



Straw mushroom (*Volvariella volvacea*) cultivation for livelihood diversification in Laos

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Summary

This technology describes the cultivation and cost-benefit analysis of straw mushroom cultivation in Laos. By diversifying agricultural livelihoods, the resilience of small-scale farmers to drought and flood risks is increased.

Description

1. Introduction

Straw mushrooms (*Volvariella volvacea*) are suitable to be planted in flood and drought risk areas.

- In flooded areas, they should be grown in baskets that can be moved. In drought-prone areas, containers should be used. If growing in a growing house, a high location should be found, so that flooding does not affect it and there is no water flowing through the area.
- In order to save water during the growing phase, a basin should be available. Soaking rice straw to make the rice straw wet will save more water than sprinkling.
- Materials for straw mushroom growing are rice straw, banana leaves or dry banana trees that have not been sprayed with pesticides or herbicides.
- Straw mushrooms can be grown in both the rainy and dry seasons, and can

improve the living conditions of farmers affected by such risks.

1.1 Choosing a suitable location

Mushrooms can be grown indoors or outdoors. The procedure for growing the mushrooms is the same.

As a first step it is necessary to find a suitable place that is easy to access and to ensure that there is no impact from flooding and/or drought. In areas affected by dry spells, the location should be near the water or near a pond. The location should be easily accessible so that the mushrooms can be moved when there is a disaster. A clean location should be selected that is free from chemicals and other substances. The arrangement of a location for straw mushroom growing depends on the growing method. If growing indoors there should be shade, not much sunlight, no harm from animals, and the ability to maintain and water easily when needed. In the dry season, a location near a water source should be found, or a water storage vessel should be made. For growing straw mushrooms, per 100 kg of rice straw, materials in Table 1 are required.



Climate Change Adaptation and Disaster Risk Reduction

1.2 Collecting the mushroom spores

Collect mushroom spores that are ready to be planted, considering that the young and older spores should not be planted. Mushroom spores are the seedlings that can be cultivated and grown in the dry season at high temperature and low moisture.

1.3 Growing method and preparation of materials

Bring the amount of straw from rice or banana leaves or dry banana tree as needed. After that, soak the rice straw in water for about 24 hours. Instead of soaking for 20 hours, the straw can also be sprayed with water until the straw is completely wet, then stacked to be the plot as appropriate.

1.4 Preparation of the location to make the stack and plot for rice straw mushrooms: stack growing form (plot)

Bring the prepared rice straw to stack into plots with a width of 40 to 80 cm, and the length as needed. The stacking in the first layer requires spreading the rice straw out to the outer edge of each side flatly. When the rice straw is spread out higher than 10 cm, use the hands to push it down or trample upon it. After stacking on the floor for 10 cm, take the dung and husks to spread on the top and spray water as in a vegetable bed, then take the thrush to spread thinly and spray water again. After that, construct the second layer and then the third and fourth. After finishing the fourth layer, cover with the rice straw and water it until it is completely wet. After that, bring plastic sheets to cover the stack to

Table 1: Materials

Items	Average amount	Remarks
Straw or stubble	100 kg	
Mushroom spore	4 bags	Be able to add more 5 to 6 bags
Rice flour	2 spoons	
Dry dung (cow or buffalo)	20 kg	Calculate the proportion of rice straw
Husks	5 kg	Calculate the proportion of rice straw
Plastic sheets with width of 140 cm	15 m	
Freshwater hyacinth or banana heart	20 kg	Calculate the proportion of rice straw
Bamboo cut into pieces	4 m	As needed
Baskets for mushroom growing		In case of growing in baskets
Stores or troughs		In case of needing the store
Water bucket	1	
Large knife	1	
Hoe	1	
Rake or harrow	1	

Source: FAO 2017



ensure that the wind will not pass through. After using the plastic sheets to cover it, take dry rice straw to cover the stack and do not allow any sunlight to get through the mushroom stack at all.

1.5 Growing as plots in the form of troughs

Growing the mushrooms in troughs will make it easier to move them compared to the plot in case of flood. Make the mushroom grow in structure by taking wood to make a pattern, of which the width is 40 cm, the length 120 cm and the height 40 cm, to facilitate easy lifting. After putting the prepared rice straw in the pattern higher about 10 cm, use the hands to push it down or trampling upon it. After the stack on the floor is about 10 cm, take dung and husks to spread on the top and spray water to wet it, then take the thrush to spread thinly and spray water again. After making stack number 4, apply the thrush and spray the water, adding more rice straw and spraying water again that completed the stack 1. The second stack should be about 25 cm from the plot 1 for the gap of mushroom growing and to be able to harvest the mushrooms. If the stacks are too far from each other, the areas will be wasted.

1.6 Growing the baskets

Growing the mushrooms in the baskets is an appropriate way in flood prone areas because they will be easy to move if there is a disaster. The baskets may be plastic baskets or wooden baskets that have plaiting similar to a net or coop to have gaps for mushroom to grow through. The baskets to plant should have a center line of 60 cm to 80 cm and a height of 60 cm. Put the prepared rice straw in the baskets higher than 10 cm, then use the hands to tightly depress it. After tightly stacking for

10 cm, use dung and husk to spread thinly and then repeat for the third. After the completion of stack 3 and stack 4, water again to complete basket 1. Basket 2 and basket 3 can stand near each other to facilitate the covering with the plastic sheets. By doing this, they can be moved and watered as needed.

1.7 Preparation of mushroom spores for the growing plots or growing stacks

The thrush is the most important part that is used to evaluate if the mushroom will grow well or not, so it should be observed that the thrush growing in the bags has full fibers beforehand and avoid using the old thrush because it can have yellow or coffee-colored fibers. Thus, the farmers should observe and pay attention to this point.

1.8 Maintenance

After inoculation, the wet straw will start to decompose which causes heat production. Three to four days after planting, it is important to check the humidity and temperature in the stacks or plots to see whether they have sufficient temperature and humidity. If there is a lack of humidity, use the watering can to water. If the nearby temperature is too hot, open the plastic cover for ventilation. If the temperature is too low, moisture them and thoroughly close them. Humidity can be observed by checking if the straw is equally wet. While the temperature can be observed by inserting a hand inside, if it is warm and has steam, then it is too hot. In addition, the follow-up and inspection of the plot shall be carried out in the morning or evening.

1.9 Harvest

When the mushrooms are large, they can be harvested, but do not let the mushrooms blossom. Mushrooms should be harvested



Table 2. The proportion of rice straw mushroom growing with 100 kg of rice straw

Items	Average amount	Remarks
Straw or stubble	100 kg	Depends on the size needed
Mushroom spore	4 bags	Be able to add more 5 to 6 bags
Rice flour	2 spoons	Spoon
Dry dung (cow or buffalo)	20 kg	Calculate the proportion of rice straw
Husks	5 kg	Calculate the proportion of rice straw
Plastic sheets with a size of 140 cm	15 m	
Freshwater hyacinth or banana heart	20 kg	Calculate the proportion of rice straw
Bamboo cut into pieces	4 m	As needed
Baskets for mushroom growing		In case of growing in baskets
Stores or troughs		In case of needing the store
Water bucket	1	Be able to use the existing materials
Large knife	1	Be able to use the existing materials
Hoe	1	Be able to use the existing materials
Rake or harrow	1	Be able to use the existing materials

Source: FAO 2017

in the morning, and the entire bunch of mushroom must be harvested. Do not leave the small mushrooms because they might become pale dry. After harvesting, the mushroom should be watered and covered by plastic tightly. For the outside of the stack, more hay should be added to prevent the sunlight.

2. Cost-benefit analysis: preliminary results for the GPO straw mushroom cultivation in Lao PDR – 2016 dry season

Straw mushroom production was introduced in small-scale farms in Lao PDR as part of the projects “Consolidating capacities for DRR in Agriculture in South East Asia” and “Institutionalizing Disaster Risk Reduction and Management (DRRM) in agriculture for enhanced resilience programming and integrated implementation across sectors”.

Straw mushrooms can be grown at very low cost, using locally available material (e.g. rice straw, cow dung). It requires little work effort and the first mushrooms can be harvested two weeks after preparing the straw beds. It is a DRR good practice technology for small-scale farmers during the dry season, when lack of water often prevents them to grow rice. Indeed, straw mushroom production requires little amount of water, thereby reducing vulnerability to dry conditions. During the 2016 dry season, the performance of this DRR good practice technology was monitored in 42, 24 and 26 farms in the Khammouane, Champasak and Savannakhet provinces respectively. None of the farms experienced hazard conditions during the monitoring period. The results of the qualitative and quantitative analyses conducted based on



field demonstration data are summarized hereafter.

2.1 Cumulative net returns over 11 years

The net benefits obtained from the good practice were valued through a cost-benefit analysis (CBA) based on quantitative data collected during the monitoring period in the 2016 dry season. The CBA projects the cumulative net present value of benefits obtained from an average mushroom house in the analysed area (6 straw beds) over a period of 11 years. A 10 percent discount rate is applied to express the future value of costs and benefits in present terms. The benefit-cost ratio (BCR) is the ratio between total discounted benefits and total discounted costs over the appraisal period. Since straw mushroom cultivation was not previously practiced in the monitored farms, control plots were not available to conduct a comparative analysis. As an alternative, the opportunity cost of agricultural labor was used, i.e. the income foregone by not employing the labor used for straw mushroom production elsewhere. Results from the dry season show that net benefits from straw mushroom production under non-hazard conditions are about 98% higher than the opportunity cost of labor under non-hazard conditions.

Figure 1 and Figure 2 provide an overview of the outcome of the CBA. In particular, it shows that:

- In the dry season and under non-hazard conditions (Figure 1), the net benefits of mushroom growing in an average mushroom house (6 straw beds) over 11 years are about two times higher than the opportunity cost of labour. The BCR is 1.74.
- Figure 2 shows the breakdown of costs and benefits accounted in the analysis.

Figure 1: Cumulative Net Benefit of Good Practice (straw mushroom production) and Opportunity cost of labour in farms not affected by hazards – 2016 Dry Season

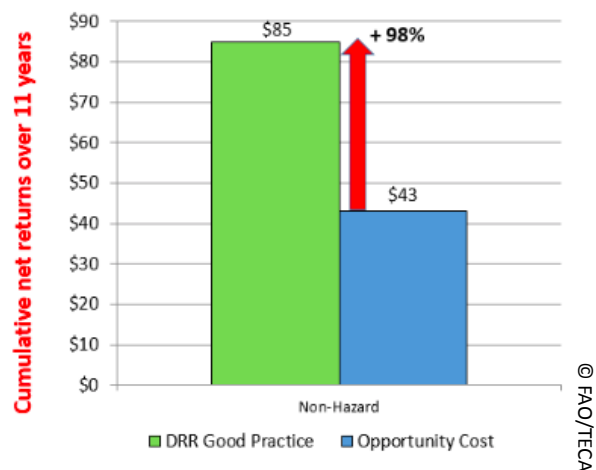
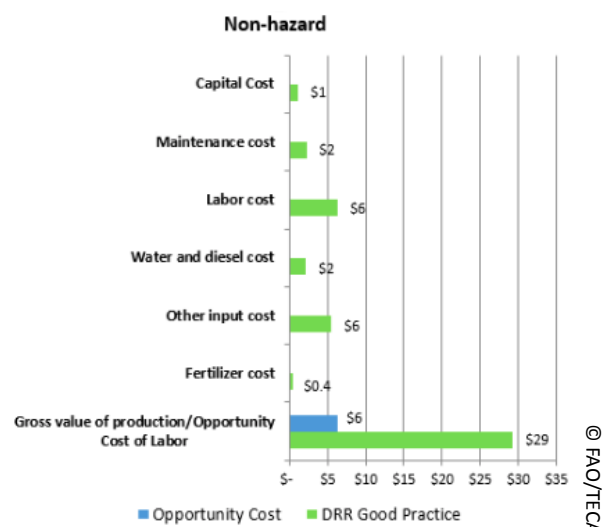


Figure 2: Costs and benefits of mushroom production, as compared to Opportunity Cost of Labor (USD per year) - 2016 Dry Season



2.2 Benefits and losses

2.2.1 Economic

Under the condition of absence of natural disasters, the net yield of straw mushroom production doubles compared with the opportunity costs of other agricultural activities. When the production is not affected by natural disasters, approaches to avoid losses cannot be measured nor analyzed.



2.2.2 Environmental

Growing straw mushroom needs less water compared with some other crops. This approach improves the flexibility in the dry season and sustainable water management.

3. Validation of the practice

3.1 Geographical area of practice validation

In the dry season of the year 2015 to 2016, there were appropriate pilot activities in three target provinces: 42 families in the Xebangfai district, Khammouane Province; 24 families in the Xaybouly district, Savannakhet Province and 26 families in the Sanasomboun district, Champasak Province. While following up and inspecting, the results of qualitative and quantitative analyses were conducted according to the data from the diagnostic site.

3.2 Additional benefits of growing mushrooms

3.2.1 Sustainability

100 percent of the 92 farmers that tested straw mushroom growing are planning to continue the activity during the next dry seasons. 72 percent say that straw mushrooms are “easy to grow”.

3.2.2 Socio-economic benefits

80 percent of farmers found that mushroom cultivation required low amount of inputs and less labor effort.

3.2.3 Environmental/natural resource management co-benefits

60 percent of farmers affirmed that mushrooms can be grown using limited amounts of water.

3.2.4 Additional needs

93 percent of farmers raised the need to receive more trainings on mushroom

cultivation, as well as to visit other villages to exchange knowledge and practices.

3.3 Farmers reactions

All farmers interviewed declared that they would be willing to replicate this disaster risk reduction (DRR) good practice technology in the next seasons. 72 percent of the farmers explicitly mentioned that straw mushrooms are “easy to grow”. They reported that growing straw mushrooms is a good practice because of low investment needs (inputs and labor), and they are able to have a production and income during the dry season. Furthermore, 79 percent of all farmers noted that mushrooms need less water than other crops, and about 80 percent appreciated the reduced labor efforts required. Finally, about 60 percent of farmers stressed that mushrooms contributed to diversifying their diets.

None of the farmers highlighted any unintended effect of this DRR good practice technology. However, some farmers raised the need to get additional training on how to effectively commercialize mushrooms.

4. Related/associated technologies

- Indoor mushroom production for livelihood diversification, Lao PDR.

5. Agro-ecological zones

- Tropics, warm

6. Objectives fulfilled by the project

6.1 Resource use efficiency

Straw mushrooms cultivation requires a limited amount of water compared to other crops, thereby enhancing resilience during the dry season and sustainable water resources management.