

OYSTER MUSHROOMS PRODUCTION STEPS

ILLUSTRATIVE GUIDE FOR FARMERS






© UNDP, FAO and PPC, Lao PDR

UNDP, FAO and Plant Protection Center (PPC) encourage reproduction, use and dissemination of this publication which may be copied, downloaded and printed for private, study, research, teaching purposes, or for non-commercial products services – provided the appropriate acknowledgement of UNDP, FAO and PPC as source and copyright holders are given.

The views expressed in this publication are the authors' and do not necessarily represent those of the United Nations, including UNDP, FAO or its Member states.



OYSTER MUSHROOMS PRODUCTION STEPS

ILLUSTRATIVE GUIDE FOR FARMERS

By
Viengkham Sengsoulivong
and
Ole S. Pedersen

INTRODUCTION

Around the world edible wild mushrooms are regarded as a delicacy and can be found in and outside forests, either picked for home consumption or sold at local markets. They are used in various dishes and contain important vitamins, minerals and proteins and many species are believed to cure ailments.

Wild mushrooms, however, can also bring illnesses and even death to people, who are unaware of the many look-alike poisonous species. Thus, for many people the cultivated mushrooms are a good alternative to the wild mushrooms.

The most common and easily cultivated mushrooms in Lao PDR are:

- Oyster mushrooms (*Pleurotus spp.*)
- Straw mushroom (*Volvariella volvacea*)
- Wood ear mushrooms (*Auricularia spp.*)

Other edible species of mushrooms require more attention and knowledge, thus these mushroom are not yet cultivated in Lao PDR. These include:

- King oyster mushroom (*Pleurotus eryngii*)
- Shiitake (*Lentinula erodes*)
- Namekho (*Pholiaota nameko*)
- Enoki mushroom (*Flammulina velutipes*)

All of the above-mentioned mushrooms grow naturally on dead wood or decaying plant materials and therefore possible to cultivate. One famous medicinal mushroom is reishi or ling-zhi (*Ganoderma* sp), common in Laos and cultivated in huge quantities in China.

Another important group of wild edible mushrooms are those living in soils connected with roots of trees. These cannot be cultivated.

It is recommended that a newcomer in mushroom cultivation starts with easy-to-grow and easy-to-sell mushrooms such as the oyster mushrooms.

This illustrated farmer guide is prepared with the purpose to provide basic knowledge and techniques required for oyster mushroom cultivation and largely based on experiences from working with five farmer groups in Phonexay District of Luang Prabang Province.

Extension workers and already skilled oyster mushroom growers can help inexperienced farmers to cultivate oyster mushrooms.





OYSTER MUSHROOMS

Description

The oyster mushroom has a whitish grey color in all parts. The cap is waxy, 5–25 cm wide with an in-rolled and often splitting margin. With age the cap becomes increasingly funnel shaped. The flesh is also white and firm. The gills descend about half way down the stem. The stem is rather short and firm. In nature it grows on several living or newly dead trees.

Oyster Mushroom Production Steps



STEP 1

Detailed planning what, when & economy

One oyster mushroom production circle takes 3 - 4 months and it is important to get a good overview of all the production details, not least time and costs evolved.

Timing, helping hands and visit to growers

Oyster mushroom can be cultivated year round. Take into consideration weather and other work and make sure you have enough people to help, particularly when filling bags, sterilization and inoculation. Visit a producer in your province to get more information.

Costs, market and profit

Get a good overview of costs involved and consider how much oyster mushroom can be sold at local markets and to what price. Then calculate profit. (see example on page 41-42)

Growing materials

Check availability of sawdust as well as various minerals needed to mix with sawdust and for the bags. Look for where to buy before you start. (see proposed procurement list on page 39-40 and steps 2-5)

Equipment

Basis equipment, such as sterilization oil drums, water cans, shovels, and weights are available in most villages as well material for making simple growing houses. In addition you need plastic sheets, ring necks, caps, cotton, alcohol lamp, etc. as well as the mushroom spawn should be quality. (see page 39-40 and steps 2-5)

STEP 2

Getting started - choosing sawdust and mix with lime

Get sawdust from local sawmills. Start with small amounts such as 500-600 kg for 1,000 bags.

For 1,000 mushroom bags	For 5,000 mushroom bags	For 10,000 mushroom bags
Saw dust: 500 - 600 kg	Saw dust: 2,500 - 3,000 kg	Saw dust: 5,000 - 6,000 kg
Lime: 1 - 1,5 kg	Lime: 5 - 6,5 kg	Lime: 7,5 - 10 kg

Options for sawdust

Good sawdust is soft wood from eucalyptus, rubber and mango trees but sawdust from other soft wood trees can also be used. If using sawdust from teak tree, then mix with 10% from other soft wood trees.



Mixing sawdust and lime

(1) Make sure that the lime (Calcium carbonate) is homogenous by filtering it to fine powder through a net.

(2) The mixing of sawdust and the powdered lime should be done on a cement floor or on thick plastic sheets (avoid bare soil).

After mixed with lime, add water -until water can drip when pressing hard in your hand.

(3) Let the sawdust-lime mix rest at least one month on cement or thick plastic – and cover with a plastic sheet to maintain moisture.



STEP 3

Order spawn material

Check price and quality of spawn materials from more than one producer. Calculate number of bottles needed.

For 1,000 mushroom bags	For 5,000 mushroom bags	For 10,000 mushroom bags
Spawn bottles: 40	Spawn bottles: 200	Spawn bottles: 400



STEP 4

Final mixing and filling & closing plastic bags

A) Make sure you have all material and equipment.

Material	For 1,000 mushroom bags	For 5,000 mushroom bags	For 5,000 mushroom bags
Broken rice	25 - 30 kg	125 - 150 kg	250 - 300 kg
Rice bran	50 - 60 kg	250 - 300 kg	500 - 600 kg
Magnesium sulfate	3 - 5 kg	15 - 25 kg	30 - 50 kg
Pumice	5 kg	25 kg	50 kg
Plastic bags (7" x 12.5")	5 kg	25 kg	50 kg
Plastic necks	1 bag	5 bags	10 bags
Cotton	1 kg	5 kg	10 kgs
Rubber bands	1 bag	5 bags	10 bags
Plastic sheet	1 roll	5 rolls	10 rolls
Oil drum	2	5	10

MATERIALS



Rice Bran



Broken rice



Sawdust mix



Plastic bags



Pumice



Calcium sulfate



Magnesium sulfate



Rubber bands



Shovels



Plastic neck and caps, cotton

B) Final mixing of growing material

Mix broken rice, rice bran, calcium sulfate, and magnesium sulfate, pumice with the sawdust-lime mix.

Make sure the mixing is taking place on cement floor or on thick plastic.



C) Adding water

Add water to keep moisture until you can make a cake by pressing hard with your hand without water dripping out (equal's 60 - 65% water).





D) Filling and packing the bags

Fill plastic bags to the top with the final mix (substrate) using small shovels.

Then press by hand using a firm hand

Another option is to compress the bags with a machine



E) Closing the bag

- (i) Put cotton in the plastic cap
- (ii) Put top of bag through the neck
- (iii) Fold the plastic backwards





iv

(iv) Close with rubber band

(v) Close with plastic cap



v

STEP 5

Sterilization of substrate bags

It is very important to completely sterilize substrate bags – and if not done as described below, you will have a poor harvest or no harvest at all.

A) Placing oil-drums

Ensure steady place for drums and make sure you have enough firewood for 5-6 non-stop boiling.





B) Add frame, sisal bags and water

Prepare a 40 cm high frame on which the bags will stand on.



Soak the sisal bags/sheets in water and line with two layers and



Add until nearly covering the frame.

C) Fill the oil drum

Make sure the oil-drum is firmly packed with bags.

Each oil drum contains 100-110 bags



C

D) Close the oil drum

Fold sisal bags to the top, cover with two layers of plastic sheets and close tightly with rubber strings.



D



E) Sterilizing the bags

Boil the water for at least 5 hours and the steamed water will ensure sufficient heat to sterilize the substrate bags.

Important to keep the water boiling all the time – you will see some steam coming out.

STEP 6

Inoculation of bags

After 5-6 hours of sterilization – let the bags cool down for 20 min before taking out the cover plastic and let it cool for another 4 hours.

A) Transfer to inoculation area

Any transport method can be used, but be sure the bags are kept very clean and don't let them touch the soil.





B) Make sure inoculation room is clean

Inoculation room must be kept very clean and the inoculation should be done indoor – without much air circulation. Place the bags orderly in rows.

C) Make inoculation materials ready

Get the spawn materials from a supplier. The spawns are coated on sorghum seeds



Wash your hands. Use only clean equipment

Shake spawn bottle against semi-soft materials to loosening the sorghum seeds.

Clean spawn bottles with 70% alcohol.

Then, bring bottles to inoculation room.

Do not open the bottles.



D) Clean hands and put fill lamp with alcohol

Fill lamp with 90% alcohol and clean again your hands with soap and 70% alcohol before inoculation.



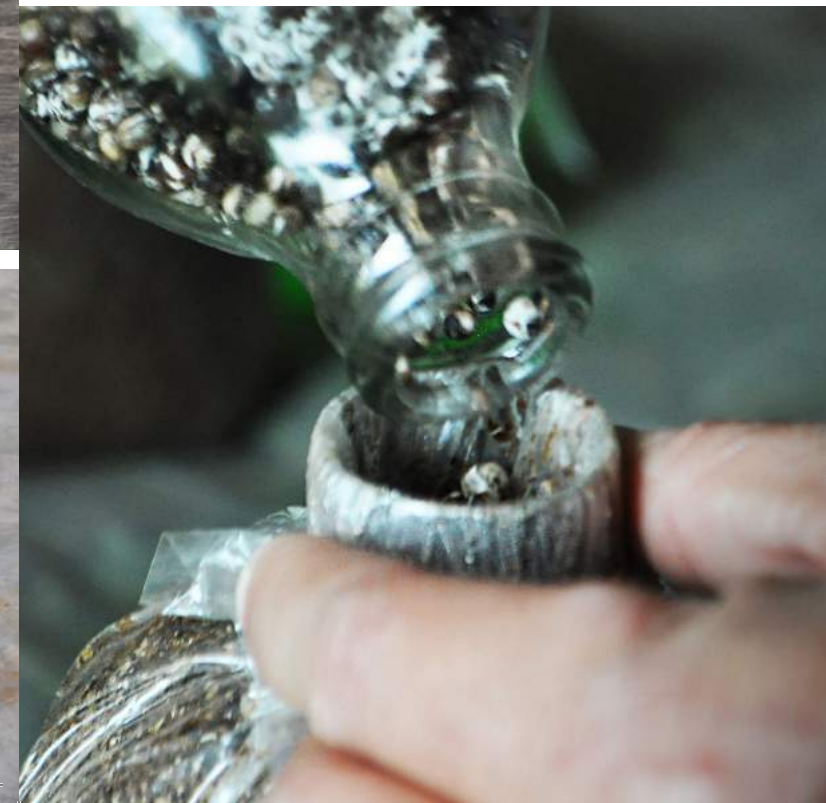


E) Start inoculation (maximum two most qualified persons)

Inoculation must be done with extreme caution in order to ensure high yields and disease free substrate bags.

Open the spawn bottle very close to the flame and heat around the opening (2-3 seconds).

At the same time another person open the sterilized substrate bag and add 10-20 sorghum seeds or fill to the top. Then shake the mushroom bag. Act quickly and close bottle with the cap.



STEP 7

Resting the bags (incubation)

Keep inoculated bags upright inside a room to let the mushroom mycelium grow for 25-30 days.

The room should be closed. but allow some ventilation.

Check if any bags develop abnormal mycelium (such as black, green, brown, orange or red spots). Remove these to a secure place and burn.



STEP 8

Making a growing house

The growing house can be made by locally available material and sized for planned harvests of 4-5 circles.

1,000 bags: 2m x 3m (6 sq m)

2,000 bags: 3m x 4m (12 sq m)

3,000 bags: 4m x 5m (20 sq m)

4,000 bags: 5m x 6m (30 sq m)

5,000 bags: 6m x 7m (42 sq m)





House should be kept semi-dark with some ventilation at the top of the roof.

Floor should have a layer of sand to keep the house clean.

STEP 9

Move bags to growing house and opening the bags

A) Move to growing house

After finished incubation, move the spawn bags to the growing house.



B) Opening the bags

The mycelium has now spread well within the spawn bag and it is time to open the bags by removing the caps. Take off the rubber bands, plastic neck and the cotton.

After 2-3 days add water to increase humidity and better growth of the mushrooms.





C) Spraying with clean water

Watering has the purpose of keeping high humidity in the growing house. Water the bags 2 times daily. Pour water from the top, so the water can run downwards but not into the bags.

A water tube can also be used – but then spray the water finely by e. g. holding the finger at the end of the tube. Humidity should not be lower than 80 %.

STEP 10

Harvesting and daily care

A) Harvesting

Mushrooms fruiting bodies will appear a few days after the bags have been opened.

Harvest the mushrooms gently. If too small the income will be less (lower weight) and if too old they are less tasty and you will get lower price.

Harvesting continues for 3-4 months.





B) Daily care

Apart from watering, check also if mushrooms and bags are healthy.

If getting diseases ([see page 34](#)), immediately remove the bags to a secure place such as in closed big plastic bags or as compost at least 200 m away from the growing house. If temperature is higher than 35°C, spray at least 3 times a day.

If you feel comfortable, it means the mushrooms are also well.

C) Problems of contamination of other small fungi

Daily, check the bags to see if there are any spots or if part of the bag becomes un-normal.

Green fungi will appear, if the bags were not well sterilized or contaminated during inoculation by e.g. dirty hands and tools. Green bags should immediately be carried outside and burned.



The best way to prevent pests and diseases is to carefully follow instructions; keep tools and growing house clean and do not allow too many people in the growing house.



D) Problems of rodents and other animals

During the incubation rodents and other animals will like to eat the sorghum seeds and will spread diseases. Also during harvest the rodents will eat the fruiting bodies. Protect by keep floor clean and use traps.

STEP 11

After harvest care

A) Sterilize growing house

After harvest wash the growing house with water and add lime to disinfect and wait at least one month before use.

Clean plastic necks and caps with soap and sundry.



STEP 12

Recording and market development

A) Record harvest date and amount

Use a book to record all harvests, problems, etc. It will help you to see if you have done well and improve for next season. Average harvest of 0.2 kg per one kg bag is regarded as very good.



B) Labels

In some cases you might add labels, so consumers can see where the mushrooms have been produced.

ເຫັດນາງລົມ

ບ້ານນໍ້າບໍ່
ເມືອງ ໂພນໄຊ - ຫຼວງພະບາງ
ໂທ: 030 9820442

1 ກລ

ສະໜັບສະໜູນ ໂດຍ
supported by
ABP: ໂຄງການຂົນສົ່ງສິນຄ້າສະໜິດ
Agri-Biodiversity Project

ເຫັດນາງລົມ

ບ້ານຫ້ວຍໂນະ
ເມືອງ ໂພນໄຊ - ຫຼວງພະບາງ
ໂທ: 020 97823921

1 ກລ

ສະໜັບສະໜູນ ໂດຍ
supported by
ABP: ໂຄງການຂົນສົ່ງສິນຄ້າສະໜິດ
Agri-Biodiversity Project



C) Signboards

If your village is producing a lot and you are close to a main road, it might be a good idea to set-up a signboard.

ECONOMY

1,000 bags

Fixed Costs

No	Fixed Production Costs	Unit	Qty	Unit cost	Total	Time used	Cost/ growing circle
1	Sterilization oil drums	Unit	2	250,000	500,000	20	25,000
2	Rack inside oil drum	Pc	2	30,000	60,000	12	5,000
3	Neck (plastic ring)	Bag	1	120,000	120,000	6	20,000
4	Cover cap	Bag	1	120,000	120,000	6	20,000
5	Watering Can	Can	1	45,000	45,000	9	5,000
6	Weight / 30 kg	Unit	1	200,000	200,000	50	4,000
7	Alcohol Lamp	Unit	1	70,000	70,000	10	7,000
8	Sisal bag	Bag	4	15,000	60,000	6	10,000
9	Bottle Sprayer	Pc	1	50,000	50,000	5	10,000
10	Thermometer	Pc	1	35,000	35,000	15	3,000
11	Big Plastic basket	Unit	1	75,000	75,000	10	7,500
12	Spade	Unit	2	56,000	112,000	16	14,000
Sub-total fixed production costs and costs per growing circle					1,975,500		130,500

Running Costs

		Unit	No	Price/unit	Total (kip)
1	Mushroom spawn (from lab)	Bottle	40	5,000	200,000
2	Saw dust (incl. transport)	kg	500	500	250,000
3	Rice bran	Kg	60	3,500	210,000
4	Broken rice	Kg	30	4,500	135,000
5	MgSO ₄ (Magnesium sulfate)	Kg	5	10,000	50,000
6	CaSO ₄ (Calcium sulfate)	Kg	5	10,000	50,000
7	Phoumai	Kg	5	10,000	50,000
8	CaCO ₃ (Calcium carbonate)	Kg	5	3,000	15,000
9	Plastic bag	Kg	5	30,000	150,000
10	Plastic sheet (cover tank)	Roll	1	100,000	100,000
11	Cotton cover	Kg	2	45,000	90,000
12	Rubber ring	Bag	1	35,000	35,000
13	Alcohol 90	Liter	1	45,000	45,000
Subtotal running costs (III)					1,345,000
1	Growing house (per season)	house	1	500,000	500,000
Total Fixed and running costs I + II + III					1,845,000

ECONOMY

The economy of oyster mushroom cultivation depends on harvest (kg) and price as shown in below example for 1,000 bags

Example:

Yield: 1,000 bags = 150 - 200 kg

Price: Per kg: 15,000 - 20,000 kip

Total income:

If total harvest 150 kg (100 x 15,000-20,000 kip):

2,250,000 kip - 3,000,000 kip

If total harvest 200 kg (200 x 15,000-20,000 kip):

3,000,000 kip - 4,000,000 kip

Profit (income – costs):

If harvest 150kg:

2,250,000 kip (income) – 1,975,500 kip (costs) = 274,500 kip (profit)

3,000,000 kip (income) – 1,975,500 kip (costs) = 1,024,500 (profit)

If harvest 200kg:

2,250,000 kip (income) – 1,975,500 kip (costs) = 1,024,500 kip (profit)

4,000,000 kip (income) – 1,975,500 kip (costs) = 2,024,500 kip (profit)

A. 1,000 bags

Harvest	Price (kip/kg)	Income (kip)	Costs (kip)	Profit (kip)
150 kg	15,000	2,250,000	1,975,500	274,500
150 kg	20,000	3,000,000	1,975,500	1,024,500
200 kg	15,000	3,000,000	1,975,500	1,024,500
200 kg	20,000	4,000,000	1,975,500	2,024,500

B. 5,000 bags

Harvest	Price (kip/kg)	Income (kip)	Costs (kip)	Profit (kip)
750 kg	15,000	11,250,000	9,877,500	1,372,500
750 kg	20,000	15,000,000	9,877,500	5,122,500
1,000 kg	15,000	15,000,000	9,877,500	5,122,500
1,000 kg	20,000	20,000,000	9,877,500	10,122,500

C. 10,000 bags

Harvest	Price (kip/kg)	Income (kip)	Costs (kip)	Profit (kip)
1,500 kg	15,000	22,500,000	19,755,000	2,745,000
1,500 kg	20,000	30,000,000	19,755,000	10,245,000
2,000 kg	15,000	30,000,000	19,755,000	10,245,000
2,000 kg	20,000	40,000,000	19,755,000	20,245,000

Additional information:

Ms. Viengkham Sengsoulivong, Mushroom cultivation expert,
Dep. Dir. of Plant Protection Center, DOA, Vientiane,

Tel/Fax: +856 21 812164

Mobile: +856 20 550 412 24

E-mail: viengkham_2007@yahoo.com

Mr. Pheng Souvanthong, NPC Agro-Biodiversity Project (ABP),

Mobile: +856 20 2244 3254

Email: pensvt@live.com

Mr. Ole. S. Pedersen, CTA, Agro-Biodiversity Project (ABP), FAO,

Mobile: +856 20 234 416 06

E-mail: olesped@gmail.com / ole.pedersen@fao.org

Ms. Chitlatda Keomongchanh, Programme Analyst, Env. Unit, UNDP,

Tel: +856 21 267 782

E-mail: Chitlatda.keomuongchanh@undp.org

Layout design: Oscar Castellanos





