rs.3.4 lakhs however the returns are much better though, because of its high perishability, there can be significant losses if not sold as fresh mushroom within a day of harvest. Whilst a lot of farmers received some form of technical training, it was observed that they would benefit from more dedicated, longer term, training programs.

The most widely preferred type is Oyster mushroom which may be because it is relatively easy to grow throughout the year, is moderately priced, and meets the taste preference of consumers. Farmers, traders and consumers trade in mushroom in all kinds of ways and there is no clearly defined flow of mushroom from the farmer to the consumer. Having said that, a lot of farmers do sell directly to consumers. Traders on average make a gross margin of 29%.

Based on the findings of the study, it is recommended that a model mushroom farm be established which can be the Centre of Excellence for all things mushroom in Manipur. It is also recommended that farmers be provided with not just technical but also management training so that they can better run their businesses. The support of mentors is also a crucial gap and a network of mentors must be set up to help farmers. Finally, even if this report has attempted to list the key steps in mushroom production for different types of mushroom, it is important that a Handbook for Mushroom Production in Manipur be developed.

Executive Summary

In recent years, there has been a boom in mushroom cultivation in Manipur. NABARD engaged MaolKeki Foundation to carry out a value chain study to understand the present status, document the different players and provide an overview of the successes and challenges experienced by the mushroom industry in Manipur.

To carry out the study, a team from MaolKeki Foundation was assigned to the project from September 2019 to January 2020 and their first task was to design a series of questionnaires for farmers, traders and consumers of mushroom in Manipur. Following the ratification and signing off of the questionnaires, the team identified over 300 individuals across multiple districts in Manipur to carry out both Face-to-Face (F2F) and phone interviews which supplemented the F2F ones as the team could not always travel to carry out F2F interviews. Despite the security and logistical challenges, the team did gather over 25,000 data points and the salient findings are given below:

Farmers: Mushroom farmers in Manipur are mostly educated unemployed adult men (76%) between the ages of 31 and 50. Most of the farmers have been in business only for the last three years or so, and many (59%) had not registered their businesses. The most common mushroom grown was Oyster (77%) due to its ease of year-round production and likely influence of farmers learning from one another. However, farmers fetched more money for rarer types like Paddy Straw and Shiitake mushrooms. 90% of the farmers also sold their mushroom fresh opportunistically to anyone buying, including customers, retailers, wholesalers and rural assemblers. Though there is year-round production, it seems to peak between October and March which we gather is primarily because of the availability of straw after the rice harvest, straw being a key substrate in mushroom cultivation. Most farmers also control pests and diseases using natural methods (47%) and many of the farmers received training from KVK, ATMA, CAU and others. Farmers source the inputs they need, especially chemicals, from their local input stores or from Imphal where the price is lower. Spawn is sourced mostly from the limited number of suppliers in the state or different initiatives while straw comes either from the farmer's own field or is pre-arranged with rice farmers. 75% of the farmers used their own savings, or money from relatives to start their businesses with very few going for financial support from the government or banks. An attempt to calculate the profitability of mushroom cultivation was made however it was challenging as no recent farmer had set up a unit purely for mushroom cultivation and were using existing facilities with make-do equipment which significantly reduced the upfront cost of mushroom cultivation. As such, spawn producers made an average margin of 73% while mushroom farmers got margins ranging from 59% for Oyster

and 68% for Paddy Straw. The financial viability analysis of a farm producing 1000kg per annum based on a Manipuri entrepreneur's current operations gave a Net Present Value of ₹4,643, Internal Rate of Return of 17% and a Benefit Cost Ratio of 1.01.

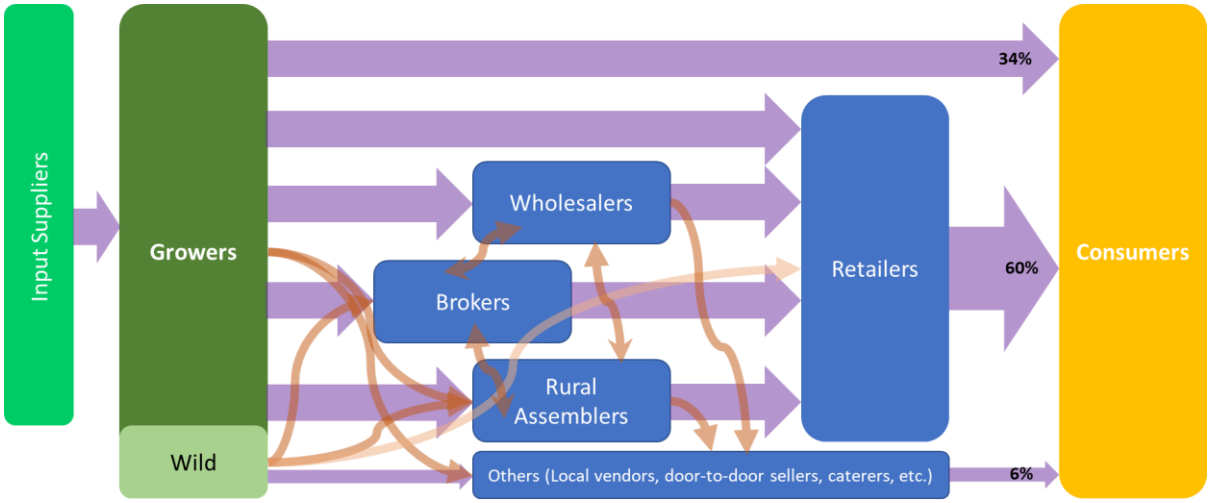
Traders: Mushroom traders, in contrast to the farmers, are mostly primary-level educated women (90%) between the ages of 41 and 60. Most of them have also been trading mushroom only for the last three years or so reflecting the recent trend in mushroom in the state. Whilst attempts were made to interview as many different types of traders as possible, 71% of those interviewed were retailers with about 22% being rural assemblers. Influenced primarily by what's available, 83% of them traded in Oyster mushroom with high demand, good margin and easy availability being the primary motivators. Whilst traders buy from a range of sellers (farmers, brokers, rural assemblers, wholesalers, etc.), 74% of them sell directly to consumers and make an average margin of 29%.

Consumers: Men may be the farmers but, when it came to deciding on what was consumed, it was mostly women in the household who decided. Both men and women consumers were interviewed however most men could not provide detailed answers on quantity, price, availability, etc. Hence, 70% of the consumers who completed the survey were women and most were aged between 21 and 40 (61%). Consumers were educated to varying levels in equal numbers however slightly more were educated up to a degree level (33%). Most households were four to six in size and consumed about 100g of mushroom once a week on average. 34% of the consumers sourced directly from farmers while 43% bought mushroom from the market. Buying was influenced by such factors as better taste and easy availability, with 37% buying only Oyster mushroom and a large 50% buying a combination of different types including traditional and wild varieties.

Dedicated mushroom cultivation, trading and consumption are relatively new phenomena in Manipur even if mushroom, sourced from the wild, has been part of local delicacies for long. This fact-based overview of the mushroom value chain shows that mushroom as an industry is still at a nascent stage and most farmers are venturing into it as a way to earn an income while keeping the risk relatively low by using existing sheds and tools as much as possible, and relying on own savings to fund the venture. There

is a real need for generating greater awareness of Good Agricultural Practices in mushroom cultivation, longer-term training and handholding of farmers through a mentorship program, and the establishment of a model farm as no farm we studied was modern with a well thought out business plan. It is clear from the market feedback that there is demand for mushroom, especially exotic varieties like Shiitake and Button Mushroom, so upskilling farmers and supporting them to venture into mushroom production as a full-time profitable venture is the critical need of the hour.

Based on the findings, the current mushroom value chain in Manipur has been drawn out below:



Acknowledgement

A study such as this would not have been possible without the interest and support of a main benefactor so we are very thankful to NABARD for taking the first step in understanding the current lay of the land in Manipur's blossoming mushroom sector. We would especially like to highlight the regular support and feedback provided by Dr. Satyasai Kovvali and his team at NABARD including Dr. R. Ravibabu, Mr. S. K. Das, Madam C. Phaimphu, Mr. James Bond, and Mr. Premjoy Irungbam.

There are many stakeholders and advisors to thank too and, in no particular order, we would like to acknowledge the support we received from Mrs. Jyotsana Nongmaithem (Sr. Scientist and Head - KVK Senapati), Mr. Dipin Wakheimayum (Senior Research Fellow, Horticulture – KVK Senapati), Dr. Solei (KVK Ukhrul), Mr. Chumsha Clement Ngoruw (Block Technology Manager - ATMA Chandel), Mr. Raingam Shinglei (Credit Officer – Ukhrul District Women Iinstitute of Micro-Credit, Ukhrul), Ms. Sonia Kamei (Block Technology Manager – Tamenglong), Mrs. Reema Khaidem (Block Technology Manager – Senapati), Mr. Ramananda Elangbam (KVK Imphal East), Thanky Chungkham (Agriculture Technology Manager - ATMA), and Mr. Selheibam Bihari (Progressive Farmer cum Trainer). We would also like to thank Dr. Susheel Sharma (Plant Pathologist – ICAR) for drafting the cultivation processes and Dr. Bireswar Sinha, Assistant Professor, Central Agricultural University, for taking the time to read this report and provide feedback.

We also take the opportunity to thank the hundreds of farmers, traders and consumers without whose time, inputs and participation, we would not have completed this study. And, finally, the support of our colleagues and stakeholders at the MaolKeki Foundation, one of whom even accompanied our associates during a field visit because of security concerns during the state-wide protests in December 2019.

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Chapter 1

Mushroom in Manipur: An Introduction

1.1 Introduction to Mushroom

Mushroom belongs to a group of Fungi. Mushrooms are reproductive structures of edible fungi that belong to Basidiomycotina. Like any other fungus, the vegetative parts of the mushroom consist of thread-like thin mycelialthallus, which under suitable conditions form fruiting bodies (sporocarps), commonly referred to as mushroom. Fungi are plants that do not possess chlorophyll, the green colouring pigment, hence direct sunlight is not a necessity for fungi to manufacture their own food. A fungus bears spores that serve as seeds. Mushrooms occur under diverse ecological conditions from desert to forest. Some mushrooms are edible, others are non-edible and a few are poisonous.


Fig 1: Oyster mushroom in a basket

Environment, quality food and health are the present concerns around the globe. Mushroom cultivation helps to address the issues of nutritional food security as they are rich in protein, have no cholesterol, offer dietary fibre, have low sodium while being full of vitamins and minerals. Bioactive compounds like glucans, and protein polysaccharide complexes that impart unique medicinal values like anti-cancer and anti-viral properties, are also present. With ever increasing demand for quality food, mushroom cultivation is emerging as an important activity in different parts of India. It requires less land and can be a good source of income for small and landless farmers, women and the youth. Mushrooms are grown on either raw or composted substrates. These substrates are mostly waste materials from farms, plantations or factories. Such agro waste is easily available and mushroom cultivation provide a solution for proper recycling of agro waste. Integrating mushroom cultivation in existing farming systems will supplement the income of rural masses, provide gainful employment and will lead to inclusive growth as all sections of society can adopt this venture. Moreover, after harvest, the leftover substrate can be converted into manure for use in the fields.

1.2 Types of Mushroom

The important types of mushroom are:

1.2.1 Oyster Mushroom


Fig 2: Oyster mushroom in growth

Oyster mushrooms are quite popular in Manipur because of the faster growth rate. It can be cultivated very easily using raw straw and can be harvested in 25-30 days. Most of the oyster mushroom species grow well in a temperature range of 20-32°C, and this mushroom also has species suitable for temperate region. The most popular ones are *P. flabellatus*, *P. eous*, *Pleurotus sajor-caju*, and *P. florida*. These varieties, particularly *P. flabellatus* (fig 1) & *P. eous* are very common in the state during May-September. *Hypsizygus ulmaruis* (Elm oyster mushroom) is a very popular variety in Manipur and it is cultivated mostly during August to April. In Manipur, *P.eryngii* & *P. ostreatus* are cultivated very rarely. Oyster mushroom in dried form can be exported. Certain unidentified *Pleurotus spp.* are found to grow naturally in the hill regions.

1.2.2 Paddy Straw Mushroom (*Charuyen)*


Fig 3: Paddy Straw mushroom in growth

Paddy Straw mushroom (*Volvariella volvacea*) is popular in the state for its taste and flavour. Its flavour is excellent and cropping cycle is short. However, this variety is highly perishable and has poor keeping quality. It can be grown in a temperature range of 25-40°C. In earlier times, Paddy Straw mushrooms were grown naturally but these days, it can be cultivated both indoors and outdoors. The best place for outdoor cultivation is under a shade.

In Manipur, seasonal farmers undertake Paddy Straw mushroom production during the summer season (May - August). Paddy Straw mushroom is expensive compared to oyster mushroom and can cost Rs350-500 per kg.

1.2.3 Button Mushroom


Fig 4: Button mushroom

Button Mushroom (*Agaricus spp.*) is the most popular variety both for domestic and export markets. Although Button mushroom is very popular in our country, it is not cultivated in Manipur because of the lack of technology and high cost of energy for year-round production. Moreover, Button mushroom cultivation is a highly scientific and labour-intensive

job with high cost of imported culture/spawn, machinery, casing materials, etc. There is a chance of growing Button mushroom in the state if good quality compost (substrate) can be easily accessed. The preparation of substrate for Button mushroom is a tedious and time-consuming process so most farmers prefer to cultivate Oyster which is much easier and can be grown on raw straw.

1.2.4 Black Ear Mushroom

In Manipur, Black ear Mushroom (*Auricularia spp.*) is known as *Uchina* and is a popular mushroom. It is also called Wood Loving Fungus and are wildly grown on rotten wood logs under moist and shady conditions. This mushroom grows naturally in the wild in north-eastern states and are collected and consumed in many ways. Black Ear mushrooms are primarily available in dried form mostly after the rainy season.


Fig 5: Black Ear mushroom

1.2.5 Shiitake Mushroom

Shiitake mushroom is one of the most popular mushrooms both as food and medicine. At a global level, it ranks second after Button mushroom and contributes 24% of total mushroom production. In India, its cultivation is negligible. However, experiments show that this variety can be successfully grown on saw dust when temperature is about 20°C. Some Manipuri farmers have experimented with Shiitake cultivation but the results needed improving.


Fig 6: Shiitake mushroom

1.2.6 Kanglayen

Kanglayen (*Schizophyllum commune*) is also a popular mushroom in Manipur and it is known as Split Gill Mushroom. This mushroom is found in the wild in decaying trees after the rainy season and can be consumed in many ways – *eronba*, *kangsoi*, *salad*, *paknam*, etc. It is collected in the wild and sold fresh or in the dried form at various markets, especially in the hill stations of Manipur.


Fig 7: Kanglayen mushroom

1.3 Mushroom Cultivation in Manipur

In Manipur, mushroom has been part of the diet for their flavour and higher food value since ages. The earliest attempt to cultivate mushroom in the state was made by the State Agriculture Department in the early seventies. It is evident from earlier records that successful growing of mushroom was achieved by Dr. R.N. Verma (1978) at the laboratory of Plant Pathology, ICAR Research Complex for North Eastern Region, Manipur Centre, Babupara (now at Lamphelpat), Imphal. It was the beginning of mushroom cultivation in Manipur. Ever since, Oyster mushroom and Paddy Straw mushroom have been grown successfully in the state under controlled and uncontrolled environments. Naturally occurring edible mushrooms found in the state are *Uyen*, *Uchina*, *Kanglayen*, *NarinChengum*, *Khongnangchengum*, *Tek Tek Pan*, *Khomthokpi*, *Charuyen*, *Sendrang Makhong*, *Uyangan*, and *Phoubakchenggum*.


Fig 8: Growing bags

Mushroom cultivation is a profitable agri-business activity. Because of the relatively low input cost and favourable climatic conditions, mushroom cultivation has been adopted tremendously in Manipur by the youth. In Manipur, mushroom production systems are mixed, i.e. both seasonal farming as well as high-tech farming. The activities are taken up in both the hill and valley areas but the production rate is very low in the hill areas. Hill farmers are seasonal farmers where they grow mushroom only when straw is available while the farmers in the valley tend to store straw to produce mushroom throughout the year. Also, unavailability of spawns in the hill districts can lead to low production. Bishnupur, Imphal West, Imphal East, and Thoubal districts are the largest producers of mushroom in Manipur. The production rate in the hill regions is not sufficient enough to meet the demand so mushrooms from Imphal are sold in the hill districts.

With the climatic conditions of Manipur, all types of mushrooms can be grown in the state but Oyster mushroom and Paddy Straw mushrooms are the most popular two. Oyster and Paddy Straw mushrooms require lower input cost and lesser land compared to others and hence they are cultivated mainly by the landless farmers and youth. Although Button mushroom ranks first in production in the country, it is not cultivated in Manipur due to lack of technology and high cost of production.

Although the current mushroom industry is predominantly focused on the trade of fresh produce, some small firms produce value added products of mushroom. Dried mushrooms, mushroom powder, chow, pasta, mushroom nuggets (bori), and pickles are some of the processed products. One such firm, Binita Mushroom, has been profiled in the appendices.

Chapter 2

Mushroom Production, Pest & Diseases, and Watch Outs

2.1 Production of Mushroom

Production of mushroom takes place in multiple steps and requires favourable conditions either available naturally like in caves or in controlled growth chambers. The process starts with the production of spawn which is essentially the 'seed' for larger-scale mushroom cultivation. Spawn is produced by growing mycelia in a sterile environment on cereal grains. The mycelia-covered grains then become the seeds for mushroom cultivation in trays or bags in a temperature and humidity-controlled environment. Depending on the type of mushroom, growth can take place within a few days to weeks. In the following sections, the steps for producing two of the most commonly cultivated mushroom types have been described.

2.1.1 Steps in Oyster Mushroom Production

Oyster mushroom, as will be shown later, is the most widely cultivated mushroom in Manipur. The steps below give a general description of its production:

Fig 9: Oyster in a growing bag

Step 1: Select good quality straw from cereals like wheat or paddy
Step 2: Chop the straw into 3-4 cm long pieces
Step 3: Prepare the substrate in one of the following ways:

a. *Hot water treatment*: The chop straw is soaked in hot water for 1hr then the excess water is drained. The straw is left to semi-dry before use. However, this method is not suitable for commercial production.

b. *Chemical Treatment*: Most farmers prefer this method as it is easy and convenient to practice. The chopped straw is soaked in clean water mixed with 10gm of Carbendizime (in 100 litres of water) for 8-12 hours. The excess water is drained and the straw is allowed to dry in a shade.

c. *Pasteurization*: This advanced method is costly and takes 3-4 days so most farmers can't afford it. In this method, the pre-wetted straw is put inside a pasteurization chamber at 58°C - 62°C for 4 hours and then at 40°C - 45°C for 36-48 hr. The temperature of the pasteurization room is maintained with the help of steam through a boiler.

Step 4: Spawning: Fill the straw and spawn layer by layer in a plastic bag of 45cm X 30cm and tie the bag.

Step 5: Pinning - Pinning is the phase when little white buds, or pins, first start appearing. Adjusting the temperature and humidity at this stage can regulate the growth rate and size of the mushrooms. Store the mushroom bags in a dark cropping room.

Step 6: Harvesting - After 20-30 days, harvesting can commence.

2.1.2 Steps in Paddy Straw Mushroom Production

Different types of methods are practiced for Paddy Straw mushroom cultivation but conventional method is practiced more in Manipur as described below:

Step 1: Soak neatly arranged bundles of paddy straw in clean water overnight and then remove the excess water.

Step 2: Prepare a bed by placing a layer of straw bundles

Step 3: Spawn the prepared bed around the edges

Step 4: Sprinkle red gram flour over the spawns and repeat steps 2 to 4 twice more with each layer of straw perpendicular to the previous layer

Step 5: Once covered with a layer of straw, press down and cover with a clean polythene sheet to maintain humidity and temperature.

Step 6: After 7-8 days, remove the polythene sheet.

Step 7: Paddy Straw mushroom will start growing after 4-5 days.

2.2 Pests & Diseases

Mushroom production yields can be significantly reduced by an array of pests and diseases. Some of the common ones are described below and anyone seriously contemplating entering into mushroom cultivation should get professional support and training. Brief control measures, which can range from adopting good practices to using chemicals to natural controls have also been described for each one of them.

Natural control method refers to following good practice of cultivation, i.e. measures taken up to prevent entry of insect pests. Hygiene and sanitation are the primary methods of pest control in mushroom cultivation. The shed used for mushroom cultivation and its surrounding areas should be kept neat and clean. Proper pasteurization/ sterilization of the substrate, incubation of bags at the right temperature, use of fresh substrate with right pH after treatment and proper hygiene should be maintained during spawning and cropping to reduce the incidence of mould and the presence of unwanted pathogens. Older crops attract insect pests so timely removal and discarding of used substrate to a faraway place should be practiced. Flies

are also a major threat to mushroom cultivation. Farmers could also use traditional and biological options such as:

- Extracting neem liquid, mixing with water then spraying on the walls and floors of the mushroom shed
- Covering the spawned bag with bags made of polyester cloth
- Covering the pin holes of spawned bag with non-absorbent cotton or fibre until mycelium starts growing
- Mixing black pepper and papaya leaf with water (10:10:80) and spraying
- Mixing ginger juice with garlic juice in water (10:10:80) and spraying three times with 12-hour gaps

2.2.1 Mushroom Flies

The flies lay eggs in the mushroom beds and the emerging larvae cause damage directly by feeding on the white mycelium. If infested at the pinhead stage, mushrooms become brown and remain stunted, wrinkled and bent downwards with a large number of larvae and pupae lying embedded inside the tissues. Adult flies are also the carriers of mites and mushroom pathogens.

Fig 10: Eggs of mushroom flies (ICAR)

Fig 11: Mushroom fly (ICAR)

Control Measures:

- Hygiene and sanitation
- Screening of doors and ventilators
- Light traps
- Poison baiting
- Proper pasteurization or sterilization

2.2.2 Brown Plaster Mould

This is first noticed as a whitish growth on the exposed surface in trays or on the sides of growing bags due to the condensation of moisture. Then, it further develops into large dense patches which gradually change colour into brown and rust colour. On these patches, no mushroom mycelium growth can occur leading to a loss of yield and contamination.

Fig 12: Brown plaster mould (ICAR)

Control Measures:

- Very good hygiene
- Proper pasteurization and sterilization
- Use of neem leaves by spraying extracted neem juice mixed with water

2.2.3 Beetles

Beetles, like the one shown in figure 13, feed on the mycelium and spawn, turning the infested fruiting bodies into abnormal shape and rotten masses. The insects can hide in between the gills of oyster mushrooms and can complete its life cycle within three weeks.

Fig 13: Beetle
(Missouri Master Naturalist™)

Control Measures:

- Strict hygiene
- Proper pasteurization of straw
- Application of chlorinated water or bleaching powder on cropping beds

2.2.4 Green mould

The first signs of this are green patches which appear in the compost, spawn, on casing surface and sometimes on the mushroom surface. This growth of mycelium can engulf the whole fruit destroying yield and quality of harvest.

Fig 14: Green mould
(Sri Vinayaga Mushroom Farm)

Control Measures:

- Very good hygiene, proper pasteurization and sterilization
- Use of neem leaves by spraying extracted neem juice mixed with water

2.3 Watch Outs

As highlighted before, mushroom production is a multi-step process and requires good hygiene and best practice. Some watch outs have been presented here so readers of this report are familiar with some of the challenges faced by mushroom farmers however this should not be taken as a manual for mushroom cultivation.

Some of the key watch outs are:

1. **Spawn quality:** As spawn is the 'seed' for mushroom cultivation, it is important that its quality is pure and clean. Some farmers produce their own spawn however this must be done with the highest standards otherwise it will affect the whole chain.
2. **Substrate preparation:** Not cleaning and sanitizing the substrate properly can lead to poor growth and pest/ disease infestations later on. For Paddy Straw, not preparing the bed layers could mean loss of significant yield and income.
3. **Temperature, humidity, aeration and lighting:** These external factors greatly affect the growth rate and growth density of mushrooms. Lack of ideal conditions could lead to delays in growth or irregular growth thus wasting time and resources.
4. **Nutrients:** As with any crop, appropriate nutrient regime is critical to good growth and harvest. Too little nutrient could lead to stunting or too much watering could lead to rotting.

Chapter 3

Value Chain Assessment

3.1 Introduction to Value Chain

The term value chain refers to the full range of activities that are required to bring a product (or a service) from the initial conception through the different phases of production to delivery to final consumers and disposal after use (Kaplinsky 1999; Kaplinsky and Morris 2001)

Mapping the mushroom value chain provided a clear sequence of activities from farm to market.

3.2 Different steps in mushroom value chain

The different key steps involved in the mushroom value chain have been schematically shown below in figure 15:

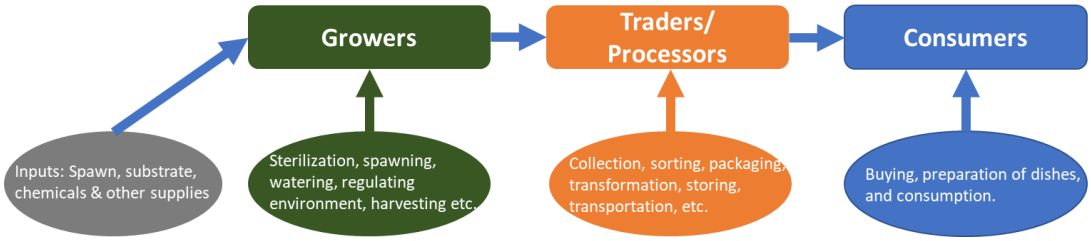

Fig 15: Mushroom value chain

The chain starts with farmers procuring the necessary materials from input providers to start the cultivation of mushroom. Once harvested, the mushroom is passed on further down the value chain to traders or processors or both. Traders may take the mushroom from farmers to processors or directly to the fresh mushroom markets. There may also be traders who take processed products from the processors to the consumers. As we will see later, in the context of Manipur, there isn't much value addition as most of the mushroom is sold fresh. However, farmers sell to many different actors based on the opportunity. This is a sign of an evolving value chain where many players are involved carrying out no one single task but playing a multifaceted role. So, a farmer not only grows mushroom but, for example, takes the crop to retailers in the market or directly to consumers. Retailers on the other hand source from a whole range of suppliers while consumers also source mushroom from a mix of farmers, retailers and other sellers.

Chapter 4

Results & Analysis

As part of the study, around 300 individuals were interviewed, including farmers, consumers and traders. Interviews included F2F sessions across a range of locations such as Ukhrul, Churachandpur, Senapati, as well as multiple locations in Imphal valley. Remote locations where there were only one or two farmers were covered by phone interviews. Phone interviews were also carried out to cover more individuals than could be covered F2F only. All the interviews were carried out with customised questionnaires for farmers, traders and customers loaded on a mobile application called doForms. Detailed questions were asked on production processes, costs, as well as trading, and information was also gathered on consumer preferences. All in all, over 25,000 data and info points were collected.

The breakup of the different players interviewed are shown below:

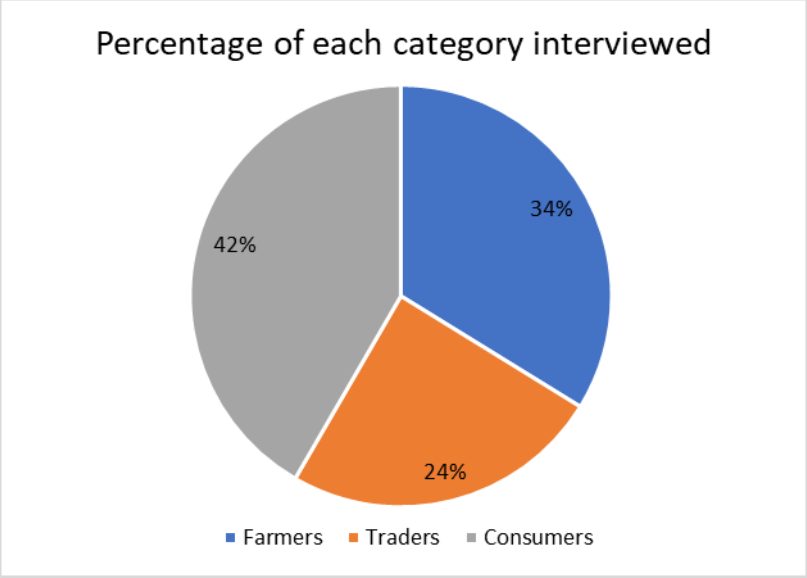

Figure 16: Summary chart of value chain players interviewed

The geographic locations of the interviews which were GPS tagged in doForms have been plotted below with each of the clusters zoomed in for granularity. Attempts to cover as many places as possible were made however, planned trips to some locations like Tamenglong had to be cancelled due to social unrest in Manipur leading up to the State Assembly session while visits to other places were cancelled due to lack of sufficient farmers to interview.

Figures 17 and 18 show the locations covered across Manipur, figure 19 shows the locations in the southern part of Manipur, figure 20 shows the locations in the central areas in and around Imphal valley while figure 21 shows the locations covered north of Imphal valley.

In the maps, the green pins indicate farmers, the red stars indicate the traders and, finally, the blue dots indicate the locations of the consumers who were interviewed:

= Farmers; = Traders; = Consumers

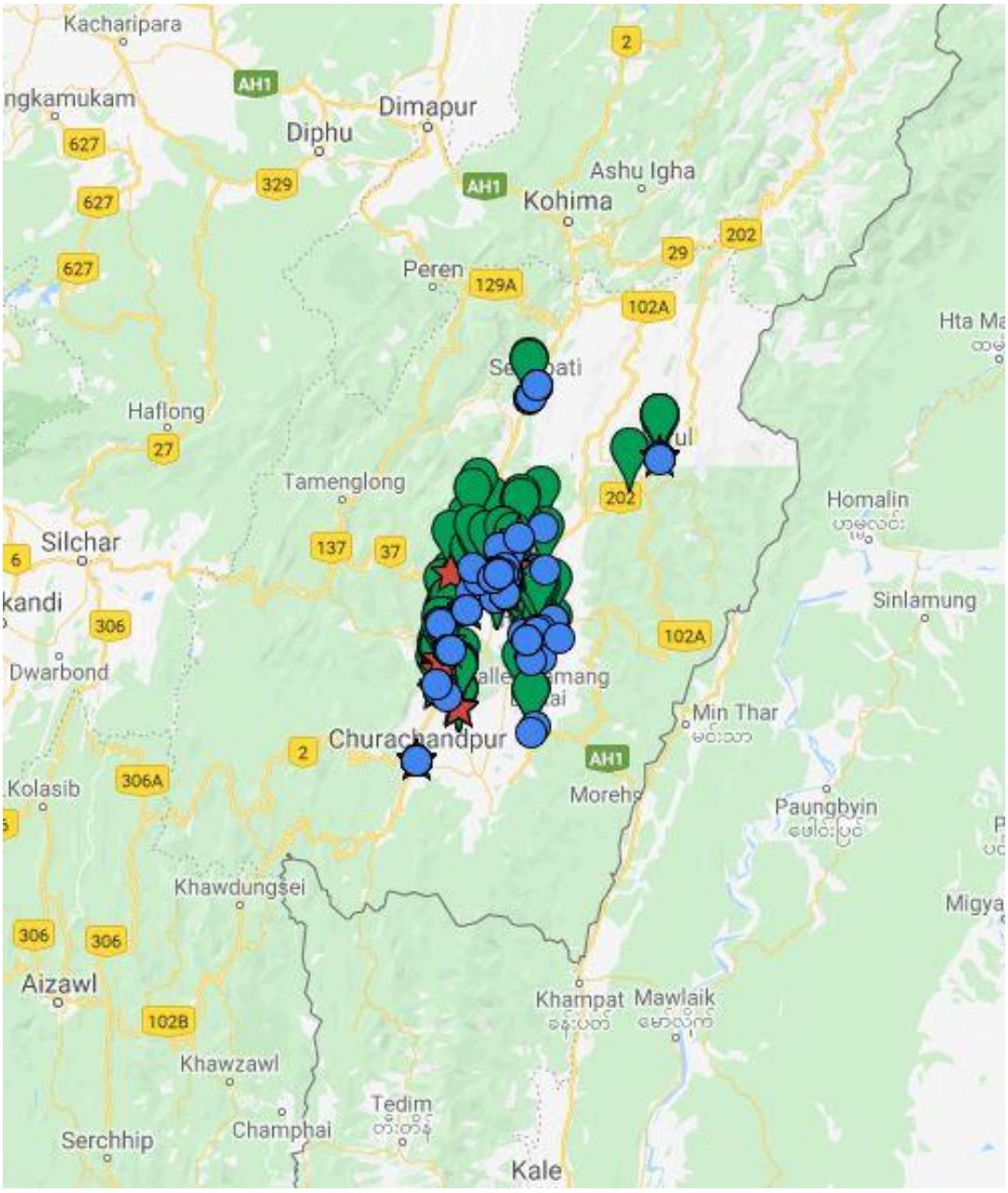

Figure 17: GPS locations of the F2F data collection points across Manipur

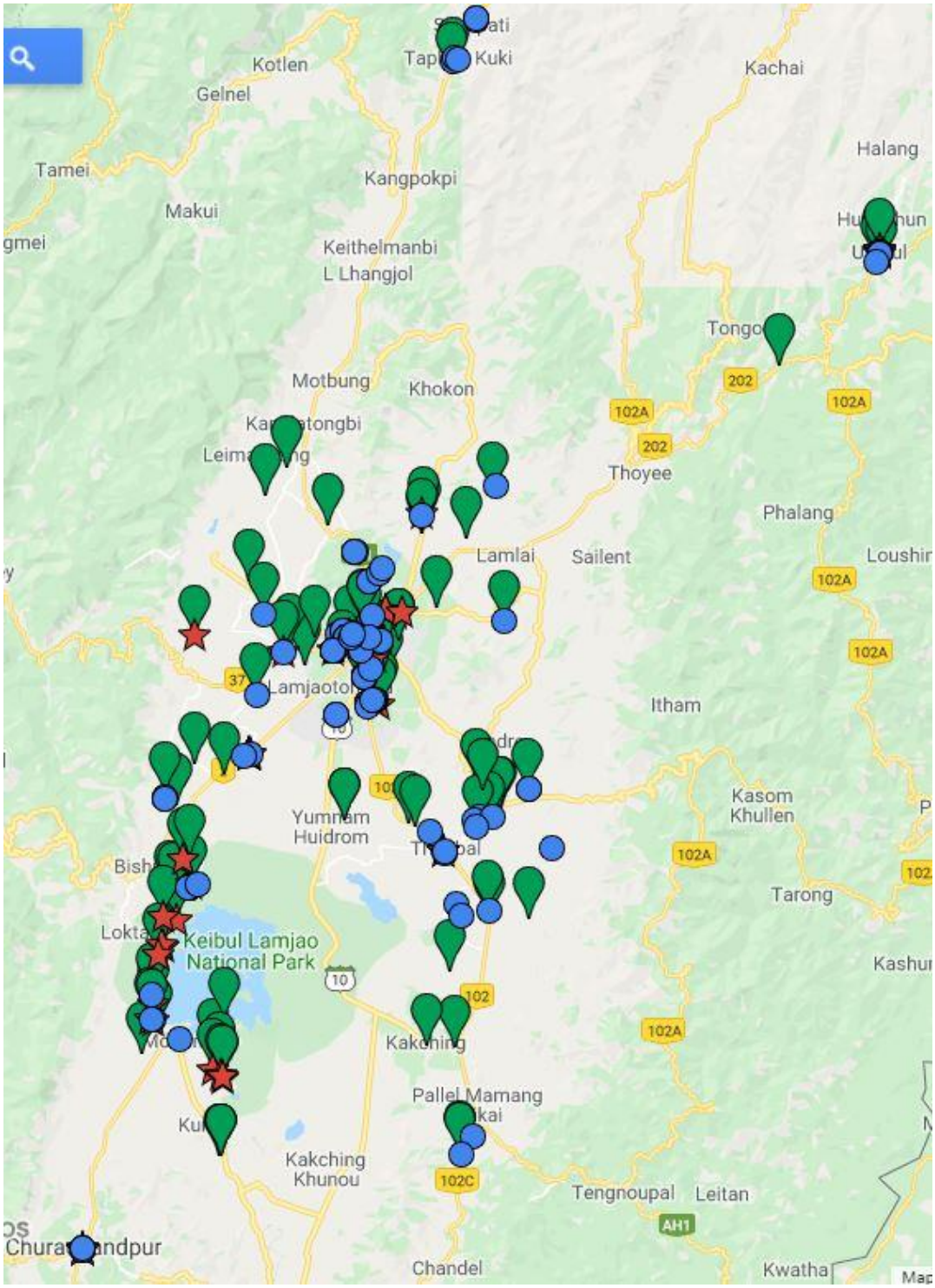

Figure 18: Zoomed in GPS locations of the F2F data collection points across Manipur

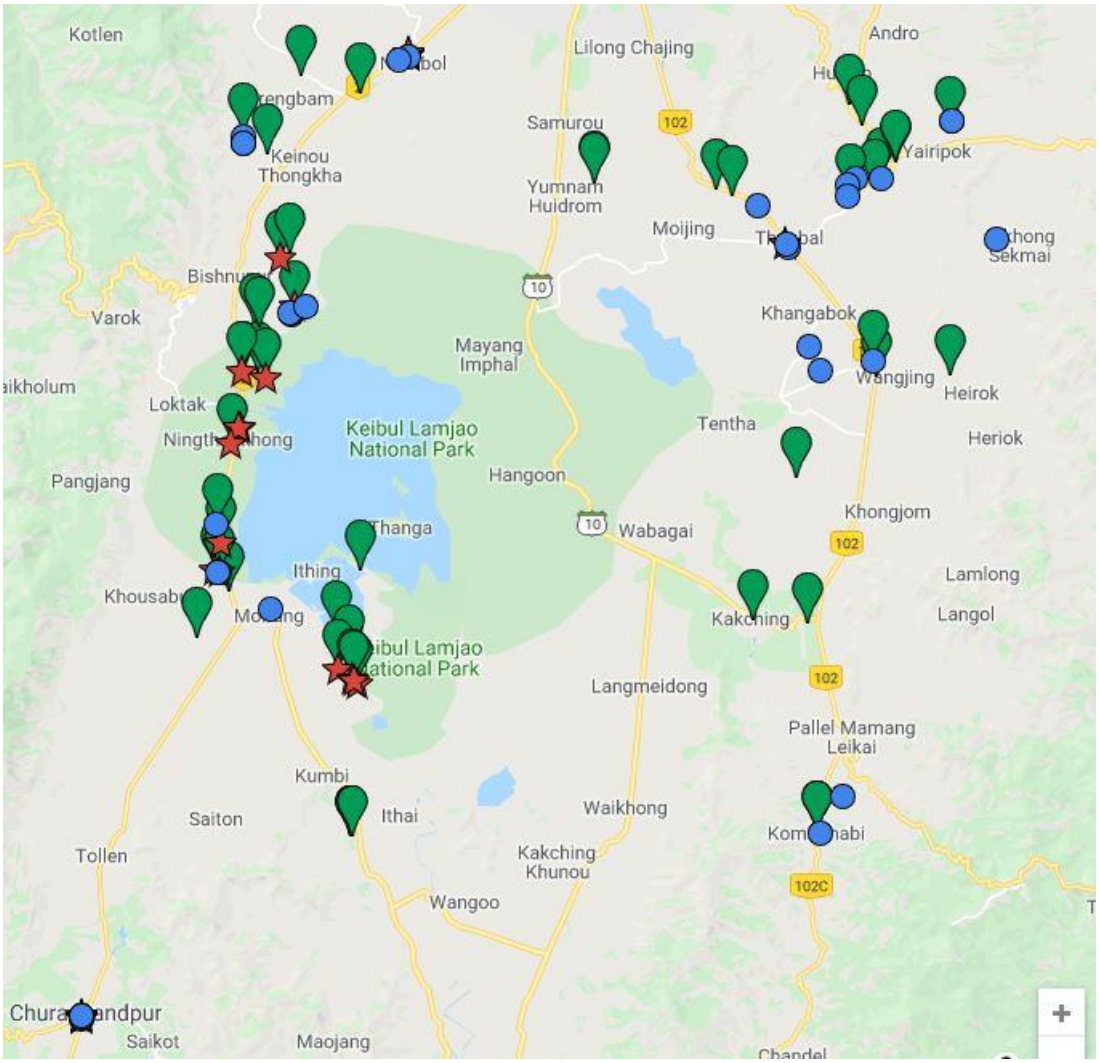

Figure 19: GPS locations of the F2F data collection points in southern Manipur

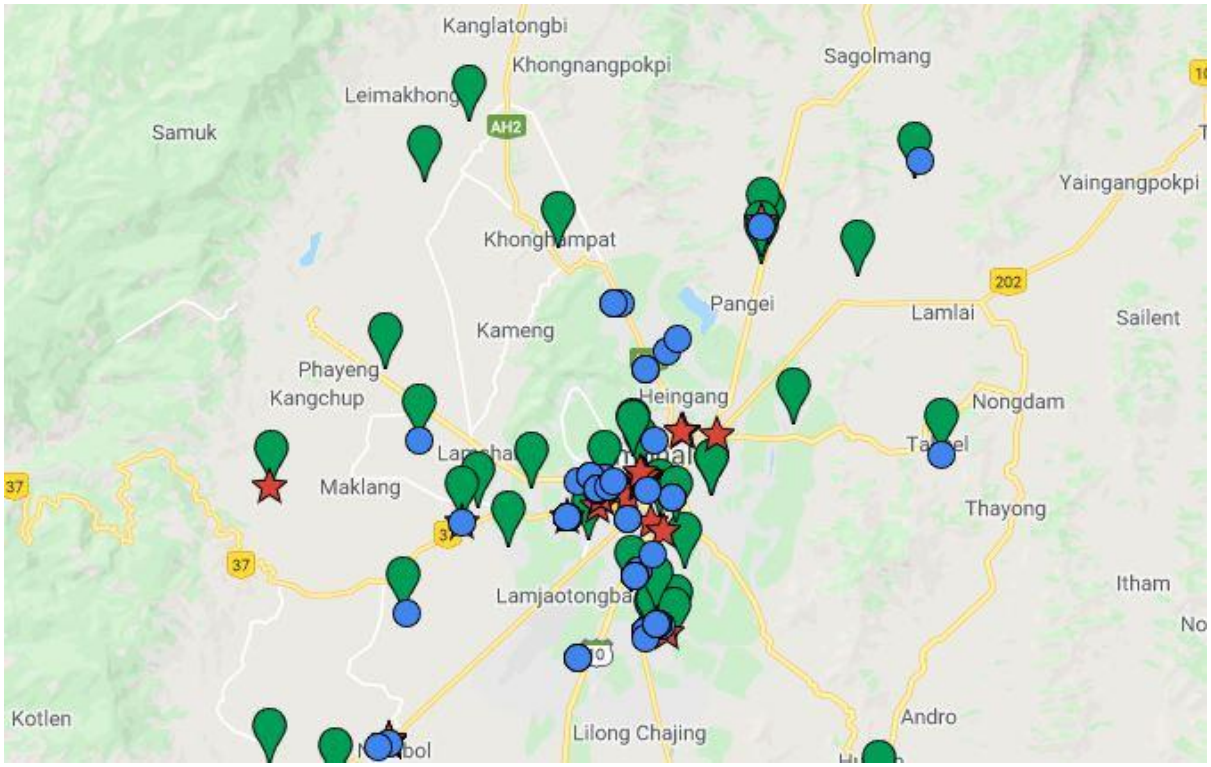

Figure 20: GPS locations of the F2F data collection points in the central areas

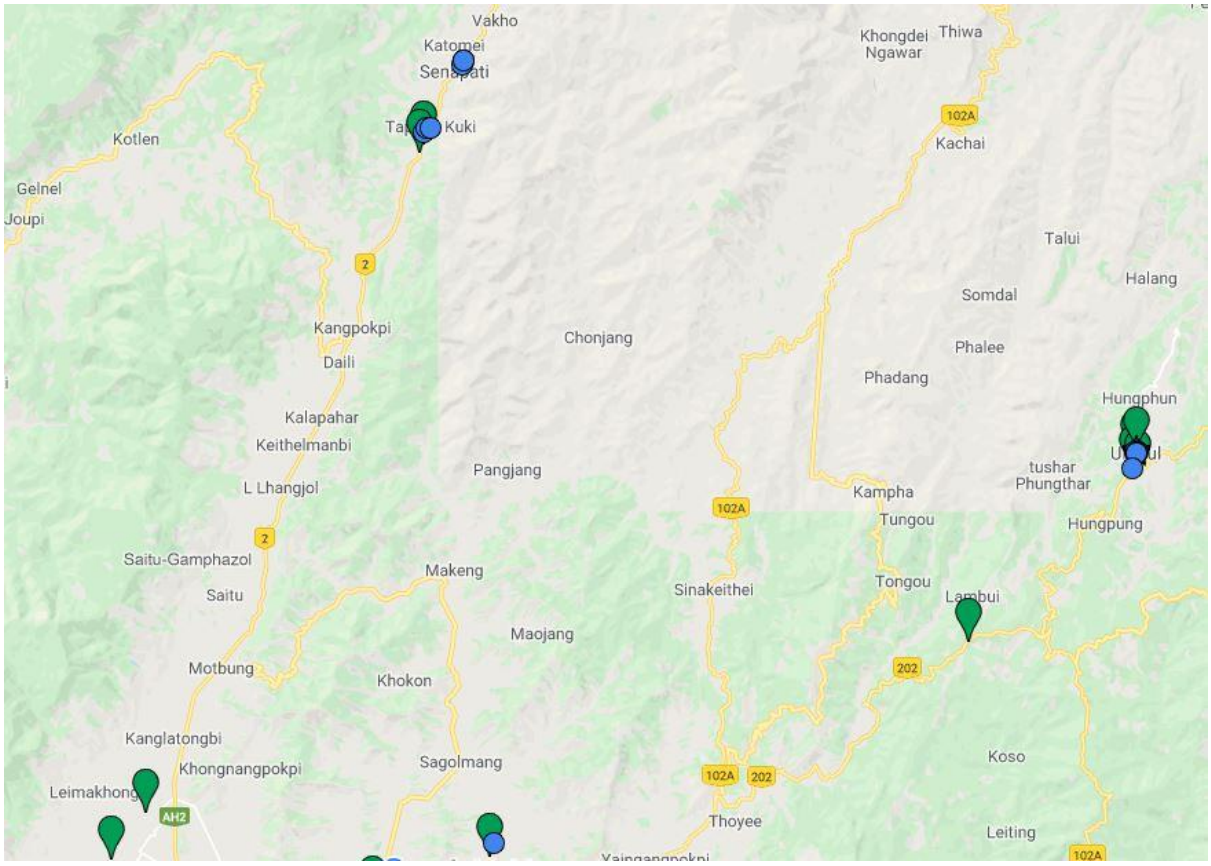

Figure 21: GPS locations of the F2F data collection points in northern Manipur

The data and information collected from the surveys were checked for accuracy, corrected where necessary, and then analysed in various ways to draw multiple conclusions. Though it is quite possible to establish another project and use a skilled statistician to analyse the data in much detail, it is not within the scope of the current project. However, the key conclusions drawn from the analyses have been presented in the following sections.

4.1 Farmers

76% of the farmers who participated were males. Of all the farmers, 60% were aged 31 to 50 with most of them educated up to tertiary level. Such a high level of education is representative of the educated unemployed youth going into self-employment by starting a mushroom cultivation business. The findings have been plotted in the figures below:

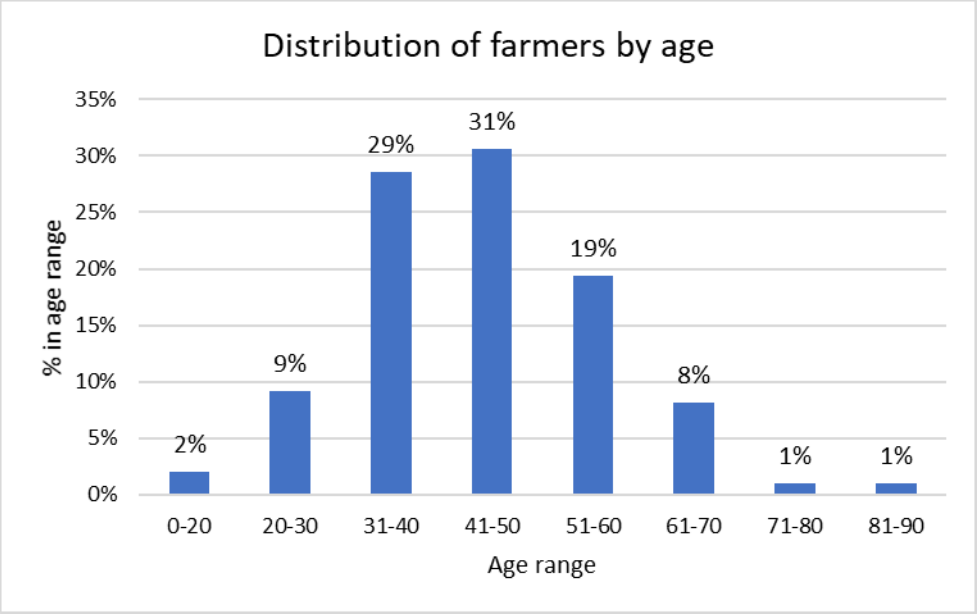

Figure 22: Age ranges of farmers

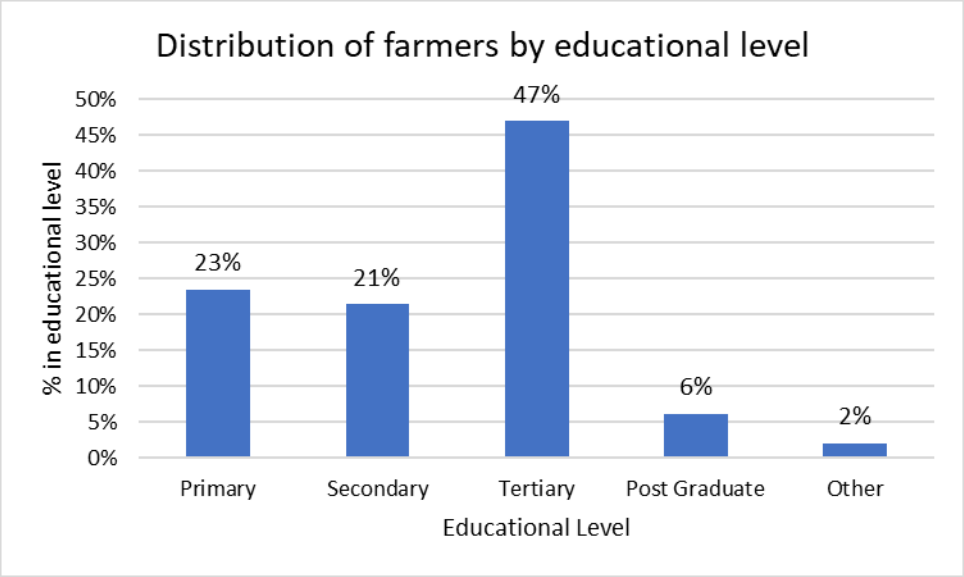

Figure 23: Educational levels of mushroom farmers

Mushroom cultivation as a business is a new trend in Manipur – this is backed by the fact that 41% of the businesses are less than three years old. This also explains why 59% of the businesses are not yet registered and this is an area that could be considered in future sector-specific programs. It was also noticed that a significant majority of the farmers grow Oyster mushroom. Besides consumer preference, inexperience might also explain the focus on one type of mushroom as farmers learn from each other in the early years of growing mushroom.

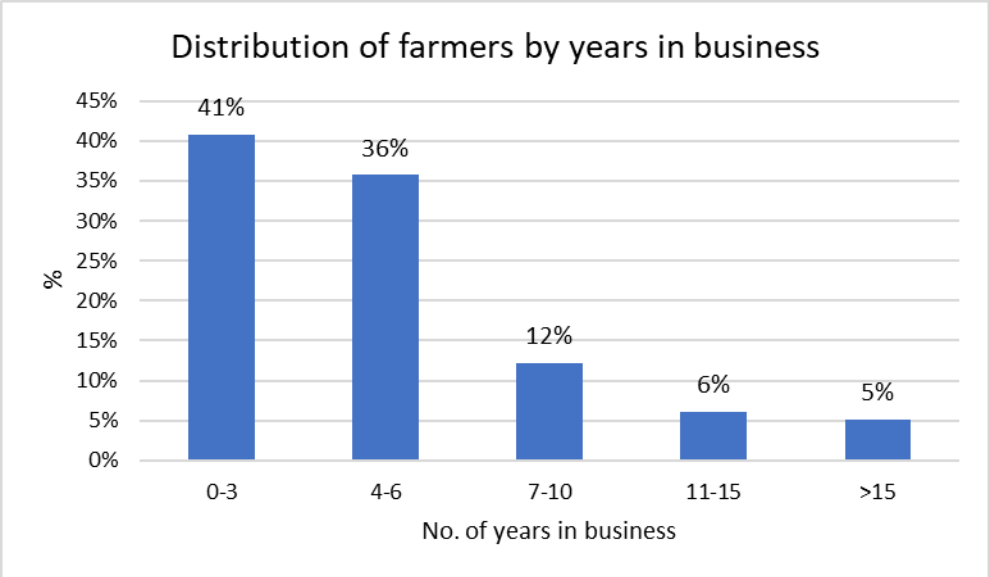

Figure 24: Number of years in business for farmers

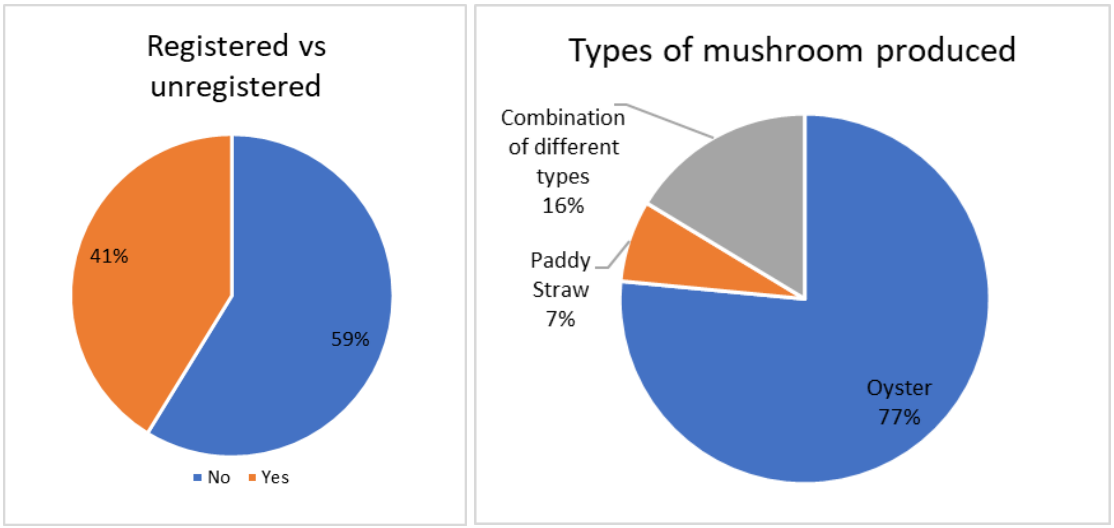

Figure 25: Registration ratio of business and type of mushroom grown

Average farm gate prices per kg range between about Rs131 per kg of Oyster to Rs281 per kg of Paddy Straw mushroom. ~90% of the farmers sell fresh mushroom rather than dried or processed. Farmers sell directly to consumers or wholesalers however a large majority of them would sell in multiple ways depending on the opportunity presented to them as shown below:

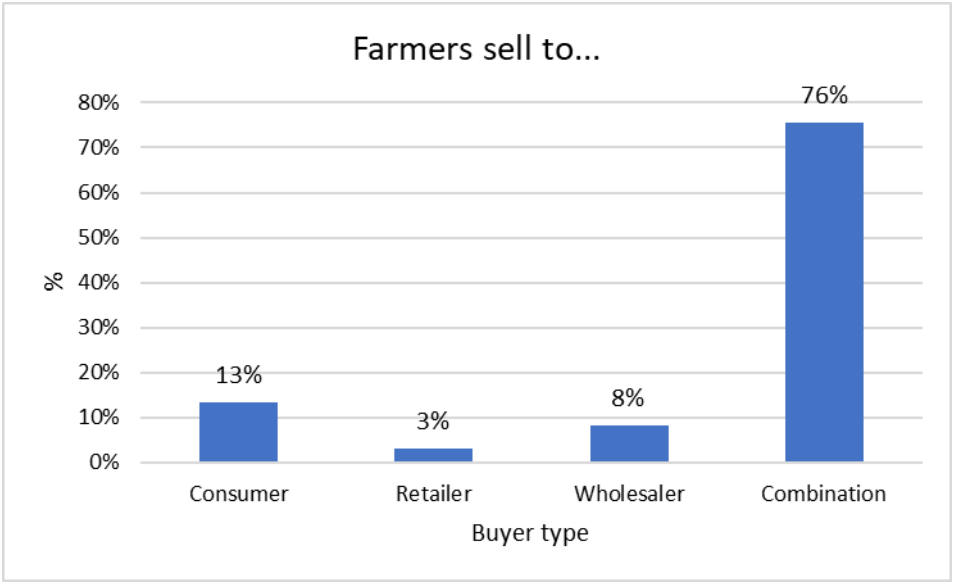

Figure 26: Buyers of mushroom from farmers

In terms of workforce, most farmers have at least two family members helping, two seasonal employees and one full-time employee working with them suggesting that mushroom cultivation plays an important role in not only keeping the family members occupied but also in creating jobs locally. Our assessment covered a majority of the mushroom farmers in the state which would indicate that primary production is keeping 600 or so people, including the farmers, engaged in some form of productive activity. The impact through overall job creation such as construction of the sheds, installation of equipment, etc. is expected to be at least two to three-fold higher.

Fig 27: A farmer showing her mushroom

Whilst the farmgate price provided by all the farmers is, as mentioned before, Rs131 per kg of Oyster or Rs281 per kg of Paddy Straw mushroom, differences were observed in the price at which a farmer would sell to a customer, or a trader. For Oyster mushroom farmers, farm gate prices for consumers averaged Rs150 per kg while prices per kg for retailers/ wholesalers averaged Rs120 per kg. For Paddy Straw mushroom farmers, farm gate prices for consumers averaged Rs350 per kg while prices per kg for retailers averaged Rs300 per kg.

Fig 28: Preparing to grow mushroom

Even though Oyster mushroom is suitable for production throughout the year, the frequency with which farmers said they undertook production activity varied significantly between the summer and winter months. Whether it is the abundance of straw - a key substrate in mushroom production used by all of the farmers interviewed - after the rice harvest in October and November, or the detrimental impact of high temperature and humidity during the summer on production, it was noticed that production dropped dramatically between March and September. We envisage that lack of appropriate temperature and humidity control over the summer months might be leading to crop damage and hence the reduced production. According to the farmers, demand and price both pick up around July until about November. However, there is a lag of a month or so in productivity which could be because straw is not

easily available until the early rice harvests have started and it is likely that the still high temperatures and humidity lead to higher pest and disease incidences.

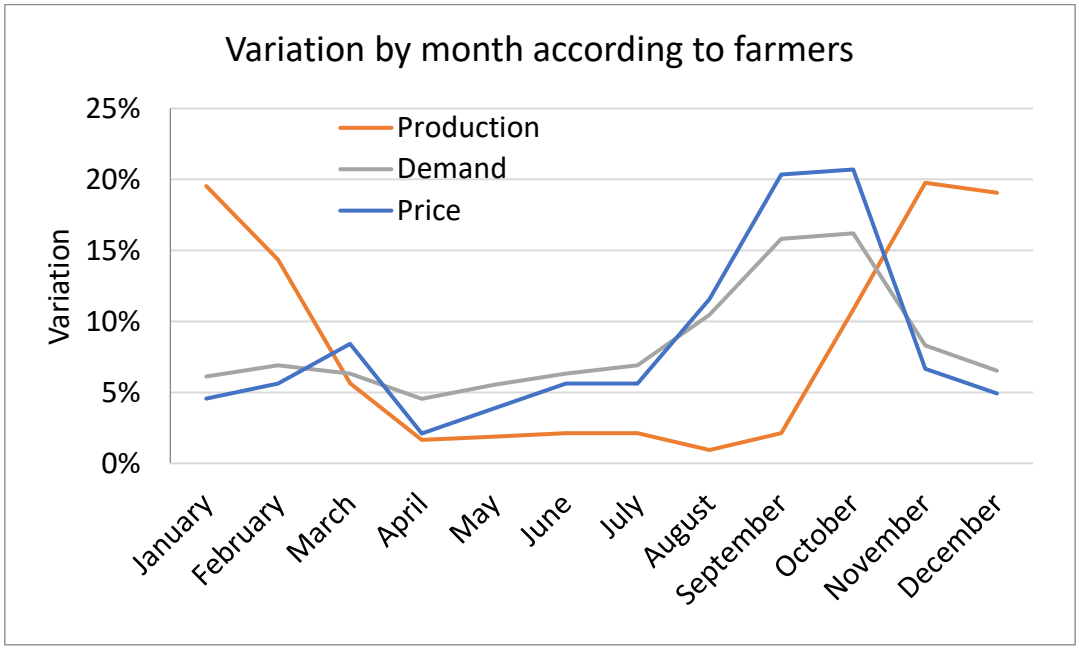

Figure 29: Monthly variation of current mushroom production in Manipur

The temperature and rainfall profiles in Imphal are shown in the following charts. Humidity during the rainy season can be well over 80% dropping to 60% or so during the winter months.

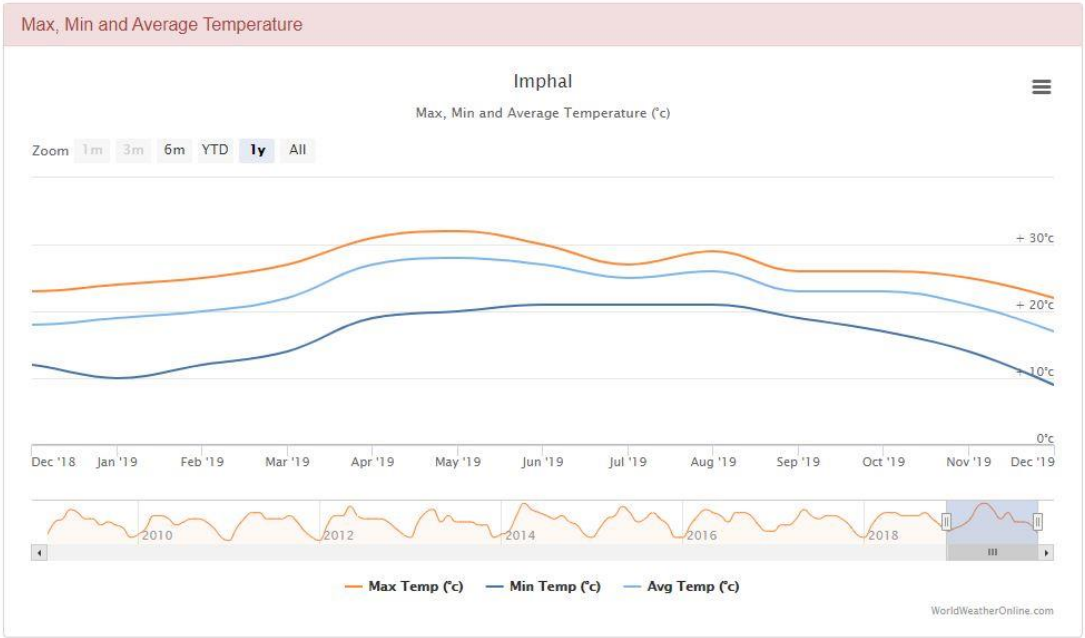

Figure 30: Temperature variations in Imphal (WorldWeatherOnline)

Figure 31: Rainfall variations in Imphal (WorldWeatherOnline)

It is also interesting to observe that almost 50% of farmers use natural means to control pests and diseases that affect mushroom production. This, however, does not mean that their production is organic certified as the straw substrate, for example, could be from a field treated with chemicals.

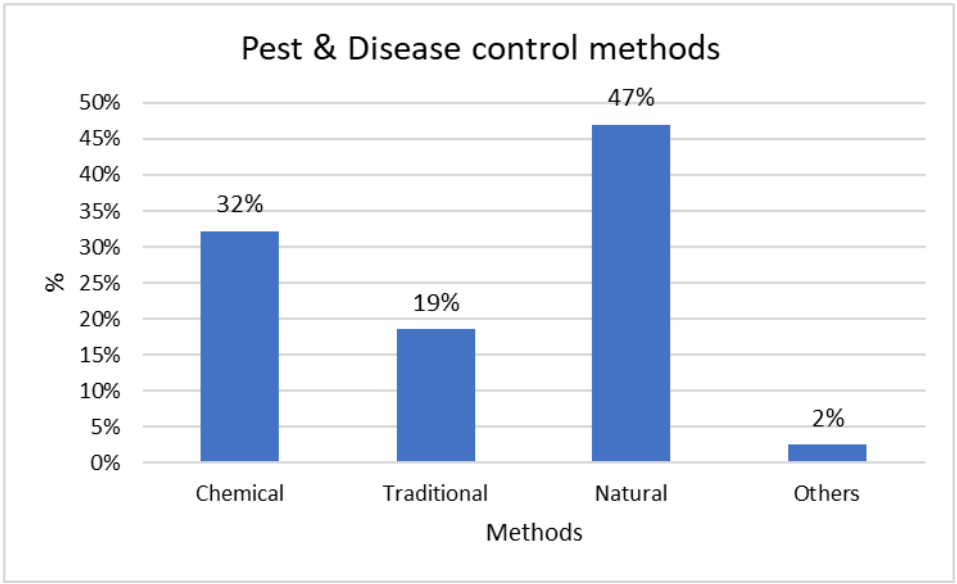

Figure 32: Pest and disease control methods

Many of the farmers surveyed received basic training in mushroom cultivation from Krishi Vigyan Kendra, Agricultural Technology Management Agency, Indian Council of Agricultural Research, District Industries Centre, Central Agricultural University,

Institute of Cooperative Management, NABARD, Manipur Tribal Development Cooperation, Directorate of Mushroom Research Centre - Solan, or from fellow farmers. However, what is missing is a season-long mentorship program centred around a model farm(er). Developing a guidebook on mushroom cultivation with core practices to be followed is also highly desirable.

As part of the survey, farmers were also asked to share a range of the different costs they incurred in cultivating mushroom. This enabled us to conduct a simple annual Profit & Loss (P&L) analysis in which we split any investment in constructing a shed over 10 years. The costs of buying materials like sprayer, humidifier, bags, etc. which can be reused over a few seasons were split over three years. Labour cost, spawn cost, etc. were taken as annual variable costs. Some farmers also only produced spawn while some produced both spawn for own use and sale, and mushroom. A critical general observation is also that most farmers are extremely weak in proper book-keeping and rely weakly on own memory and rough notes to keep track of their finances. This, combined with the fact that farmers are also reluctant to share their full financials especially if they suspect they were losing money, made it quite difficult to get accurate details of their finances. However, we did our best to get as much detail as possible and below are some conclusions we can draw, albeit with a large pinch of salt.

Most, if not all, spawn producers are also mushroom farmers so the cost for spawn production was almost impossible to calculate as the farmers didn't allocate costs separately. They were asked to give their estimated cost of production and selling price per kilogram which helped to work out the margin as shown below:

	Amount per kg (Rs)
Cost of production	31
Selling price	113
Profit	82
Margin (%)	73%

Table 1: Gross margin for a spawn producer
based on cost and selling price given by the farmers

So, farmers (23 in total of the total 98 interviewed) who produce spawn do well and get a relatively high margin of 73%. However, spawn production is a difficult process so most farmers only stick to growing mushroom. The next table shows the best available average P&L for farmers who grow both spawn and mushroom for Oyster mushroom, and average P&Ls for those who only grow Oyster or Paddy Straw mushrooms. Whist the table presents an interesting and meaningful view, it must be noted that there are still gaps and questions on some of the figures – some figures are too low to be realistic yet these are the findings from the farmers - that can only be

answered by a more thorough study of the detailed financials of a mushroom grower. Farmers who grow both spawn and oyster mushroom have the highest revenue however their margin is the lowest at 54%. This is in line with the fact that in well-established mushroom growing countries, spawn production is carried out by specialized agencies rather than by mushroom farmers as it takes effort, cost and time. Farmers who grow Oyster only have a margin of 59% while farmers of Paddy Straw only earn the highest margin at 68%. This could be explained by the need for lower investments in both fixed and variable items however, as mentioned before, some of the items cost very little raising doubts if they are realistic.

	Spawn and mushroom growers	**Only mushroom growers**	
	Oyster	**Oyster**	**Paddy Straw**
Cost item	**Annual amount (Rs)**		
Long-term shed cost (10 yrs)	25,250	21,813	7,429
Straw Cutter	3,957	1,564	-
Humidifier	3,107	-	-
Humidity Meter	190	99	24
Sprayer	1,238	524	167
Racks & Ropes	4,714	3,296	3,262
Tub	2,093	2,111	2,619
Boiler	48	2,779	-
Trays	281	190	76
Mat	345	363	2,119
Short-term fixed cost (3 yrs)	15,973	10,926	8,267
Annual Daily Wage	10,857	11,195	2,143
Electricity Bill	6,000	3,895	857
Straw	45,357	27,131	30,071
Spawn	58,257	48,936	47,397
Water	536	2,579	-
Plastic	33,801	10,537	9,286
Rubber	343	98	-
Spirit	821	149	-
Cotton	1,679	89	-
Chemicals	3,714	2,011	1,629
Misc	5,643	1,475	1,143
Total Variable Cost	217,173	133,693	99,811
Total Variable + Fixed Costs	258,396	166,433	115,507
Revenue as given by the farmer	566,479	401,068	364,714
Profit	308,082	234,636	249,208
Margin (%)	54%	59%	68%

Table 2: Gross margins for mushroom farmers based on costs collected from the surveys (these must be taken with caution as none of the costs were properly allocated or captured)

Table 2 gives a snapshot of the average costs involved in mushroom production. In Manipur, apart from one or two individuals, farmers use existing facilities and infrastructure and convert them into mushroom cultivation sheds with some modifications. Also, the farmers do not invest in all necessary equipment and tools like autoclaves, boilers, etc. The farmers are also not trained in basic bookkeeping and accounting principles which means no one is allocating cost to a particular activity or keeping track of expenses diligently. Therefore, as it stands, it has been difficult to extract the exact total cost in establishing a new mushroom facility, which also makes it difficult to calculate the Internal Rate of Return.

An attempt was made to calculate IRR, BCR and NPV using an Oyster farm model based on an existing farm in Imphal as shown in table 3. It can be observed from table 3 that a mushroom facility producing 1,000kg of mushroom per annum could turn a profit in the second year of operation itself. The first-year investment of Rs2.3lakhs is primarily to build a shed, pay salaries and finance raw materials such as straw and spawn. Table 4 provides a similar economic analysis of a model Paddy Straw farm operating seven months of the year from April to October. The upfront cost is higher besides the running cost, especially water and the higher amount of substrate used, however the faster crop cycle and higher price per kg more than make up the cost yielding higher IRR and NPV values. Paddy Straw is highly perishable so must be sold as soon as it is harvested which means that there can be significant losses if not sold on time.

Economics of Oyster Mushroom Production in a low-cost Mud House										
S.No.	Particulars	Quantity	Unit	Rate (Rs/ unit)	Year 0	Year 1	Year 2	Year 3	Year 4	Comment
A	**Capital Cost**									Year 0 is the current year so scenario estimates three months spent constructing the shed and starting the business with the remaining nine months bringing in income. Year 0 is not discounted.
i	Cost of Mud House	300	sq ft	350	105,000					
ii	Sprayer Pump	1	item	1,000	1,000					
iii	Cost of Tubs/Drums	2	items	1,000	2,000					
iv	Thermometer	1	item	500	500					
v	Tarpoline Sheet	1	sheet	500	500					
vi	Plastic Ropes	1	roll	500	500					
vii	Weighing balance	1	item	2,000	2,000					
	Sub Total				**111,500**	-	-	-	-	
B	**Recurring expenditure**									
i	Owner/ Farm Manager Salary	1	pa	60000	60,000	60,000	60,000	60,000	60,000	
ii	Farm Assistant Salary	1	pa	30000	30,000	30,000	30,000	30,000	30,000	Could be part-time
iii	Paddy straw	100	bundles	75	7,500	7,500	7,500	7,500	7,500	
iv	Polythene bag	20	kg	160	3,200	3,200	3,200	3,200	3,200	
v	Spawn	100	kg	120	12,000	12,000	12,000	12,000	12,000	
vi	Chemicals									
	- Carbendizime @ 320/kg for 3.5kg	3.5	kg	320	1,120	1,120	1,120	1,120	1,120	
vii	Miscellanous Expenses				1,000	1,000	1,000	1,000	1,000	
	Sub Total				**114,820**	**114,820**	**114,820**	**114,820**	**114,820**	
	Total Cost				**226,320**	**114,820**	**114,820**	**114,820**	**114,820**	
C	**Income Statement**									
	Yield & Price Assumption									
i	No. of growing bags		bags		750	1,000	1,000	1,000	1,000	Year 0 yield is 75% of what's
ii	Yield per bag		kg/ bag		1	1	1	1	1	possible as three months are
iii	Sale price		Rs/ kg		155	155	155	155	155	spent constructing the shed.
	Income				**116,250**	**155,000**	**155,000**	**155,000**	**155,000**	
D	**Economics**									
i	Cost				226,320	114,820	114,820	114,820	114,820	
ii	Income				116,250	155,000	155,000	155,000	155,000	
iii	Net Income				(110,070)	40,180	40,180	40,180	40,180	
iv	Cost per Kg		Rs		301.76	114.82	114.82	114.82	114.82	
v	Profit/ loss per kg		Rs		(146.76)	40.18	40.18	40.18	40.18	
vi	Margin		%		-95%	26%	26%	26%	26%	
vii	Discount Rate			15%	1.00	0.87	0.76	0.66	0.57	
viii	Discounted Cost				226,320	99,843	86,820	75,496	65,649	**554,129**
ix	Discounted Income				116,250	134,783	117,202	101,915	88,622	**558,772**
x	Discounted Net Income				(110,070)	34,939	30,382	26,419	22,973	
xi	**Internal Rate of Return (IRR)**				**17%**					
xii	**Benefit Cost Ratio (BCR)**				**1.01**					
xiii	**Net Present Value (NPV)**				**₹ 4,643**					

Table 3: Economic model of an oyster mushroom farm

Economics of Paddy Straw Mushroom Cultivation in a shed for April-October production										
S.No.	Particulars	Quantity	Unit	Rate (Rs/ unit)	Year 0	Year 1	Year 2	Year 3	Year 4	Comment
A	**Capital Cost**									
i	Cost of Shed	4500	sq ft	5	22,500					Year 0 is the current year so scenario estimates one month of the seven months spent constructing the shed and starting the business with the remaining months bringing in income. Year 0 is not discounted.
ii	Bamboo racks	20	bamboo	300	6,000					
iii	Sprayer Pump	1	item	1,000	1,000					
iv	Cost of Tank	1	items	10,000	10,000					
v	Thermometer	1	item	500	500					
vi	Plastic Sheet	25	kg	180	4,500					
vii	Plastic Ropes	6	roll	150	900					
viii	Weighing balance	1	item	2,000	2,000					
	Sub Total				**47,400**	-	-	-	-	
B	**Recurring expenditure**									
i	Owner/ Farm Manager Salary	1	pa	60000	35,000	35,000	35,000	35,000	35,000	For seven months
ii	Farm Assistant Salary	1	pa	36000	21,000	21,000	21,000	21,000	21,000	For 7 months, part-time
iii	Paddy straw	4200	bundles	25	105,000	105,000	105,000	105,000	105,000	For seven months
iv	Spawn	437.5	kg	160	70,000	70,000	70,000	70,000	70,000	For seven months
v	Chemicals			2000	14,000	14,000	14,000	14,000	14,000	For seven months
vi	Miscellanous Charges	20%			49,000	49,000	49,000	49,000	49,000	Includes water, transportation, etc.
	Sub Total				**294,000**	**294,000**	**294,000**	**294,000**	**294,000**	
	Total Cost				**341,400**	**294,000**	**294,000**	**294,000**	**294,000**	
C	**Income Statement**									
	Yield & Price Assumption									
i	No. of beds	1400	beds		700	1,400	1,400	1,400	1,400	Year 0 yield is 50% of what's possible.
ii	Yield per bag		kg/ bed		1	1	1	1	1	
iii	Sale price		Rs/ kg		350	350	350	350	350	
	Income				**245,000**	**490,000**	**490,000**	**490,000**	**490,000**	
D	**Economics**									
i	Cost				341,400	294,000	294,000	294,000	294,000	
ii	Income				245,000	490,000	490,000	490,000	490,000	
iii	Net Income				(96,400)	196,000	196,000	196,000	196,000	
iv	Cost per Kg		Rs		487.71	210.00	210.00	210.00	210.00	
v	Profit/ loss per kg		Rs		(137.71)	140.00	140.00	140.00	140.00	
vi	Margin		%		-39%	40%	40%	40%	40%	
vii	Discount Rate			15%	1.00	0.87	0.76	0.66	0.57	
viii	Discounted Cost				341,400	255,652	222,306	193,310	168,095	**1,180,764**
ix	Discounted Income				245,000	426,087	370,510	322,183	280,159	**1,643,939**
x	Discounted Net Income				(96,400)	170,435	148,204	128,873	112,064	
xi	**Internal Rate of Return (IRR)**				**201%**					Paddy Straw is extremely perishable so likely to have a higher wastage which is not factored in here.
xii	**Benefit Cost Ratio (BCR)**				**1.39**					
xiii	**Net Present Value (NPV)**				**₹ 463,176**					

Table 4: Economic model of a paddy mushroom farm

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4.2 Traders

In a similar way to farmers, traders were also asked a whole set of questions in both F2F and phone interviews. Many of these traders were identified either from visiting markets directly or by following up on recommendations from farmers and other traders.

90% of the traders assessed were females - this is representative of the fact that most veg traders in Manipuri society are women - and 65% of the them were aged between 41 to 60 years of age with 20% aged 40 or below. 82% of them studied up to primary level with only 10% educated up to tertiary level which presents an interesting contrast to the farmers, many of whom were educated up to tertiary level. It is not clear if lack of further education is related to gender and this is a subject definitely worth exploring further.

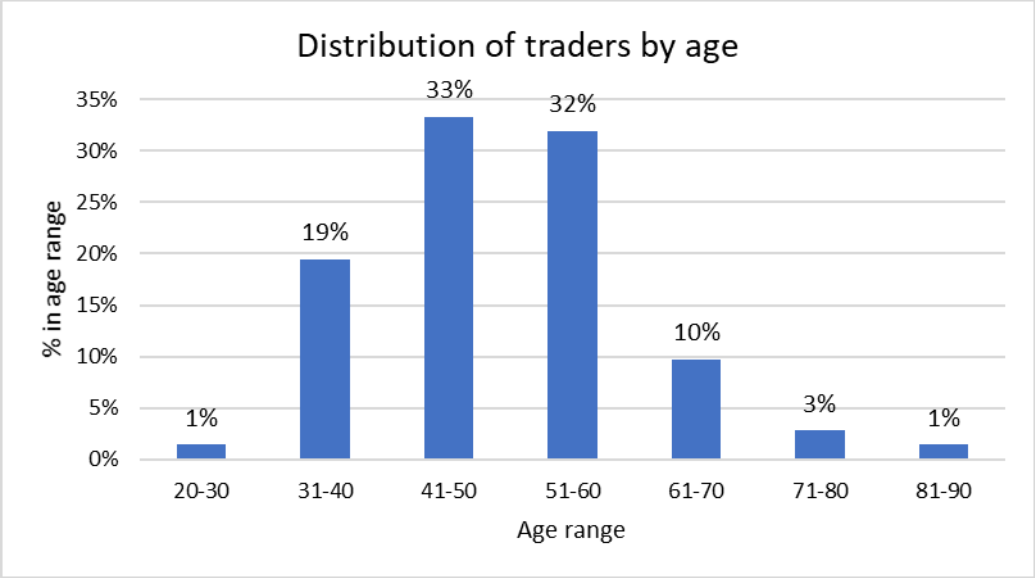

Figure 33: Age range of traders

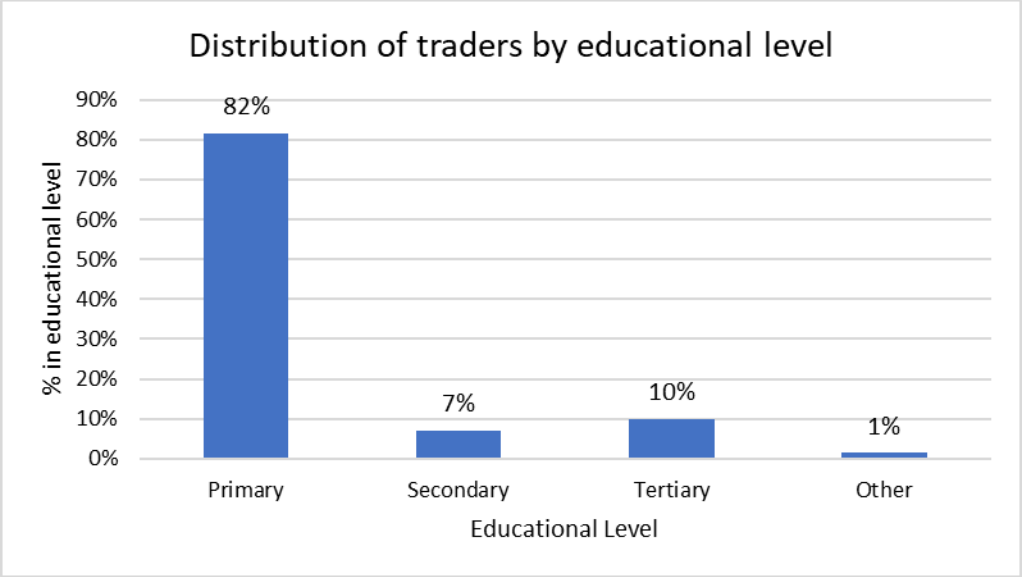

Figure 34: Educational levels of traders

The study also shows that many of the traders were relatively new in the business which is intriguing considering their age range but easily explained by the fact that mushroom cultivation, and therefore mushroom trading, is a relatively new business area.

Figure 35: Experience in years of traders

Of the traders interviewed, 71% of were retailers and as seen earlier with farmers, Oyster is the most popular type of mushroom traded, probably as a consequence of it being the only type produced by the farmers. Whilst the separation between the different types of traders is vague as most are opportunistic and sell to whoever they can – also affected by many social issues in Manipur and the fact that mushroom is highly perishable – Retailers are ones who sell primarily to consumers, Rural Assemblers work with farmers to collect at scale and sell on, Brokers primarily help to arrange trades while Wholesalers, as described by themselves, deal with slightly larger volumes and feel more sophisticated or experienced.

Fig 36: Fresh veg in a typical market

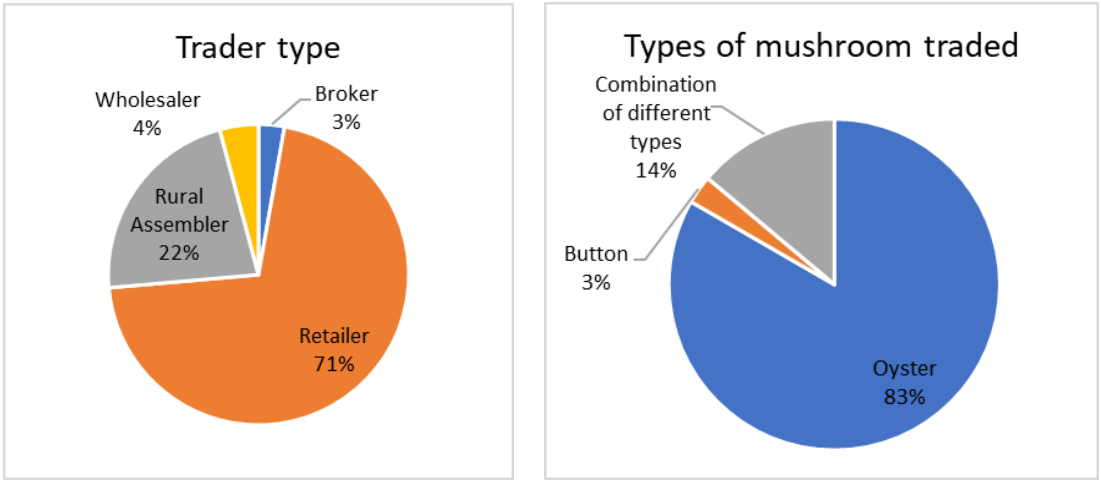

Figure 37: Trader types interviewed and traded mushrooms

The traders buy from a range of sellers including directly from farms, and wholesalers. Traders are motivated by high demand products that are easily available with good margins and sell mainly to consumers directly (over 70%). Traders buy Oyster mushroom for an average of Rs121 per kg and Button mushroom for Rs264 per kg however there is a difference in the source price depending on the type of trader.

Fig 38: Mushroom and veg on sale

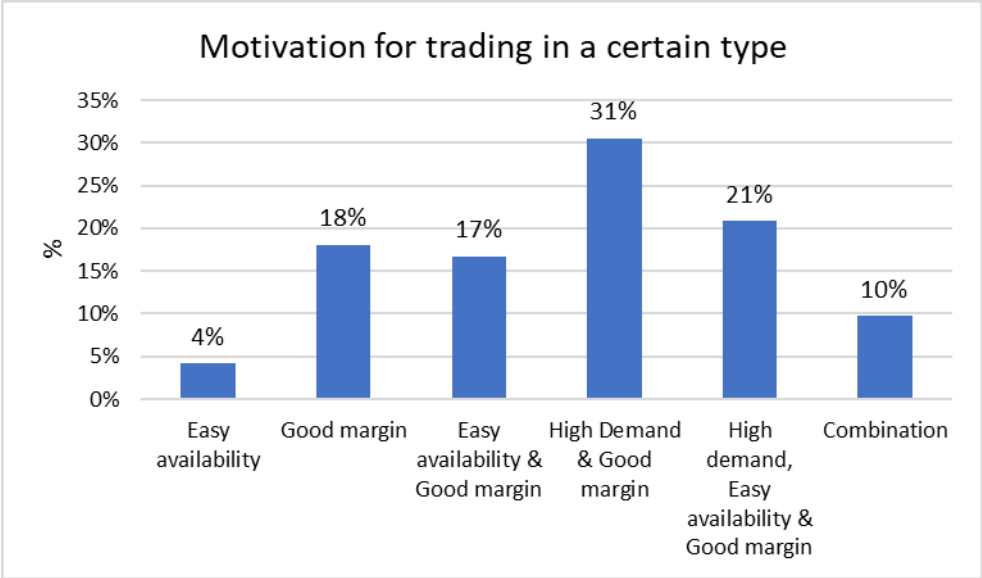

Figure 39: Drive for traders

The different sources the assessed traders buy from are shown below:

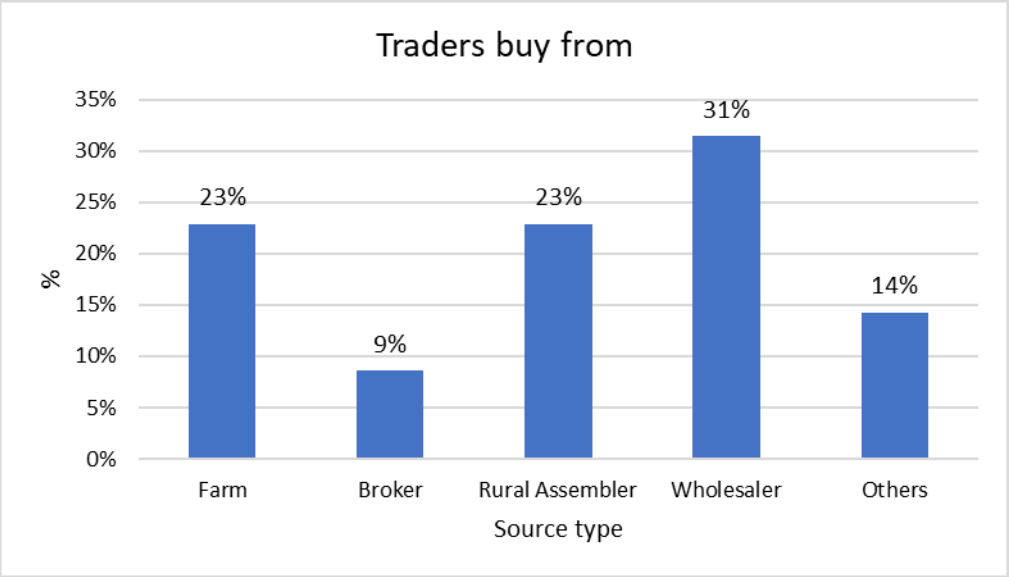

Figure 40: Sources of traders

Most of the traders (74%) sell directly to consumers with 19% selling to a combination of customers and other traders. Wholesale trading is limited with only 6% of the traders selling to wholesalers perhaps because most of the farms are still small and there is a thriving community of small volume traders.

Fig 41: Mushroom on display

Notwithstanding the type of trader, traders on average make a margin of 29%. The volume traded can vary significantly with some trading only a few kilograms a day to others trading tens of kilos. A chart showing the margins for different types of traders is shown in figure 42.

Figure 42: Customers of traders

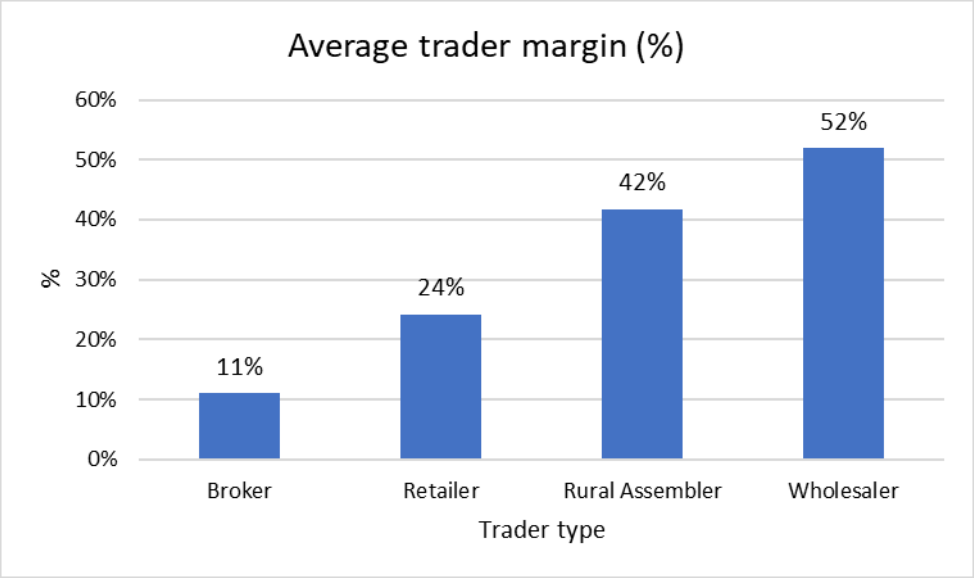

Figure 43: Trader types and their margins

Whilst the chart in figure 43 would lead one to believe that wholesalers make the most margin, one should be careful not to draw such conclusions as wholesalers represent a very small fraction of the market and one of the wholesalers interviewed trades in Button mushroom which fetches a good premium.

Fig 44: Mushroom on display

As with farmers, traders were also asked to share when they had the highest demands for mushroom and when they were able to fetch the highest prices. This is shown in the figure below:

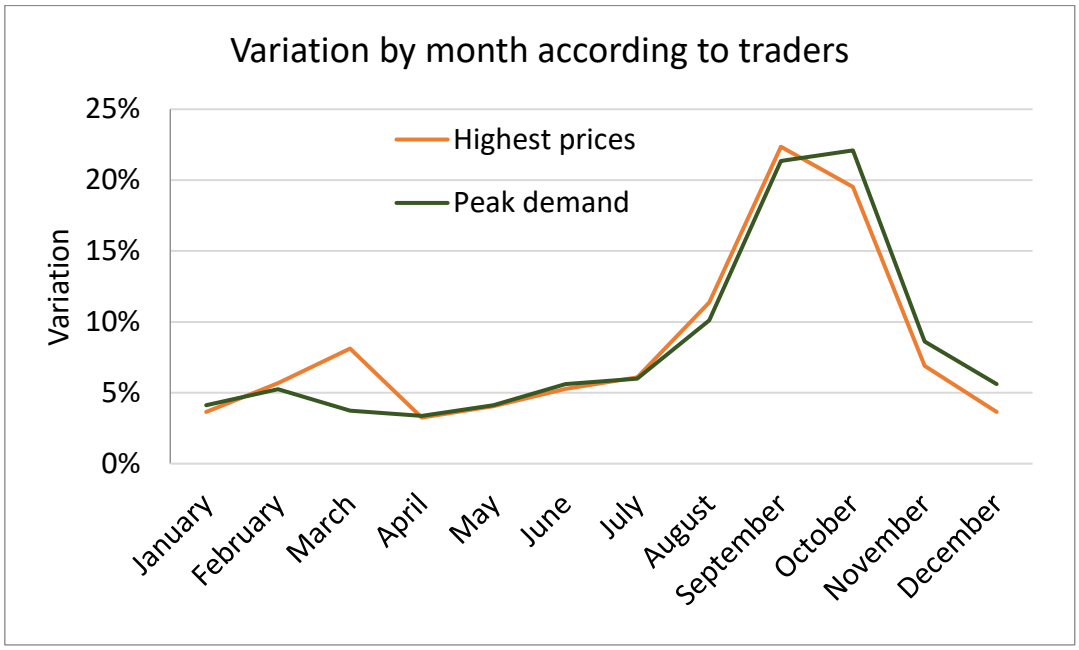

Figure 45: Monthly variation in demand and mushroom prices as per the traders

Demand and price track each other well. The increase in demand from July onwards is also in line with what mushroom farmers indicated as the beginning of peak demand period. It remains to be seen if this matches with what consumers say is their peak period for mushroom consumption.

4.3 Consumers

To complete the study and get a holistic view of the mushroom value chain in Manipur, many consumers were also interviewed, again both F2F and by phone. 70% of the consumers who participated were females and this was primarily because many of the men approached could not answer the complete set of questions being asked as part of the survey as they did not buy the mushroom or cook the dishes. All the consumers surveyed were buying primarily for personal consumption so there is no data available on the portion bought by hotels and restaurants however it is quite likely that they send their own shoppers to the same markets where we collected retail info from. More than 60% of the consumers were aged 21 to 40 with a varying range of educational levels.

Fig 46: A consumer in traditional phanek

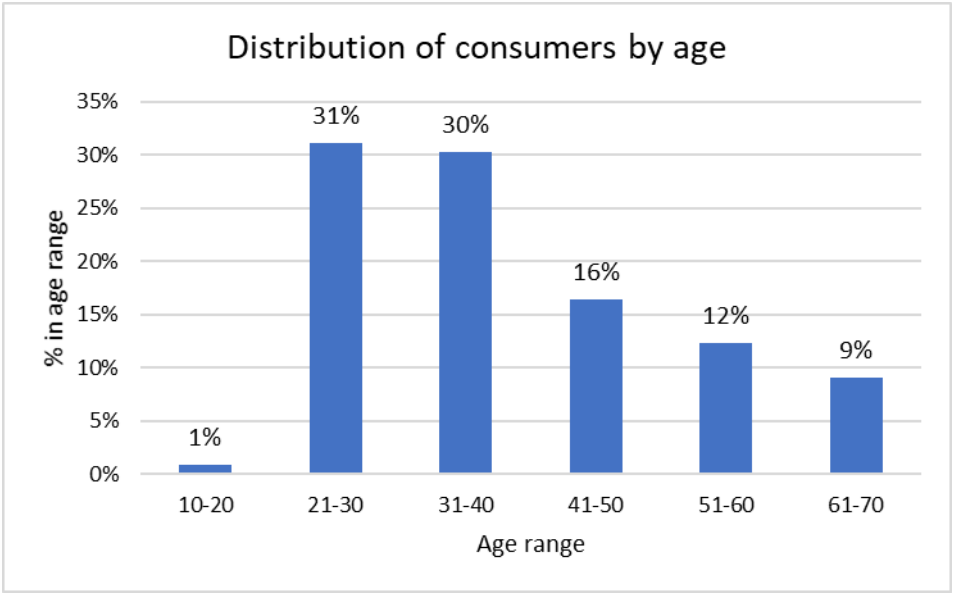

Figure 47: Consumer age ranges

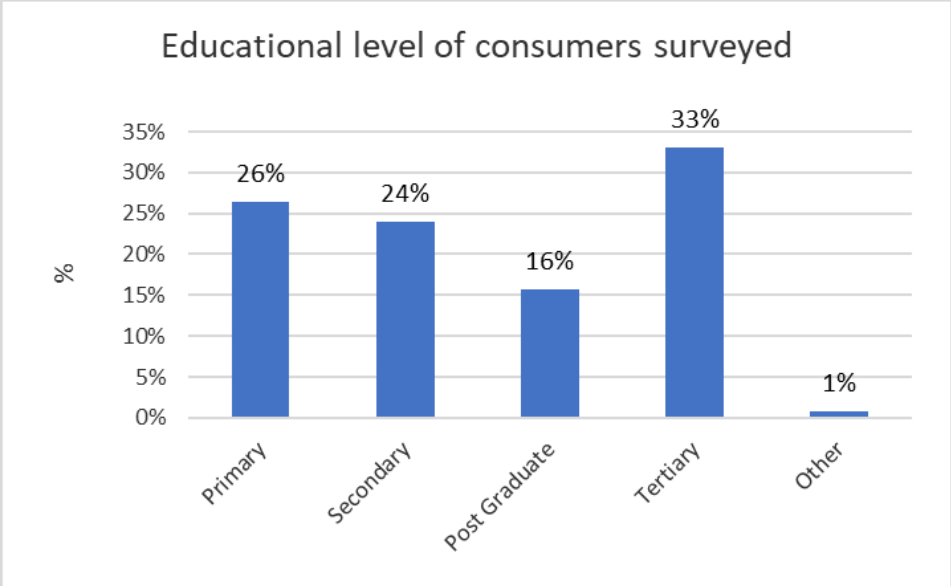

Figure 48: Educational levels of consumers

It was also observed that 73% of consumer households were four to six in size with most of them (>80%) consuming mushroom once a week. The average consumption per week per capita was about 100g.

Most consumers buy from the market while a significant segment also buys directly from the farmers. Oyster was the most popular type of mushroom but consumers seem to also mix with other types, especially wild and local mushroom types. Consumers gave taste and ease of access as the reasons for their preference which implies that other types could gain popularity if easy to find.

Fig 49: Fried snack on sale

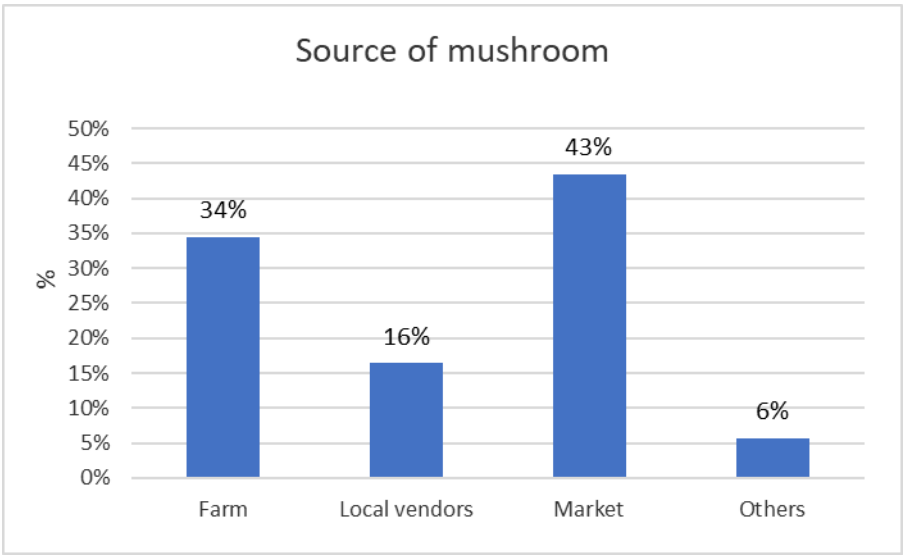

Figure 50: Source of mushroom for consumers

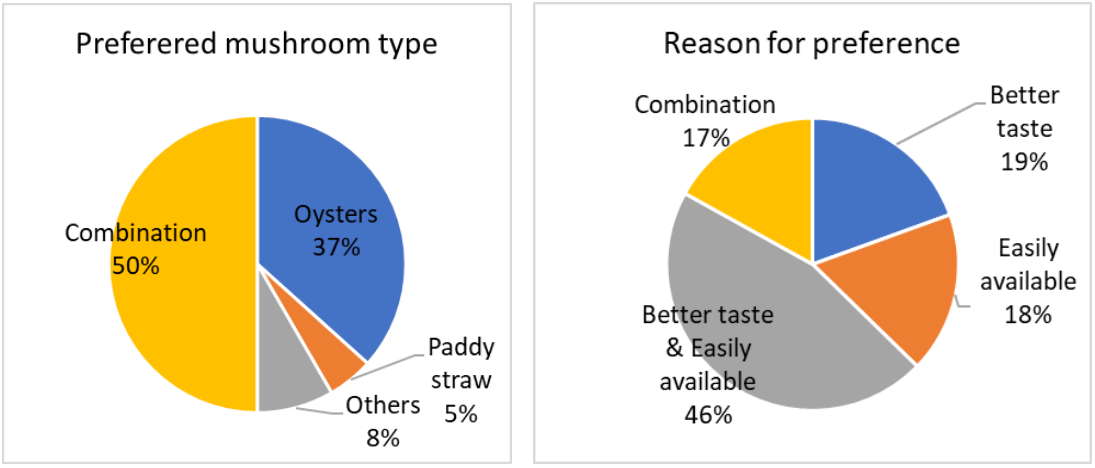

Figure 51: Preferred mushroom type and reason for preference

The average retail prices per kg ranged between Rs159 per kg of Oyster to Rs300 per kg of Paddy Straw mushroom. >50% of the consumers also showed preference for fresh mushroom and many of those interviewed reported that mushroom was easily available (67%). Consumption of mushroom is in a variety of dishes such as curry, fried mushroom, soup, *eromba*, *paknam*, etc. Recipes of some of the dishes are provided in Appendix III.


Fig 52: Consumer posing for the team

As with farmers and traders, consumers were also asked to indicate when they felt demand was highest and when they felt prices were lowest. The frequency of responses has been plotted in the chart below:

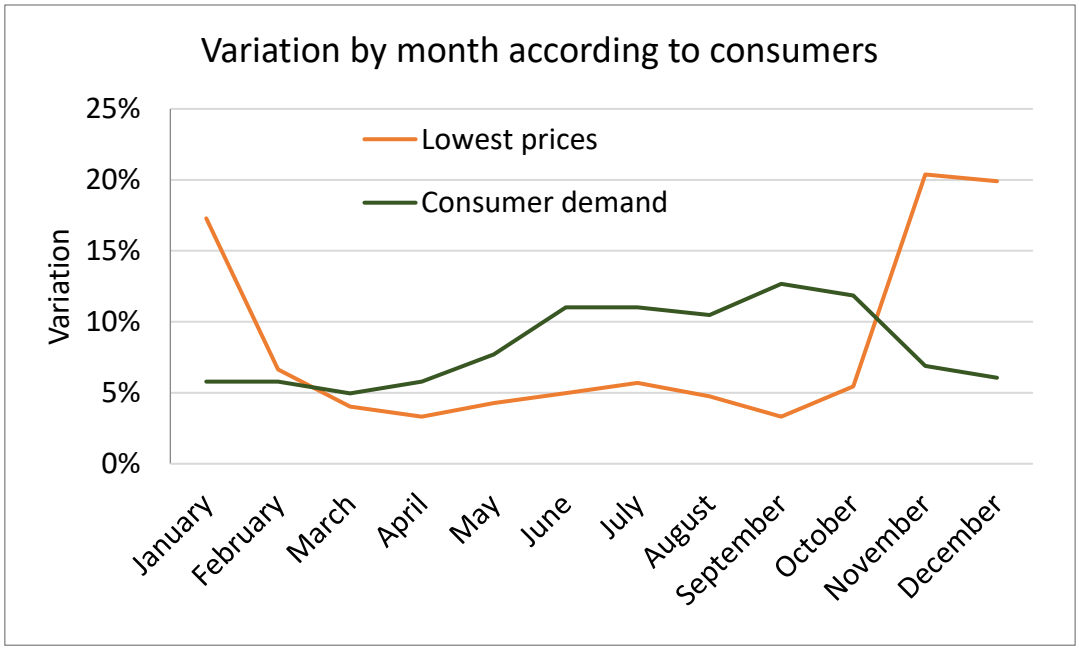

Figure 53: Distribution of demand and price according to consumers

For the consumers, except for a dip from December to April, demand is fairly uniform throughout the summer and autumn months. Perhaps, there is a slight peak in August and September when there are traditional rituals such as *tarpan* (remembering the dead) meals. There has been a dietary shift in recent years where mushroom is becoming more and more a part of daily meals which is confirmed by this demand pattern.

Chapter 5

Summary and Recommendations

This study has indeed been a first step in understanding the mushroom sector in Manipur. It covered around 100 farmers, 70 traders and over 120 consumers. While most of the farmers interviewed were educated young men looking to create self-employment through mushroom cultivation, the traders were primary school educated older women who have been trading for much longer. However, most trader and farmers have been dealing with mushroom only for the last few years confirming that the sector is still relatively new. Farmers relied on existing infrastructure to set up the cultivation units thus saving on costs as its mostly their own private savings or money from relatives that they were investing. Most of them have had exposure to some form of short-term training from experts in the crop however they tend to rely on learning by doing and from one another. The farmers also sell to a wide range of buyers including retailers, rural aggregators, consumers and wholesalers. This, we believe, is primarily because of the demand for mushroom and the volatile security situation in Manipur because of which the markets may be shut at short notice. Even though farmers are aware of periods of peak demand and high prices, their production do not match these and this has been discussed in much detail further on. Spawn producers made a margin of 73% (calculated using cost versus price values), while mushroom producers who can get a margin of 26% for Oyster mushroom to 40% for Paddy Straw mushroom based on our economic models. It is worth noting that most farmers did not have basic bookkeeping skills, did not fully comprehend the concept of assets, liabilities, Return on Investment and other financial terms critical to running a business successfully or securing financing.

The 70 traders or so interviewed made an average margin of 29% with brokers and retailers making a smaller margin compared to rural aggregators and wholesalers. Yet, many of the traders interviewed were retailers who source from a range of sellers and primarily sell only to end consumers. Interestingly, further strengthening the fragmented nature of this value chain is the finding that 34% of consumers buy directly from farmers and only 43% rely on retailers in the local markets. Consumers also go for a range of mushroom varieties, from the easily growable oyster mushroom to paddy straw or a combination of different types of newer and traditional types of mushrooms.

The flow of mushroom from the grower to the end consumer is therefore a multifaceted journey taking a number of pathways with no one structured flow dominating the chain. It is clear that consumers do not rely solely on traders and will happily source directly from farmers as Manipur is a relatively small society so a grower may only be one or two degrees of relationship away from a consumer. There are also many opportunistic traders - whether by choice or just trying to eke out a living we are not clear yet - who play a wide range of roles in getting fresh mushroom from the farms to consumers. Drawn out, the chart looks a little convoluted as can be seen in the figure 54. And, as can be expected, such a complex flow makes it difficult to visualise the value chain as a step by step flow with incremental costs/

margins before the product gets to the consumer. However, as mentioned before, farmers make a margin of 25% to 40% while traders on average make a margin of 29%.

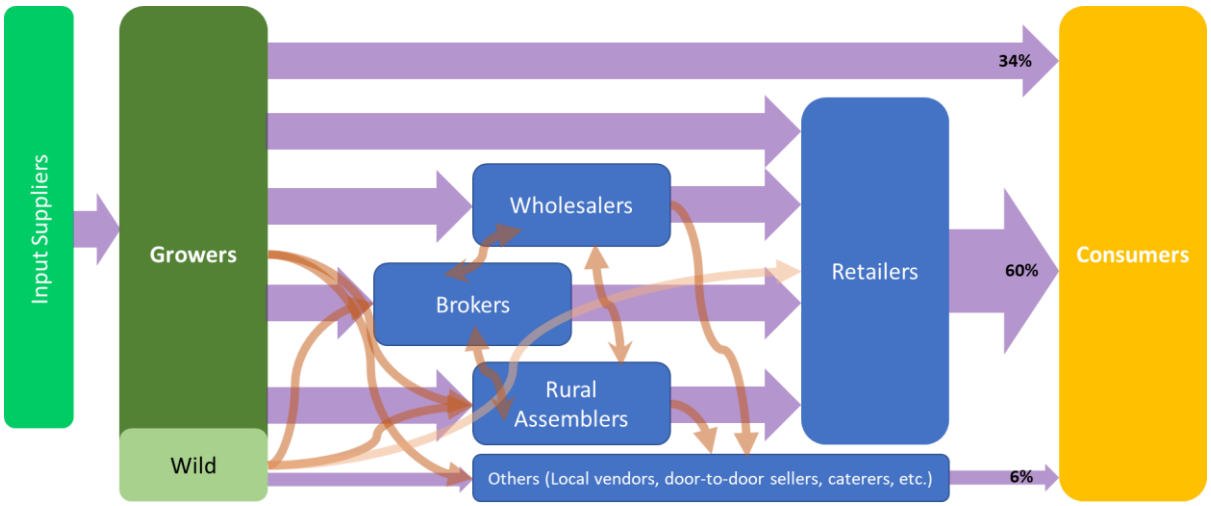

Figure 54: Flow of mushroom from the farmers to consumers in Manipur today

In the findings presented for farmers, traders and consumers, we saw that there were different months in the year when each group felt prices were high or low, or demand was at its peak or when production was maximum. These trends have all been brought together in figure 55 below:

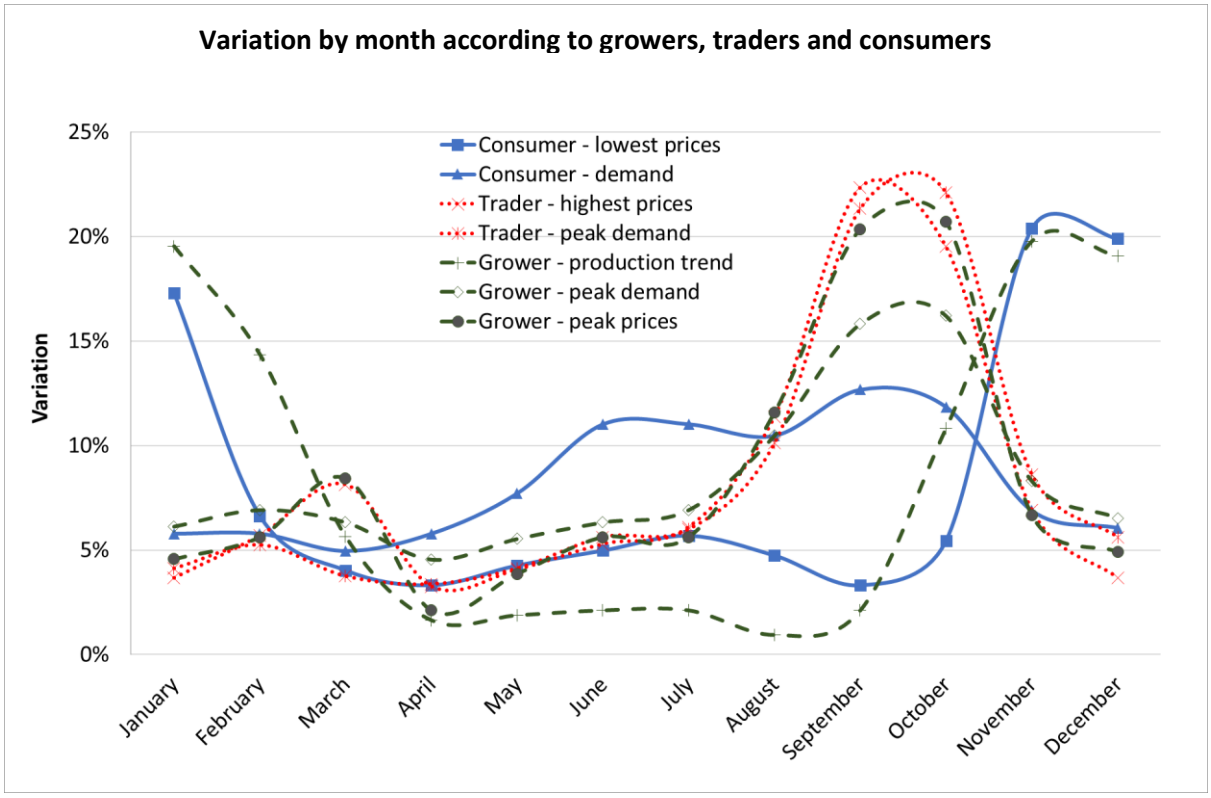

Figure 55: Plot of different trends identified from farmers, traders and consumers

At first glance, the chart looks busy however, if we look at it one step at a time, it makes a lot of sense. According to the farmers (green dash lines), they experience maximum demand and prices in the months from July to November. These are in line with what traders said were the months when demand and prices were both high (red dotted lines). However, the same farmers also said production was highest between September and March which is totally not in sync with when they said demand was high and so were prices. Interestingly, the same period when farmers said production was high was also when consumers (blue solid lines) said prices were lowest. However, according to the consumers, their appetite for mushroom is fairly consistent throughout the year even if demand between June and November could be seen as higher than between December and May. So, what is really going on? Despite knowing demand is high from August onwards, why are farmers not responding by producing mushrooms during these months? We believe there are a few circumstantial and skills-based reasons to fully understanding this as described below:

1. A lot of the farmers, as described before, rely on straw as the substrate. Straw is easily available after rice harvest which commences in autumn and could explain the increase in production from September onwards when straw would be readily available. It is also quite possible that mushroom farmers are also themselves farming rice and hence tied up during the summer months.
2. The natural conditions in Manipur are such that winter months, when day temperatures drop to 20°C or below and humidity is lower, are easiest for farmers to grow an easy-to-grow variety such as oyster mushroom. This is because the lower temperatures and humidity also lead to a reduction in pest and disease pressure.
3. Finally, farmers do not have all the necessary facility or skillset to grow mushroom throughout the year as their basic facilities are dependent on nature and their knowledge of pest and disease control is limited.

There is no clearer evidence than the above chart, based on data provided by the farmers, traders and farmers themselves, that many are missing out on the opportunity to run a steady business and provide regular access to affordable as well as high-quality mushroom throughout the year. It is on the basis of this that the following recommendations have been made:

1. **Model mushroom farm:**
   There is a real need to establish a model mushroom farm to demonstrate Good Agricultural Practices in mushroom production and to raise awareness amongst all Manipuri farmers on how best to carry out mushroom production taking into account the local conditions and available resources. Such a model farm could be established in conjunction with entrepreneurial farmers, NABARD, ICAR, CAU and other relevant institutions under the championship of an implementation partner with a clear mandate and defined project timelines. There is also a clear recognition that such a farm would have to rely on an expert partner, most likely from outside the state, with experience and skills in establishing and running successful mushroom farms, with a

caveat that it must be adapted to local conditions. The model farm will be the Centre of Excellence that all farmers can look up to, visit as and when they can or need to, and reach out to when they themselves are having challenges on their farms.

2. **Management and Technical training:**
   One of the many observations this study made was on skills gaps that farmers have. And, the skills are not just around agronomic capabilities. Many, if not all, of the farmers had no skills in running a business through proper bookkeeping, cost allocations, accessing financing mechanisms, labour management, etc. Most started farming out of lack of other opportunities and on an ad hoc basis. Whilst many of them benefited from day or week-long seminars and training programs that may have been run by various organizations, none benefitted from being taught a combination of theory and practical applications over a period of time.

3. **Mushroom Production Handbook:**
   As part of the study, many entrepreneurs were interviewed and assessed. Many of them had trained themselves from watching others or through sheer trial and error. This is a time-consuming and costly exercise so there is also an urgent need to develop a *Handbook for Mushroom Production in Manipur* along the lines of what the National Horticultural Board (NHB) has been promoting. Such a manual should prepare interested parties on the many steps involved in mushroom cultivation, the likely investment costs for the shed, machinery and tools, as well as the technical competencies needed. It is only after gaining knowledge and training in these different parameters that our farmers could consider applying for support from the NHB. An attempt has been made in this study in partnership with ICAR to develop a production program - see appendices – however this is only a first step and a much more detailed exercise is required to fill this significant gap.

4. **Mentorship:**
   A key area that's also missing is that agripreneurs who take up mushroom cultivation, by choice or through lack of other opportunities, do not have a scheme to handhold them in their first years of venturing into the sector. Thus, a mentorship program combining those with theoretical skills, real practitioners and key stakeholders is critically needed if this industry is to scale in Manipur and remain competitive in the coming years. Such a program could be made conditional for anyone willing to secure funding from a bank for mushroom cultivation.

Appendix I: About MaolKeki Foundation

MaolKeki Foundation (MKF) is a pioneering organization established with the purpose of catalysing positive development in Manipur primarily in the areas of agriculture, education and healthcare. Besides providing farmers with training on Good Agricultural Practices, our field nurse carries out last mile health assessments of the farmers and their families. It is MKF's mission to help farmers overcome the common ailments of inadequate last mile services across both agriculture and healthcare. The Foundation also supports an academically bright student from Manipur with proven financial needs through the annual MaolKeki Memorial Scholarship in partnership with St. Stephen's College, Delhi.

In numbers, since MKF was founded in December 2017, more than 1,000 farmers have been trained, and the health of over 2,000 farmers and their family members have been assessed. MKF also established a soil laboratory called Leibak Leihao Labs, and has awarded two MaolKeki Memorial Scholarships. In 2020, MKF in continuing partnership with Syngenta Foundation India is launching an Agri Entrepreneurs Program which will enable farmers to become agripreneurs thus creating more value and employment in rural areas.

MaolKeki Foundation is registered as a trust under the Indian Trusts Act, 1882, and works in a fully transparent, legal and compliant manner.

For more info, visit http://www.maolkekifoundation.org or write to us on contact@maolkekifoundation.org.

Appendix II: About the Value Chain Study team

Study Associates

Ms. Menaka Chirom

- 1st Class Agricultural Graduate from Gahrwal University, pursuing PG Diploma in Sustainable Rural Management
- Former HR & Operations Manager at Green Biotech EcoSolutions Pvt. Ltd., a biologicals company
- Well-established network across Manipur
- Mushroom entrepreneur

Ms. Rajina Potsangbam

- 1st Class Agricultural Graduate from Assam Agriculture University and PG from PDKV Akola Maharashtra
- Conducted a value chain analysis of the horticultural value chain for MaolKeki Foundation's Veg-in-a-Basket initiative, a sociopreneurship model to deliver fresh veg direct to urban homes
- Budding entrepreneur by co-launching Veg-in-a-Basket

Study Coordinator

Mr. Surjeet Luwangcha

- BSc Life Sciences from Bangalore Agriculture University and MA in Public Administration from IGNOU
- Worked with HDFC Life and FORTUNE INFOTECH
- Joined MaolKeki Foundation in June 2018 to manage day-to-day operations
- Budding entrepreneur by co-launching Veg-in-a-Basket

Study Advisor

Dr. Shachi Gurumayum

- Founder, MaolKeki Foundation
- 16-yr technical and management experience in Agriculture, Chemicals and Oil & Gas in four continents
- BSc, MSc/ PhD in Formulation Science, MBA in Strategy & Marketing, Advance degree in Healthcare Management
- Manipur Public School, St. Stephen's College, Bristol University, HEC Paris, INSEAD, Purdue, Harvard and Swiss TPH

Appendix III: Mushroom growing protocols

Source: ICAR Research Complex for NEH Region, Manipur Centre, Lamphelpat, Imphal-795004

CULTIVATION OF OYSTER MUSHROOM

The different steps involved in the cultivation of Oysters mushroom are:

1. **Preparation of substrate:** Oyster mushroom can be grown on a variety of agro-industrial by-products which have high contents of cellulose, lignin and hemi-cellulose. The substrate should be fresh, dry free from the mould infestations and properly stored. It is recommended that substrate which is harvested immature, having green chlorophyll patches should not be used. A variety of substrates such as wheat straw, paddy straw, ragi straw, stalk and leaves of maize, jawar, bajra and cotton, sugarcane bagasse, wastes of jute and cotton, peanut shells, dried grasses, used tea leaf waste etc. can be used for Oyster cultivation.

   Steps in Substrate Preparation:

   a. First chop the selected straw into small pieces of the size 5-10 cm

   b. Pasteurize this straw by either of the following method:

   Hot water treatment: Soak the straw into hot water (85° C) for 30-45 minutes. Then drain the excess water and let the straw cool down by spreading on a sterile surface.

   Chemical method: Take 90 litres of water in rust proof drum or tub. Slowly steep the straw into water. In another plastic bucket prepare a solution of carbendazim 50WP @ 7.5 grams and formaldehyde @ 125 ml by mixing them well. Now slowly pour this solution in already soaked straw. Press the straw and cover it with polythene sheet. After 15-18 hours take out the straw and drain out the excess water. Spread the straw on sterile surface to evaporate the excess water.

   As per the latest recommendations, the chemical pasteurization of substrate is discouraged and only hot water treatment has been recommended for the substrate pasteurization (Proceedings of XVII Annual Group Meeting of Research Workers, 2015, Directorate of Mushroom Research, Solan).

2. **Spawning:** Spawning should be done in a room which was earlier fumigated with 2% formaldehyde for 48 hours. If spawning is done outside, then the surface of tarpaulin sheet as well as hands should be sterilized with spirit or alcohol. Then mix the spawn thoroughly or in layers while putting the straw into polypropylene bags (60 x 45 cm, 125-150 gauze thickness). 300 grams of spawn grain is sufficient for 10-12 kg of wet substrate. Around 10-15 small holes should be made on all the sides of polypropylene bags with the help of a pin.

3. Incubation & Fruiting: Keep these bags in incubation room for mycelial run. Bags can be kept on raised platforms or shelves or hanged from the roof. Optimum temperature for growth is 22-26°C. Once the mycelial run is over i.e. the bags have become white due to the growth of mushroom mycelium, make some holes at several places in the bag so that the fruiting bodies can grow out. During fruiting maintain the relative humidity of 75-85% by spraying water on the gunny bags or sand spread on the floor. One or two spraying of water daily is sufficient. There should be 8-12 hours of light during fruiting.

4. Harvesting: Harvest the mushrooms before water spray by gently twisting the fruiting body. After first harvesting keep the bags in growing chamber so that other mycelium can grow and produce more fruiting bodies which can then be again harvested. Pack the fresh mushrooms in perforated polythene bags for marketing. In a period of one and a half months to two months, 500-700 kg of fresh mushroom can be harvested from 1 ton of paddy straw.

CULTIVATION OF SHIITAKE MUSHROOM

1. Strain selection: Shiitake strains are temperature-dependent. Strains are classified according to their preferred temperature during the fruiting period. The growth rate during spawn run differs according to the different strains, and results in either short or long durations for the mycelia maturation. Some short duration strains take only 60 days to mature while long-duration strains require 90 days. It is important that a strain is selected that matches a grower's specific needs. Shiitake strains vary widely not only in fruiting temperature, maturation characteristics (early or late; shorter or longer production time), but also in substrate selectivity, growth rate, fruiting quality (size, thickness, colour and fragrance, *etc*) and ecological adaptability to extreme temperature.

2. Substrate selection: Selection of the tree species for sawdust cultivation should be done carefully. Fresh sawdust that has not been aged can be used for production of shiitake only if it is from high quality tree species. Oak (*Quercus* sp.), chinkapin (*Carpinus* sp.), sweetgum (*Liquidambar* sp.), alder (*Alnus* sp.), willow (*Salix* sp.) are some examples of commonly used non-aromatic broadleaf hardwoods. Sawdust from tree species of lower quality has to be aged before it can be used successfully.

3. Substrate formulation: Commercial cultivation can be carried out on sawdust of broad leave trees and the most common formulation is:

a. Saw dust 80%
b. Rice bran 20%
c. Water content 65%
d. pH should be adjusted to 5.5-6.0 using gypsum and lime

The saw dust has to be soaked for 12-16 hours. A high-water holding capacity of the substrate combined with good aeration usually gives good results. The air flow in the substrate will be clogged if the substrate is too wet. The substrate materials must be evenly mixed.

4. Filling and sterilization of bags: Fill the bags (1.5 to 2.0 kg) immediately after mixing and wetting the substrate to avoid fermentation and contamination. Polypropylene (heat resistant - 15-16 cm diameter and 55-60cm long) bags should be used for filling and must first be loosely filled and later by applying pressure to get a cylindrical shape. The time between mixing the supplements and sterilization should be less than six hours to avoid fermentation. Ends of the filled bags are wrapped with iron/plastic ring and plugged with non-absorbent cotton. Sterilization is carried out in an autoclave at 22 psi for 2 hours.

5. Spawning and spawn running: After sterilization, cool the bags to room temperature. Spawn prepared on grain-based substrate can be used for cultivation. Spawning/ inoculation is carried out by removing the cotton plugs. Grain spawn is introduced @ 3-5% under aseptic conditions. The bags are placed in cropping rooms where these are generally incubated in a 4 h/ 20 h light/dark cycles at 23-25°C. Spawn run may take 60-80 days or more depending upon the strain and environmental conditions. During the period it goes through mycelia growth, mycelia coat, mycelia bump and browning stage.

6. Mycelial coat formation: A thick mycelia sheet/coat will develop on the surface of the substrate. This will occur 7-8 weeks after inoculation.

7. Mycelial bump formation: Bumps are clumps of mycelium, commonly formed on the surface of most strains after 9-10 weeks. These bumps can turn into mushroom primordial at a later stage but most of them abort. Fluctuating temperatures and high CO_2 promote bump formation.

8. Pigmentation: Some aeration should be provided when the bumps have formed for this phase to occur. After longer spawn runs (more than 60 days), the surface of the colonized substrate may begin to turn brown, some exudates may be there during spawn running.

9. Coat hardening phase: Remove the plastic when bags have partially (half or one third) turned brown. The coat will gradually become hard. While outside of the substrate should be hard, the inside should be softer and moist. The core of the substrate has moisture of about 80%.

10. Fruiting: To stimulate maturation of primordial when browning is completed, blocks are soaked in cold water treatment (4°C water, 5-10 minutes). After soaking, blocks are placed on shelves at medium temperature (12-18°C), high relative humidity (80-85%) and good ventilation, and the mushrooms will begin to enlarge. Approximately 7-12 days after soaking, mushrooms are ready for harvest.

11. Harvesting: Mushrooms are twisted by holding the stalk of the mushroom from the residual substrate. Harvest the mushrooms at an early stage. Normal yields are 15-30% of the wet weight of the substrate. After the harvest, a dry/rest period of 7-21 days should

be maintained depending on the type of strain used between each fruiting. After rest period, blocks are again soaked in cold water treatment to get the second crop.

CULTIVATION OF BUTTON MUSHROOM

1. Cut 300kg of paddy straw
2. Before composting, clean the area thoroughly with 2 % formaldehyde solution
3. Wet the paddy straw by spraying water (70% moisture content) up to 48 hrs
4. Prepare a bran fertilizer mixture (20kg bran, 5kg urea, 1.5kg DAP and 3kg MOP) and cover with polythene sheet
5. Mix the bran fertilizer mixture with paddy straw
6. After two days of staking the paddy straw substrates, turn the straw by applying the bran-fertilizer mixture, 150g Furadon 3G and 5kg of molasses and cover with polythene - spray water after every turn and in-between turning
7. Turn a second time after two to three days, turn a third time after another two to three days by mixing with 10 kg gypsum
8. Fourth, fifth and sixth turning are after every 2/3 days of piling the substrates
9. Turn a seventh time after another two to three days. If the smell of ammonia is still present, then turn more after 2-3 days. Once the ammonia smell is gone, go for chemical pasteurization with 2l of formalin and 50g of bavistin
10. Spawning is done in poly bags or in tray, and casing soil must be prepared on the day of spawning
11. After the mycelium runs thoroughly, put the casing soil for casing
12. After 15 days from casing, pin head appears.

Note: The temperature for incubation must be 25°C and 18-22°C for fruiting.

CULTIVATION OF PADDY STRAW MUSHROOM

1. Prepare paddy straw bundles of 0.75 – 1.0 kg (80-95cm long & 12.16cm wide), preferably from hand threshed paddy
2. Immerse bundles in clean water for 12-18 hours in a cemented water tank
3. Drain excess water by placing bundles on a raised bamboo platform
4. Make a bed by placing four bundles side by side and another four bundles similarly but from the opposite side, forming one layer of eight bundles.
5. Form a second, third and fourth layer with intermittent spawning between first and second, second and third, and third and fourth layers.
6. Spawn on the entire surface of the layers of the beds at a space of 5cm apart leaving a margin of 12-15cm from edges
7. Sprinkle red gram powder over the spawned surface
8. Use 500g spawn and 150g of red gram powder for a bed of 30-40 kg of dried paddy straw
9. Press bed from the top and cover with a clean plastic sheet for maintaining required humidity (80-85%) and temperature (30-35°C)

10. Remove plastic sheet after 7-8 days of spawning and maintain a temperature of 28-32°C and relative humidity of about 80%
11. Mushroom will start appearing after 4-5 days of sheet removal and will continue for next 20 days; time to harvest!
12. After crop harvest, the substrate can be used for manure in the field

Appendix IV: Manipuri Mushroom Recipes

1. Mushroom soup

- Mushroom – 250 grams
- Corn flour- 20 grams
- Ginger-15 grams
- Garlic-15 grams
- Salt & pepper- to taste
- Boil the water with ginger, garlic and pepper for 5-7min then put the shredded mushroom with salt to taste and again boil for 5-10 minutes and serve.
- Mushroom soup can be prepared with vegetables or chicken.

2. Mushroom curry

- Mushroom-250 grams
- Oil – 3 table spoon
- Ginger & Garlic - 15 grams
- Onion, Tomato – one each
- Turmeric powder – pinch
- Salt – to taste
- Green chilies – 2-3 pieces
- Coriander, chili powder– one table spoon
- Pepper, Gram masala – ½ tea spoon
- Heat the oil in a pan then put the chopped onion, garlic, ginger, green chili, and tomato one after the other with all the required masala and fry for 1-2min. Then, put the mushroom with some salt to taste and fry again for 10-15min before serving.
- Mushroom curry can be prepared with vegetables or fish or chicken.

3. Mushroom Eronba

- Mushroom- 250 g
- Potatoes/ Dry peas- sufficient amount
- Salt, Chili &Dried fish – to taste
- It is a local dish which lots of people preferred it.
- Boil the ingredients (mushroom and potatoes/ dried peas) for 10-15min, let it

cool down for some time then mash it together in a utensil. Mix it with the steam dried fish and chili then put some salt to taste and its ready. In this we can put some chopped spring onion, coriander or onion to give taste.

4. Mushroom Fry

- Mushroom- 500 g
- Oil – Half cup
- Onion–2-3 medium size
- Garlic- 4-5 cloves
- Ginger- 50 g (grated)
- Salt, Pepper – to taste
- Turmeric, coriander powder- ½ table spoon
- Coriander leaves- 50 g
- Firstly, shred the mushroom in small pieces and half fry it in oil and leave in a bowl or a plate. Secondly, put the chopped onion, ginger, garlic, and green peas and fry for 2-3min then put salt, pepper, turmeric powder, and coriander powder to taste. Finally, put the half fried mushroom in the pan and mixed all the ingredients together and fry for 5-10min and it's ready.
- Mushroom fry can be fried with vegetables or fish or chicken.

5. Boiled mushroom

- Mushroom – 250 grams
- Onion – 1 medium size
- Chives – to give aroma
- Ginger - 15 grams
- Dried fish or fermented fish – to taste
- Salt & pepper- to taste
- Boil appropriate volume of water with dried fish or fermented fish, chili/pepper, chives, and ginger. While the water is boiling, shred the mushroom in small pieces and add to the water after 5-10min of boiling. Add salt to taste and boil for another 5-10min, and it's ready to serve.
- Mushroom boil mostly prepared alone or with the potatoes.

6. Mushroom Paknam

- Mushroom – 250 grams
- Maroi napakpi (Hooker Chives) – 2-3 bunch
- Ginger – 15 grams
- Garlic -15 grams
- Dried fish or fermented fish – to taste
- Salt – to taste
- Green chili – 4-5 pieces
- Some masala – to taste
- Turmeric and banana leaves – 1-2 pieces (to wrap it up)

- Firstly, shred the mushroom and chop the chives in small pieces and mix them with all the ingredients listed above. Secondly, spread the mixture on turmeric leaves and wrap it up. Wrap this with banana leaves and bake for 20-30min in a pan by turning from one side to another every 4-5min. Turmeric leaf is the main ingredient to get the typical taste of paknam.
- We can also put gram flour to thicken the dish. Then the dish will be in a flat shape so it can be cut in square or rectangle shape before serving.

Appendix V: List of input suppliers, trainers, financiers, etc.

	SPAWN & INPUT SUPPLIERS				
Sl.No	Name	Farm Name	Address	District	Contact No.
1	Gitendro	M/S Gitendro Spawn Production	Chingmei Mayai Leikai	Bishnupur	7085337070
2	S. Bihari Singh	Universal Mushroom	Thangmeiband	Imphal West	9366690243
4	Ningombam Ibomcha	HeeYai Mushroom	Bashikhong	Imphal East	9862558286
5	Asem Robinson	Thaddaeus Nutraceuticals Pvt.Ltd.	Kakwa	Imphal East	9612677303
6	Dhanajit	Temperate Mushroom	Sangaiporou	Imphal West	9856213731
7	K. Sanaton Singh	Sanaleibak Mushroom	Konthoujam Makha Leikai	Imphal West	9402263586
8	Punil Angom	Leima Mushroom	Porompat Thawanthaba Leikai	Imphal East	9862271869
9	Soram Rajendro	Rama Foundation	Nagamapal	Imphal West	8414980977
10	N. Roneldro Singh	Jamini Mushroom	Bashikhong	Imphal East	9856084246
11	Laimayum Churamani@Mani		Bamon Leikai	Imphal West	9612024915
12	Chongtham Baram		Wangjing	Thoubal	7005153306
13	B. Khogen Sharma	Thambal Leima Mycelia	Khongman Zone III opp UNACCO School	Imphal East	8794222982
14	Maibam Ashakumar		Khudrakpam Mayai Leikai	Imphal East	9862095777
15	ICAR		Lamphel	Imphal West	0385-2414749
16	KVK Imphal West		ICAR Complex, Lamphel	Imphal West	0385-2410485
17	Dr. Solei	KVK Ukhrul		Ukhrul	8729995910
18	Sharatchandra	Masci Agro	Torongloubi mayai leikai	Bishnupur	8837467210
19	Thokchom Maipak	Star mushroom	Lourembam	Thoubal	7005815412
20	Lungaingam		Wainem	Chandel	8787810004
21	Subhashchandra Khwairakpam		Ngaikhong khullen	Bishnupur	8787487747
	TRAINING PROVIDERS				
1	ICAR-NE Centre	Lamphelpat	0385-2414749		
2	Leima Mushroom	Malom	9862271869		
3	Rama Foundation	Nagamapal	8414980977		
4	Universal Mushroom Centre	Thangmeiband	9366690243		
5	Institute of Cooperative Management (ICM)	Lamphel	0385-2414526		
6	Central Agricultural University (CAU)	Iroisemba	0385-2410644		
7	District Industries Center (DIC)	Lamphel	0385- 2414220		
9	Integrated Mushroom Training Center	Thangmeiband	9774983141		
10	KVK Imphal East	Leitanpekpham, Andro Manipur	0385-241389		
11	KVK Imphal West	ICAR Research Complex for NEH Region, Manipur Centre Lamphelpat Imphal- 795004	0385-2410485		
12	KVK Ukhrul	Hundung village, Distt. Ukhrul District, Manipur-795142	3870265548		
13	KVK Bishnupur	Bishnupur District, Utlou, P.O. Nambol, Manipur-795134	0385-2453444		
14	KVK Chandel	Krishi Vigyan Kendra, Chandel. ICAR Research Complex for NEH Region, Manipur Centre Chandel-795127	9471212014		
15	KVK Tamenglong	Charoi-chagotlong, Tupul, Tamenglong District,Manipur	0385-2414654		
16	KVK Churchandpur	Pearsonmun Village Churachandpur, District – Manipur-79512	0385-2414654		
17	Krishi Vigyan Kendra-Senapati	Hengbung Village, BPO Hengbung, P.O. Kangpokpi – 795129, Senapati District, Manipur	03871-201591		
18	Krishi Vigyan Kendra Thoubal	Rice Research Station Wangbal, Thoubal-795138	03848-201559		

CHEMICALS, EQUIPMENTS & OTHER MATERIALS SUPPLIERS					
Sl.No	Name	Address	Contact		
1	Sharma Bros Sc. Instruments Co.	Paona Bazar, Imphal, Manipur 795004	0385 245 0162		
2	Surgichem Agencies	Khuyathong Nagamapal Road	7005401564		
3	Amen Plastics	Sagolband Salam Leikai	89745 62777		
FINANCIERS					
1	Manipur State Co-Operative Bank Ltd.	Old Assembly Road, Imphal	0385-2451540		
2	Manipur Rural Bank	Keishampat Keisham Leikai, Imphal	0385-2451590		

Financing Option from Manipur State Co-Operative Bank Ltd.

Farmers who are interested can take a loan if he/she has a bank account with regular transaction for at least 6 months. Documents required are as per MSCB norms:-

1. Photostat of PAN CARD
2. Share held (5% of the Loan Amount)
3. Margin Money Required (10%)
4. SECURITIES OFFERED:
    a. Collateral Security
        i. Original Copy of Registered Sale Deed or Gift Deed for collateral security
        ii. Land Valuation certificate of (minimum value of the land shall be 40% above the loan amount)
        iii. Non encumbrance certificate (within 3-months)
        iv. T.R. for tax Clearance, Trace Map (showing Dag No.)
        v. Land Ownership Certificate
    b. Liquid Security (5% of the loan amount)
    c. State Govt. Employee Guarantor(s):
        i. Letter of Guarantee and DDO's pay deduction certificate (Recent Passport size Photograph and signature of the guarantor(s) to be attested by the DDO. Every Page of Letter of Guarantee should be signed by the guarantor)
        ii. Undertaking for deduction of pay
        iii. Authorization for deduction of pay
        iv. Salary Slip
        v. Xerox copy of Identity Card
        vi. Xerox copy of Aadhar Card/ PAN Card

* If the loan amount is up to Rs.2 Lakhs, security should be either collateral Security or State Govt. Employee Guarantor. And submission of a Project is required if the loan amount is more than 2 Lakhs. And both Collateral and State govt. Employee Guarantor is needed.

*If the applicant is a NABARD sponsored than securities offered are exempted and only applicable to Piggery, Poultry & Dairy.

Financing Option from Manipur Rural Bank

One can take a loan if he/ she has a bank account with regular transaction for at least 6 months. Manipur Rural Bank, a rural Bank Documents required are as per Manipur Rural Bank norms -

1. KYC (Aadhar Card, PAN Card, Voter Card and Passport Photo)
2. Margin Money Required (10%)
3. SECURITIES OFFERED:
   *No Collateral & Margin Money for loan upto Rs. 160000/-.
   a. Collateral Security
      i. Original Copy of Registered Sale Deed or Gift Deed for collateral security
      ii. Land Valuation certificate of (minimum value of the land shall be 40% above the loan amount)
      iii. Non encumbrance certificate (within 3-months)
      iv. T.R for tax Clearance, Trace Map (showing Dag No.)
      v. Land Ownership Certificate
   b. Liquid Security (10% of the loan amount)
   c. State Govt. Employee Guarantor(s):
      i. Letter of Guarantee and DDO's pay deduction certificate (Recent Passport size Photograph and signature of the guarantor(s) to be attested by the DDO. Every Page of Letter of Guarantee should be signed by the guarantor)
      ii. Undertaking for deduction of pay
      iii. Authorization for deduction of pay
      iv. Salary Slip
      v. Xerox copy of Identity Card
      vi. Xerox copy of Aadhar Card/PAN Card

* If the loan amount is above Rs. 50,000/- then CIC Report should be taken up.

* Detailed Project Report (DPR) need to be submitted.

LEDP project, Ukhrul

Creating sustainable livelihood and enterprise development amongst SHG members through adoption of Mushroom Production Technology.

- PIA: Ukhrul District Women Institute of Micro-Credit (UDWIM)
- The LEDP was sanctioned to UDWIM, Ukhrul vide our sanction letter Ref. No. NB(MNR)/222/MCID/LEDP-UDWIM/2018-19 dated 16 August 2018.
- Amount sanctioned: Rs. 6.43 lakh
- Project period: 1 year
- Beneficiaries: 150 members selected from 10 credible SHGs which have fulfilled the criteria of Panchasutra and credit linked with banks for at least 6 months.
- Technical support: KVK Ukhrul
- Exposure visit as a part of refresher training: Attended by 30 SHG members and visited Leima Mushroom, Malom village, Imphal West District, Tayai Mushroom of Khundrakpam village, Imphal East District and Green Biotech Ecosolutions Pvt. Ltd. , Imphal
- Demonstration unit: 1 unit established costing about Rs. 1.58 lakh, out of which, support from NABARD: Rs. 0.60 lakh
- No. of members adopted the trained activity: 130 out of 150 trained SHG members.

Contact No. of PIA: Contact details:
Ms. Ringyuichon Vashum
Member Secretary/ Credit Manager, UDWIM
Office No. : 03870265865
Mobile No.+91 9774887307/ +91 9402081321
Email ID: rchonvashum@gmail.com/ udwimukhrul@gmail.com

Contact no. of technical provider:
Dr. Solei Luiram, SMS Horticulture
KVK , Ukhrul
Contact No. +91 8729995910

LEDP project, Maklang village, Imphal West

Creating sustainable livelihood and enterprise development amongst SHG members through adoption of Mushroom Production Technology.

- PIA: Rural Service Agency (RUSA)
- Launched on 18 September 2019
- Amount sanctioned: Rs. 6.43 lakh
- Project period: 1 year
- Beneficiaries: 150 SHG members selected from 4 villages from Imphal West and 1 village from Kangpokpi districts
- Technical support: KVK Imphal West
- No. of members trained till date: 30 out of 150 SHG members
- Demonstration unit under process to set up at Maklang village, Imphal West with support from NABARD: Rs. 0.60 lakh

Objectives of the programme:

- Women Empowerment
- To provide a sustainable income generating livelihood activities for matured SHGs of Imphal West and Kangpokpi districts through intensive training programme, credit linkages with banks and other support services
- To promote mushroom cultivation for commercial production throughout the year.
- To increase the credit flow in agriculture and allied sector by providing a good platform for financing
- To provide proper handholding support and social empowerment to SHGs members capacity building, skill up gradation, market orientation, etc.
- To provide proper linkages to the SHGs women

Contact No. of PIA: Contact details:
Ms. Y Sileima Devi.
Secretary/ Rural Service Agency (RUSA)
Office/ Mobile Nos.: +91 (0)385 223145/ +91 9611799409
Contact No. of technical provider:
S Gunamani, SMS Horticulture, KVK , Imphal West
Contact No.: +91 8974008739

Natural Agrotech Research and Processing Service, Churanchandur

Registered Users Details

Registered Date	30-08-2018
Name of the Agency	NATURAL AGROTECH RESEARCH AND PROCESSING SERVICE
Type of the Agency	Training Provider
Type of the Organization	NGO
Address	District Industries Centre DIC Complex, Manipur, Tuibong Opposite Post
Operation Area	Churachndpur District
Email Id	talk2narps@gmail.com
Phone Number	, 9862433118
Contact Person Details	Joma Neihsial, Programme Manager, jomccp7@gmail.com, 9862433118
Registration Number	33/1995
Registration Date	1995-02-07
Registration Act	Societies Act
Associated Activity	SKILL TRAINING

Director Details

Name	Phone no	E mail
KAPLIANLAL THANGLUAI	8011158298	kthangluai@gmail.com

Appendix VI: Processor profile – Binita Mushroom

Binita mushroom is a processor adding value to mushroom but is only at the beginning of its journey. Binita, the founder, got training to grow mushroom from various institutes and, a few years back, she and her fellow trainees started growing mushroom to sell but, when customers didn't buy as expected, it led to a lot of wastage so she started collecting unsold fresh mushroom to dry and add value. In brief:

- Started by making mushroom pickle herself in 2018 and got *Fssai* license in 2019
- She is not producing the value-added products commercially for now as she's carrying out various analytical tests on the products
- She only sold the value-added products at agricultural fairs to date
- Some value-added products she currently produces are noodles, pickles, dried mushroom, masala powder, mushroom powder, etc.
- She also makes cookies and bori but the processing is done by other people.
- She is going to supply her products to Manipur Organic Mission Agency (MOMA)
- She now has two solar dryers; one from ICAR and another one from KVK Imphal East
- Prices of the products:
  - Noodles: 200g (Rs.40)
  - Pickles: 100g (Rs.100) and 150g (Rs 150)
  - Bori: Rs.1/ bori
  - Powder: 50g (Rs.100)
  - Dry Mushroom: 100g (Rs.150)
  - Cookies: Rs.5/ piece
  - Masala: not yet decided.

Future plans:

- Hiring a food nutritionist to make cookies
- Drinks from mushroom (like tea)
- Delivery service by e-rikshaw of the product, maybe fresh or processed
- Selling of the products to various retail outlets
- Selling of straw – sell cut straw ready for use by farmers

Appendix VII: Additional pictures

Consumer buying vegetables

Hanging mushroom grow bags

Bags of spawn on a rack

Elm, a kind of oyster mushroom

Mushroom pin heads

Straw for substrate production

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