

# Oyster Mushroom Cultivation

## Part I. Mushrooms

### *Chapter 2*

#### Mushroom Growing for a Living Worldwide

## **MUSHROOM PROJECT IN SWAZILAND** **A Government Initiated Mushroom Bag Distribution Center**

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Through the four articles about Nepal, Zimbabwe, India, and Thailand, it has been emphasized how profitable and appropriate mushroom growing is for poverty alleviation. However, its application is another story. Let us have a closer look on the difficulties in performing mushroom project.

Mushroom projects for poverty alleviation have been carried out in many countries with support from various international and local organizations. Each country or region has conducted its own mushroom projects using different methods or systems according to its particular situation. In some countries the government has initiated mushroom projects by inviting consultants from overseas and attracting funds from various organizations (**government-initiated case**). In other countries, several pioneer farmers have produced substantial profits from their mushroom growing and therefore mushroom growing has become popular among other farmers as well, and at this point the government has started to pay attention to mushroom growing and support it (**grower-initiated case**). Both models have their strong points and weaknesses.

Most mushroom projects carried out in African countries can be categorized as government-initiated projects. Nevertheless, they can be also divided into two types. Some programs emphasize training for each grower and financially and technically support them to grow mushrooms by themselves. In other cases government agencies perform key production steps such as spawning and incubation in order to manage the projects. It would be difficult to say which is the better method, but examination of both cases will help project planners when they choose the best methods for their own situations. To help illustrate this point, a mushroom growing project in Swaziland will be described in which the government initiated the project and was in control of the key production systems. Management team of this project performed research to find the most suitable substrate materials, supplied them to growers, produced spawn-impregnated bags, and educated farmers in the management of growing houses.

### **Kingdom of Swaziland**

Swaziland (Fig. 1) might not be a familiar country to some readers. It has a short history as a modern country, as it

only became independent from England in 1968. In general, Swaziland is a beautiful country with green hills and many cattle. Some call it the 'Switzerland in Africa' (Fig. 2, 3). The climate is moderate, ranging from subtropical to temperate depending on the altitude. As one can see from its formal name, the Kingdom of Swaziland, the king has a firm grip on the country. Though people have the right to vote for one of the cabinets by election, the king appoints the Prime Minister and two-thirds of the country's parliament, and some important government positions are always filled by members of the king's family, known as the Dlamini.



Figure 1. Kingdom of Swaziland

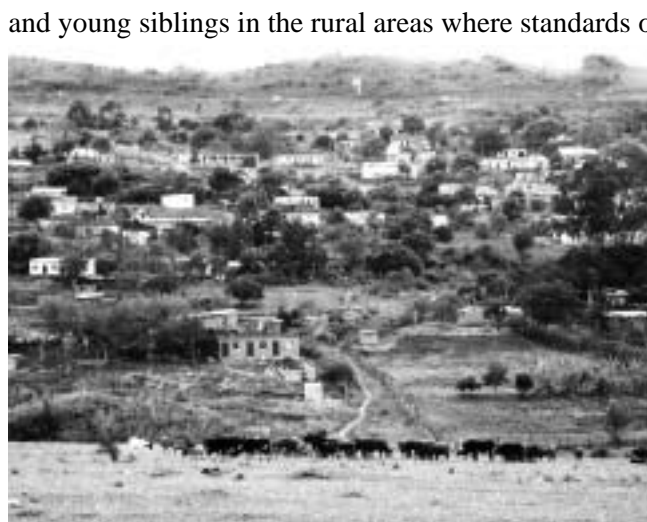


Figure 2. Swaziland-'Switzerland in Africa'



Figure 3. Traditional houses in Swaziland



Figure 4. Students after school



Figure 5. A girl selling fruit on the street

Though Swaziland is not categorized among the least developed countries in the world, the peoples' standard of living is quite low, especially in rural areas (Fig. 5). The GDP per capita was USD4,200 in the year of 2001, and the major industries are sugar, mining (coal and asbestos), wood pulp, agriculture, and the production of soft drink concentrates. It produces a large amount of agricultural wastes such as sugarcane bagasse, corncobs, and other crop refuse. It has several factories in Matsapha and most of the investment capital comes from Taiwan.

Like other African countries, Swaziland has a high percentage of its population living with HIV-AIDS, and even more suffering from chronic malnutrition. Most young adults live in the cities, having left their parents and young siblings in the rural areas where standards of living are far lower than that of cities.

## The Beginning of Mushroom Project

This mushroom growing project in Swaziland was initiated by the king. The king had visited mushroom farms in Thailand and decided in 2000 to start a mushroom project in Swaziland. The king dispatched five persons to a mushroom training center in Thailand, and invited Thai mushroom consultant Anon Auetragul to Swaziland. Anon has had a great deal of consulting experience in the last 20 years with mushroom projects in many Asian and African countries. Anon stayed in Swaziland for six months and taught cultivation technology and production skills to local mushroom growers. He helped perform the research to find appropriate substrate materials, established the distribution center for spawn-impregnated bags, introduced the mushroom growing system used in Thailand, and applied it to the situation in Swaziland. During the course of his stay some local Swaziland people were trained in mushroom workshops that were held for 2 weeks in Shanghai and later in training courses held in Namibia and Malawi. From 2000 to 2002, there were a variety of activities, preparations, and investments made in the local mushroom industry.

Malkerns Research Station was the key facility for this project. It performed research on the preparation of cultures and produced grain spawn from the 3 available oyster mushroom strains. Many mushroom growing research projects were started. The most important were experiments to find the most appropriate substrate materials in this country. They had imported rubber tree sawdust, the main substrate material in Thailand as a control substrate material, and experimented to identify suitable local substrate materials and mixes. Five promising substrate mixes were selected for further observation, for all of which fresh bagasse was the main substrate component. Because bagasse is waste from the sugarcane factories, the growers could get it for free.

## Malkerns Research Station-Mushroom Bag Distribution Center

As briefly mentioned above, the bag distribution center is one of the most important features of the mushroom project of Swaziland. Preparation of substrate, bagging, sterilization, and incubation are all done in this distribution center. A mixer (Fig. 7) and a bagging machine were imported from Thailand because it would have required a great deal of time to produce these machines locally. Two sterilizers (Fig. 9) were locally made within 6 months.

### Distribution Center of Spawn-impregnated Bags



Figure 6. Place for preparation and mixing



Figure 7. Imported mixer for substrate materials



Figure 8. Mushroom bags after bagging



Figure 9. Locally made sterilizers for bags



Figure 10. Inside sterilizer



Figure 11. Inoculation room



Figure 12. Incubation room (temp. controlled)-various Sizes of bags are incubated



Figure 13. Various cultures in storage inside refrigerator



Figure 14. Inside experimental growing house

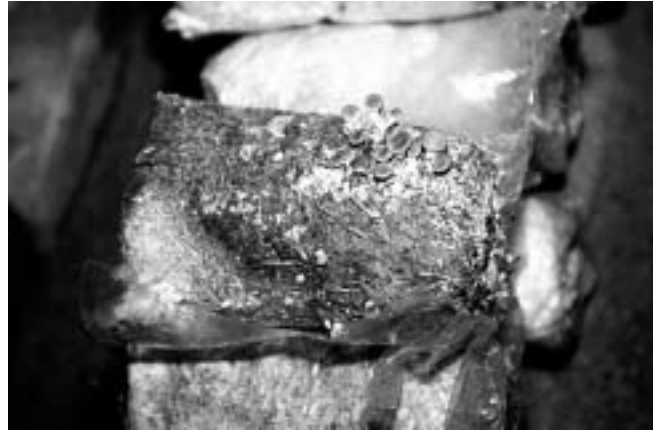


Figure 15. Oyster mushrooms on grass substrate

Figure 16, 17. shiitake and *Ganoderma* mushroom in experimental growing house

Figure 18, 19. Plants cultivated on spent substrate of oyster mushroom

The mushroom bag distribution center established the following oyster mushroom production system; the substrate materials were mixed using the mixer (Fig. 7) and the mixed material was put into bags (Fig. 8) with the bagging machine. The bags were all imported from Thailand, and needed to be heat-resistant as they were sterilized in sterilizers after bagging (Fig. 9, 10). After being sterilized, they were delivered to the inoculation room (Fig. 11). After being cooled down, the bags were carried to the incubation room where the temperature was controlled by an air conditioner (Fig. 12). During incubation, any contaminated bags were destroyed, and finally, well-incubated mushroom bags were distributed to farmers for free. The farmers then watered the bags and controlled the environments of their growing houses and harvested mushrooms.

The distribution center also had its own growing house for research (Fig. 14) and storage for substrate material. The center distributed only bags of oyster mushrooms (Fig. 15), but they are also growing shiitake (Fig. 16) and *Ganoderma lucidum* (Fig. 17) on an experimental scale. They have also done research on the use of spent mushroom substrate (SMS). Spent substrate of oyster mushroom contains a high amount of nutrition in comparison with other fertilizers (see ‘recycling of Spent Oyster Mushroom Substrate’ at Chapter 9). In front of the growing house, they were growing cucumbers, spinach, and eggplant on the SMS-fertilized field (Fig. 18, 19).

## Two Pilot Export Production Villages (EPVs)

As sites for a pilot project, two export production villages were selected (Fig. 20), each with a different environment and then distributed mushroom bags to the farmers in these regions for free. One village is Siphofaneni in the East where they have somewhat dry weather and the other is Mbangweni (Fig. 21) in the South, where they have a relatively high humidity. The project aimed to find the appropriate growing methods for each region as well as the differences between the fruiting bodies of mushrooms produced in both regions. To begin, the distribution center supplied 300 mushroom bags to about 50 farmers in each village. The center began to distribute spawn-impregnated bags to farmers in March 2001, and it had distributed about 20,000 bags by the end of the year 2002, including 2,000 spawn-impregnated bags imported from Thailand.



Figure 20. Map of Swaziland

The recipients of the bags were expected to keep a complete daily record on numbers of supplied bags, weather, the amount of watering and harvesting, income, and any other observations made within their growing houses. Some of the farmers successfully managed their growing houses until their bags were exhausted after 3 months. Some of the substrate mixes tried did not give good results and produced only minimal harvests. On average, a farmer earned SZL\*300 (USD45.57) per month from the 300 bags supplied from the distribution center. Though the number of supplied bags was limited to 300 bags per farmer, they considered this income reasonable because they got the bags for free.

Oyster mushroom samples were distributed to NAMBOARD (National Agricultural Marketing Board of the kingdom of Swaziland) and some catering companies in order to establish product market acceptance, and NAMBOARD was impressed by this mushroom product. However, they couldn't create a formal market for mushrooms because of the limited production capacity and erratic supply. Instead the farmers created informal market channels by themselves and sold their mushrooms through those relationships.

What the farmers at Mbangweni accomplished was particularly noteworthy. They established markets at Nhlangano and supplied mushrooms at the price of SZL20 (USD3.04) per kg, which brought them a fair income. They are now in an advanced stage in the construction of a mushroom center with an office, mushroom storage facilities, a packing room and a processing room (Fig. 22). Encouraged by their success, the government provided additional training in business management for the Mbangweni farmers.

Unfortunately, the farmers at Siphofaneni had difficulties in mushroom growing due to their dry climate and unfavorable market conditions. It was quite difficult for them to access clean water for use in their mushroom cultivation activities. Encouragingly, eight of the farmers from the group managed to install piped water systems for watering their mushrooms.

Demonstration mushroom cropping houses were initially constructed and then each of the farmers constructed

\* SZL (Swaziland Lilageni, SZL1 = USD0.1519 in Feb. 2004)

their own houses by themselves (Fig. 23, 25). The growing houses were made of logs and thatched grass (Fig. 26), but these growing houses were not sufficiently durable. They deteriorated quickly and did not allow the farmers to regulate important growing parameters such as temperature and humidity. The use of more efficient and durable materials such as plastic sheeting and bricks were recommended. At Siphofaneni during the dry weather cattle and goats were very hungry due to lack of grasses, so sometimes they ate the grasses of the growing houses! This was the fate of the mushroom farm that we visited in Siphofaneni. The farmer then borrowed a plastic sheet from his friend and surrounded the growing house (Fig. 25). He kept a record of numbers of supplied bags, weather, the amount of watering and harvesting, income, and changes in the growing house everyday (Fig. 27) until he received the last mushroom bags in April of 2003.

### Mbangweni EPV in South



Figure 21. Mbangweni EPV



Figure 22. Mushroom center for storage, packing, processing (under construction)



Figure 23. Growing house at Mbangweni



Figure 24. Oyster mushroom bags inside

### Siphofaneni EPV in East



Figure 25. Growing house with plastic sheet  
-cattle ate grasses (the materials of the house)



Figure 26. Inside growing room made by logs  
and grass-the roof



Figure 27. Mushroom farmers with records book  
on her hand



Figure 28. Inside the growing room-mushroom bags

### Problems of the Mushroom Project

The activities of the farmers in this mushroom growing project were hindered by unexpected problems: suspension of sugarcane bagasse supply and lack of financial support. Notably, the sugarcane mills stopped supplying sugarcane bagasse in late 2002. Sugarcane bagasse had been previously thrown away by the factory, so the distribution center could get the substrate material for free. However, the factory had stopped disposing of the bagasse after they found that their waste could be utilized by the mushroom industry. This caused a serious problem for the project, and the distribution center was no longer able to produce mushroom bags. The center then asked the factory to sell them bagasse, and the factory replied that it would set the price of bagasse, but in the meanwhile it used all the available bagasse as fuel. The center had to find new substrate material to replace bagasse, and this required additional research.





Figure 29. Substitute material -grass



Figure 30. Substitute material -corncobs



Figure 31. Farmers at Mbangweni maintain their growing-houses anticipating mushroom bags



Figure 32. Inside growing house in Mbangweni

At this point, the center faced a critical lack of funding. UNDP Swaziland, the custodian of the finances for the project, now blocked funds from the ZERI Regional Project, refusing to support endless research without considerable results. The center was forced to stop the distribution of mushroom bags in April of 2003 and have since produced only a small amount of bags for substrate substitute research. One alternative substrate mix included hay from Bermuda grass obtained from the Highveld, other mixed grasses from the Lowveld (Fig. 29), with added corncobs (Fig. 30). Among other sad news, the center also now needs to establish new facilities to prevent the high contamination rate (20%) of bags. They believe they could lower the contamination rate if they had better facilities and a temperature control system in the inoculation room and all this requires considerable new funding.

Since the center stopped distributing mushroom bags, the farmers have been maintaining their growing houses and waiting for the distribution of new bags (Fig. 31, 32). With extension workers we visited Mbangweni, one of the export production villages. The farmers there were upset that the center is no longer providing mushroom bags. Most of the farmers are very poor and starving. But without additional funding for the distribution center, there seems to be no way to resume its operation.

UNDP Swaziland, which witnessed a considerable amount of money being used up with few satisfactory results, now has another idea in mind, something different from a distribution center controlled by the governmental sector. UNDP Swaziland believes a mushroom project at the farmer's level would provide better results, as projects do in other African countries such as Uganda. Their theory is that they need to educate farmers and let them do the research by themselves to find appropriate and economically feasible substrate materials. The agriculture and environment varies from region to region, so appropriate substrate materials and efficient growing

methods will also be different according to region. Farmers would learn from others' experience as well as their own. Moreover, they would be more active in finding better growing methods because they would be working for their own poverty alleviation. Now, growers in Swaziland are helpless and can do nothing for themselves when facing difficulties because they have very little knowledge about mushroom growing. Once educated about the fundamentals of mushroom growing however, they would do whatever they could in time of difficulties instead of waiting for mushroom bags helplessly. UNDP Swaziland believes this bottom-up system will make new mushroom projects more powerful and energetic.

### **Mushroom Project: Top-down vs. Bottom-up**

Although it could be a controversial topic for discussion, and we have many unanswered questions, we can learn a lot from this mushroom project in Swaziland. If the bags are well incubated, fruiting and harvesting is not a difficult job. Most techniques and know-how are concentrated in the distribution center while the farmers' jobs in this case don't require much skill. This system is more effective and productive if the government manages the mushroom growing as farmers have little knowledge about mushroom cultivation. Unlike the situation in Asia, which has a long history of mushroom growing and consumption, here in Africa the people have very little knowledge about mushroom cultivation. Most people even don't know what mushrooms are, so it could take a relatively long time for farmers to learn the whole process of mushroom growing. Moreover, Swaziland has enough agricultural extension workers to support farmers in practical ways. Therefore, the top-down system could be the best for Swaziland.

On the other hand, this top down system has a crucial weak point. If the center stops, everything stops, as one can see in the current situation of Swaziland. If they had focused on teaching farmers the whole process of mushroom growing, they could have produced mushroom bags by themselves like mushroom farmers in other countries when faced with these kinds of difficulties.

We all know the government distribution center and UNDP Swaziland have both done their best. Moreover, they have the same goal of facilitating mushroom growing as a means of poverty alleviation. We believe they could cooperate in striving for this goal. If they did, then Swaziland could try to encourage mushroom growing in two levels. The distribution center could be operated by the government, and could sell mushroom bags to growers, and the project could include a new strategy by investing funds in education at the farmers' level. Then both sides could cooperate, which would further promote mushroom growing in Swaziland. Though they resume the mushroom project by focusing education on farmers, distribution center itself and what have been already invested into it including money, time, research, teamwork should not be wasted.

In spite of the current stall in the situation in Swaziland, this mushroom project has appreciable implications for their efforts toward poverty alleviation. It is also expected that their cooperative efforts will hopefully bear fruit even if the future project adopts a different strategy. We still believe that mushroom growing will be an effective strategy for poverty reduction in the near future of Swaziland.