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POTENTIALS AND CONSTRAINTS OF MUSHROOM PRODUCTION IN ETHIOPIA



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ABSTRACT

The use of mushrooms as food is probably as old as civilization itself and mushrooms have been treated as a special kind of food. Currently, mushroom farming is being practiced in more than 100 countries and its production is increasing at the rate of 7 per cent per annum. Production of mushroom has already crossed 6 million metric tons annually in the world and is expected to reach around 7 million metric ton in the next ten years. The world market for the mushroom industry in 2005 was valued at over \$45 billion. Ethiopia has suitable climatic factors that favor the production of mushrooms with slight modification of the growing environment. The availability of cheap labor for labor intensive tasks and the abundant agricultural residues for mushroom cultivation, and the ease use of alternative production options for marginal and small scale producers are amongst the opportunities. However, the production and marketing of mushrooms in Ethiopia is at an awareness creation stage. As a result the country is not benefited from mushrooms as the rest of the world. This is mainly because of the following constraints that exist in the country long before. Mushroom growing is one of the most science-based branches of agriculture and horticulture. It is a large, sophisticated, competitive and capital-intensive industry. Together with these, lack of concept and skill on production technology, lack of research, extension, and adaptation works, lack of appreciation about the food and dietary importance of mushrooms, low infra structural development, low level of information supply both on production and marketing aspects, and the monotonous traditional diets and the conservative eating habit of the people may be a few of the impairments that constrained the introduction of this industry into the country. Nevertheless, presently, there is a considerable level of awareness and interest among certain groups of the society for mushroom production. As part of its agricultural research and extension work, the Haramaya University has initiated a project on "Development and Transfer of Mushroom Production Technology to Rural Poor and Marginal Farmers of Ethiopia" in 2004/05. Furthermore, there are few pioneer fresh mushroom growers around Addis Ababa, who can be paradigms for the newly emerging producers. Smaller cafes and restaurants serve mushrooms as condiments and pizza flavoring though the scarcity of fresh mushrooms is common. Last but not one, the construction of cargo terminal at Bole airport and the opening of an industrial unit that produce packaging materials and amendment of Investment code by the government with the aim of encouraging the involvement of foreign and local investment remain as remarkable features worth to mention. In view of this, for those who have the courage, success is expected if they follow the chief considerations for establishment of the farm, production, processing and/or packaging, and marketing of fresh and processed mushrooms. Therefore, although the current status of mushroom production and marketing in Ethiopia seem deterring, there exists a satisfying and rewarding opportunity for whom with the commitment to get it right.

1. INTRODUCTION

The use of mushrooms as food is probably as old as civilization itself (Chaube, 1995) and mushrooms have been treated as a special kind of food (Tripathi, 2005). Today, approximately 14,000 described species of the 1.5 million fungi estimated in the world produce fruiting bodies that are large enough to be considered as mushrooms. The world market for the mushroom industry in 2005 was valued at over \$45 billion (Chang, 2006).

Presently, mushroom farming is being practiced in more than 100 countries and its production is increasing at the rate of 7 per cent per annum. Production of mushroom has already crossed 6 million metric tons annually in the world and is expected to reach around 7 million metric ton in the next ten years (Bhupinder and Ibitwar, 2007).

Ethiopia has a favorable climate, comparatively abundant land and labor as well as reasonably good water resources that created ample opportunities for horticulture production. The range of altitude, temperature, and soil variability of the country has created an enormous ecological diversity and a huge wealth of biological resources. However, the production and utilization of mushrooms in Ethiopia is neglected. As a result this country is not benefited from mushrooms as the rest of the world. This is mainly because of the following constraints that exist in the country long before.

This is mainly because of the following constraints that exist in the country long before. Mushroom growing is one of the most science-based branches of agriculture and horticulture. It is a large, sophisticated, competitive and capital-intensive industry. Together with these, lack of concept and skill on production technology, lack of research, extension, and adaptation works, lack of appreciation about the food and dietary importance of mushrooms, low infra structural development, low level of information supply both on production and marketing aspects, and the monotonous traditional diets and the conservative eating habit of the people may be a few of the impairments that constrained the introduction of this industry into the country.

Though the current status of mushroom production and utilization seem deterring, it is a satisfying and rewarding opportunity for those with the commitment to get it right. Thus, apart from the constraints mentioned, there are good opportunities that can be taken as the precursor of the products excellent future this country. Among these, the following are described just to mention a few.

Mushroom cultivation is based on recycling of agricultural residues, which are available in huge amount in every corner of the country. The availability of alternative production options for

marginal and small scale producers is a good opportunity for those interested to engage in small scale level.

Initiation of development and research projects on low cost production of mushrooms by different bodies of the country, the increasing level of awareness and interest among certain group of the society about mushrooms production, and the emergency of few mushroom growers in Addis Ababa are indications of the products good future. Today, one may encounter the rarely occurring mushrooms even in smaller cafes and restaurants served as a condiments and pizza flavoring, although there shortage is remained unresolved.

There is high demand of fresh mushrooms in the market that surpasses the current supply and the concomitant high prices of imported canned mushrooms have made the cost of mushrooms beyond the reach of average consumers.

On the other hand Ethiopia is among the countries in the world malnutrition is one of the major factors responsible for high mortality and morbidity in the country. As reported in government study (Ministry of Health [MOH], 2005), health problem of the majority of the population of Ethiopia stem from lack of adequate and balanced diet. Children, pregnant women, lactating mothers, adults; generally all the persons of all age groups, male and female are victims of this problem.

Good news is the comparison of nutritional indexes shows that high value mushrooms rank above all the vegetables and legumes except soybeans (Tripathi, 2005). Edible mushrooms are usually considered to be highly nutritive and are rich sources of highly digestible protein, essential and nonessential amino acids, Vitamin B-Complex, carbohydrates, and minerals. That is why, in some developing countries such as India, national agricultural development programs are focusing on the need to increase the production of mushrooms in order to increase their proportion in the daily food ration. In view of these, mushrooms will play an important role in solving the dire need of food and balanced diet in Ethiopia. Therefore, although the current status of mushroom production and marketing in Ethiopia seem deterring, there exists a satisfying and rewarding opportunity for whom with the commitment to get it right.

Objectives of this paper are:

- To assess and elucidate the potentials, opportunities and constraints of mushroom production in Ethiopia
- To recommend some corrective measures, important considerations and actions to be taken for the ease introduction and adaptation of mushroom production technology.

2. ECONOMICS OF MUSHROOM CULTIVATION

Mushroom cultivation is a highly technical and skilled activity. It involves investment depending on the size of the unit/production targets. In most developing countries like India, mushroom growing is a seasonal activity for marginal and small farmers around cities. These farmers prepare compost either by long method or purchasing from composting units and sale fresh mushroom in nearby market or on to the canners of the locality.

On the other hand in most countries, the commercial large scale, year round mushroom production units, are equipped with composting, growing, spawn production and processing units. These producers sale their products for domestic consumption and external markets mostly in canned and partially in freeze dehydrated form (Singh and Chaube, 1995). Only about 45% of mushrooms produced are consumed in the fresh form. The rest of the 55% is processed with 5% in the dehydrated form and 50% in the canned form. This is because their shelf life in the fresh form is very short. Hence mushrooms are traded in the world market mostly in the processed form (India Agronet, 2000).

However, the commercial production of horticultural crops is not evenly distributed over agricultural regions but tends to be concentrated in limited areas of the world. Horticultural geography deals with the distribution of the industry and is concerned with the environmental, economic, and social factors that determine its location and development (Janick, 1986).

Thus, geographical location is one of the most important factors determine the success of small scale mushroom growers. The peripheries of big towns, cities, and metropolitans enable them to market their produces in fresh form which is otherwise fresh mushrooms perish before they reach distance markets (Singh and Chaube, 1995).

To this end, the government and other pertaining bodies should give incentives and trainings to farmers, unemployed youth and other economically back-ward families for setting up units in villages close to such location. Support to investors who would like to invest their knowledge and money is incontrovertibly expected from the central and local government functionaries so as to promote large scale production of mushrooms both for domestic and export market.

2.1. Food value of mushrooms

The use of mushrooms as food is probably as old as civilization itself (Chaube, 1995) and mushrooms have been treated as a special kind of food (Tripathi, 2005). Greeks believed mushroom provides strength in battle. The Chinese treasured mushrooms as a health food the elixir of life. Romans regarded it as food of the gods (Tripathi, 2005). The Egyptians regarded them as food for Pharaohs (Chaube, 1995).

Mushrooms have been recognized by FAO as food contributing high protein in nutrition. Mushrooms usually contain 20-30% protein (about 3% on fresh weight basis) which is higher than most of the vegetables. Quality of mushroom protein is superior to that of vegetable protein (Bhupinder and Ibitwar, 2007). The proteins have high digestibility.

Mushrooms are rich in essential amino acids that cannot be synthesized by our body as well as the most commonly occurring non-essential amino acids. In mushrooms, starch is absent. Moreover, cholesterol and the sterol known to be dreaded for heart patients, remain absent in mushrooms. Mushrooms are rich in Vitamin B-Complex and they contain Vitamin C. The vitamins are well retained during cooking, canning, drying and freezing (Chaube, 1995). Fresh mushrooms contain relatively large amount of carbohydrate (4-5%) and fiber. And they contain significant amount of phosphorous, sodium and potassium with lesser amount of calcium and iron (Tripathi, 2005).

In Ethiopia the 29% malnutrition prevalence among lactating mothers, the 5-15% prevalence of vitamin deficiency diseases among the pregnant women, the 30% prevalence of iodine among the general population and the 58% child death rate are due to malnutrition (MOH, 2005).

According to the 2000 CSA study, more than 50% of Ethiopian children have not grown to the level they are expected to grow, 47% of them have weight below the standard weight set for their age and 11% are extremely malnourished. Surplus food producing areas are also among the areas where problem of malnutrition is predominantly seen. As a result of this half of all pre-school children are deprived of normal nourishment, which causes various physiological disorders and leads to mental and physical retardation. Therefore to this end it is apparently clear that mushrooms will play an important role in solving the dire need of food and balanced diet in this country.

2.2. Present scenario of world mushroom cultivation

Production of mushrooms worldwide has been steadily increasing, mainly due to contributions from developing countries such as China, India, and Vietnam. There is also increasing experimentally based evidence to support centuries of observations regarding the nutritional and medicinal benefits of mushrooms. The value of mushrooms has recently been promoted to tremendous levels with medicinal mushrooms trials conducted for HIV/AIDS patients in Africa, generating encouraging results (Chang, 2006).

From the world production figures, it is evident that *Agaricus bisporus* contributes about one third of the total production followed by Shiitake and *Pleurotus species*. Some years earlier, the trend and the demand of oyster and wood ear mushrooms have shown appreciable increase. In

most cases, the total production of different species of mushrooms has increased more than 5 times during the last 20 years (Tripathi, 2005).

Now a day, mushroom is being cultivated in more than 100 countries with an estimated annual product of around 6.6 million tons. The Europe shares about 55%, North America about 27% and Eastern Asia produces about 14% of world production. Remaining percentage of mushroom is produced in other parts of the world (Tripathi, 2005).

Technological developments in the mushroom industry in general have witnessed increasing production capacities, innovations in cultivation technologies, improvements to final mushroom goods, and utilization of mushrooms' natural qualities for environmental benefits (Chang, 2006). However, there is always the need to maintain current trends and to continue to seek out new opportunities. The challenge is to recognize opportunities such as increasing consumption capabilities with the increase in world population and to take advantage of this by promoting the consumption of mushrooms.

Table 1 World production of cultivated edible and medicinal mushrooms in different years (Chang, 1999)

Species	1981		1986		1990		1994		1997	
	Fresh wt x 10 ³		Fresh wt x 10 ³		Fresh wt x 10 ³		Fresh wt x 10 ³		Fresh wt x 10 ³	
	Tons	%	Tons	%	Tons	%	Tons	%	Tons	%
<i>Agaricus bisporus/bitorquis</i>	900	71.6	1,227	56.2	1,420	37.8	1,846	37.6	1,955.9	31.8
<i>Lentinus edodes</i>	180	14.3	314	14.4	393	10.4	826.2	16.8	1,564.4	25.4
<i>Pleurotus spp.</i>	35	2.8	169	7.7	900	23.9	797.4	16.3	875.6	14.2
<i>Auricularia spp.</i>	10	0.8	119	5.5	400	10.6	420.1	8.5	485.3	7.9
<i>Vovariell volvacea</i>	54	4.3	178	8.2	207	5.5	298.8	6.1	180.8	3
<i>Flammulina velutipes</i>	60	4.8	100	4.6	143	3.8	229.8	4.7	284.7	4.6
<i>Tremella spp.</i>	-	-	40	1.8	105	2.8	156.2	3.2	130.5	2.1
<i>Hypisizygos spp.</i>	-	-	-	-	22.6	0.6	54.8	1.1	74.2	1.2
<i>Pholiaota spp.</i>	17	1.3	25	1.1	22	0.6	27	0.6	55.5	0.9
<i>Grifola frondosa</i>	-	-	-	-	7	0.2	14.2	0.3	33.1	0.5
Others	1.2	0.1	10	0.5	139.4	3.7	238.8	4.8	518.4	8.4
Total	1,357.2	100	2,182	100	3,763	100	4,909.3	100	6,158.4	100
Increasing %			73.6		72.5		30.5		25.4	

3. POTENTIALS, OPPORTUNITIES, AND CONSTRAINTS OF MUSHROOM PRODUCTION IN ETHIOPIA

3.1. Potentials and opportunities of mushroom production in Ethiopia

- i. Mushroom cultivation is based on recycling of agricultural residues, which are available in huge amount in every corner of the country;
- ii. The availability of alternative production options for marginal and small scale producers;
- iii. Cheap labor even cheaper than most African countries for labor intensive tasks such as composting, pasteurization, and spawn inoculation;
- iv. As part of its agricultural research and extension work, the Haramaya University has initiated a project on “Development and Transfer of Mushroom Production Technology to Rural Poor and Marginal Farmers of Ethiopia” in 2004/05. Under this project training on low cost production of mushrooms is being undertaken for rural farmers, urban youth and other interested group of the society (Pant, personal communication, August, 2007);
- v. Some governmental and non governmental organizations in Amhara region such as Effort Amhara is working on the possibility of technology transfer to the youth (Ephrem, personal communication, April, 2008);
- vi. Currently there is a considerable level of awareness and interest among certain group of the society as to the importance of mushroom production in our country;
- vii. Today, one may encounter the rarely occurring mushrooms even in smaller cafes and restaurants as a condiments and pizza flavoring;
- viii. Few mushroom growers are growing especially oyster mushroom in Addis Ababa, which is an indication of the products good future;
- ix. The construction of cargo terminal at Bole airport and the opening of an industrial unit that produce packaging materials;
- x. Cultivation of fresh mushrooms is an untouched and wholly vacant business sector in Ethiopia and it is a highly lucrative type of business for those who dare it;

- xi. Demand of fresh mushroom in Addis exceeds the supply. In Ethiopia there is no commercial mushroom farm that can reach the demand of large cities and towns. According to the market survey conducted in 2006/07 in Addis Ababa, supply of fresh mushrooms is close to zero. As a result the existing few fresh mushroom producers in Addis could not meet the demand of the market. Because of this, certain supermarkets in Addis Ababa import chemically preserved mushrooms at higher costs and sell at higher prices that would be complemented on the ultimate consumers. As Addis Ababa is the center of large number of international, continental, national and regional institutions and organizations, and the seat of Diplomatic missionaries, high demand of mushrooms is incontrovertible. This is an opportunity in promoting mushroom production technology in Ethiopia;
- xii. Amendment of Investment code by the government with the aim of encouraging the involvement of foreign and local investment; the government supports entrepreneurs who wish to engage in exportable agricultural produces in supplying loans and other incentives; and
- xiii. Suitable climatic factors that favors cultivation of mushrooms with little modification of the growing environment.

In order to support this view, let us have a close look at the temperature requirement (Table 2) of the *Agaricus* and *Pleurotus* species for our purpose. These five edible fungi viz. *Agaricus bisporus*, *A. bitorquis*, *A.avensis*, *Pleurotus ostreatus*, and *P. cornucopiae* require temperature of 16-25 °C, 24-30 °C, 25-30 °C, 8-25 °C, and 18-22 °C, respectively for vegetative and generative phase of the fungi.

In most parts of our country such temperatures can be presented naturally at least 6-8 months in a year. For example, Bahir Dar and its associated wetland belongs to Woyna Dega (Warm to cool) zone and the mean annual temperature at Bahir Dar is 18.5 °C (with maximum 26 °C and minimum 10.7 °C). The coldest month is December with average temperature of 16.3 °C and the hottest month is May with average temperature of about 21 °C. Bahir Dar is located at the coordinate of 11°36'N, 37°23'E and the natural altitude of 1785masl. In Bahir Dar, at least three crops of *A. bisporus* and two or more crops of *P. ostreatus* and *P. cornucopiae* and about two crops of *A. bitorquis* and *A.avensis* can be successfully grown with slight manipulation of the growing environment. Thus, this natural gift should be exploited by intensive research and location trial.

Table 2 General view of cultivation of some edible mushrooms with their scientific name and counties of cultivation in the world (Tripathi, 2005)

Common name	Latin name	Temperature desired		Place of cultivation
		Vegetative (°C)	Generative (°C)	
Cultivated mushroom (Button mushroom)	<i>Agaricus bisporus</i>	25±2	16-18	Whole world
Hot mushroom (Button mushroom)	<i>Agaricus bitorquis</i>	29-30	24-25	Netherlands and UK
Hot mushroom (Button mushroom)	<i>Agaricus avensis</i>	25	29-30	Belgium
Oyster mushroom	<i>Pleurotus ostreatus</i>	25	8-15	Japan, France, Italy, India, etc
Branch oyster	<i>P. cornucopiae</i>	20	18-22	Asia and Europe

3.2. Constraints of mushroom production in Ethiopia

- i. Mushroom production requires considerable capital outlay.
- ii. The monotonous traditional diets and the conservative eating habit of our people.

These have largely contributed to malnutrition and lack of balanced diet even in relatively well to do families. Moreover, the belief and concept of the society about nutrition is low. According to the 1999/2000 survey conducted by CSA, the total fruit and vegetables consumption rate among the Ethiopian population is found to be 26.7 kg/person/year. This amount is far less than the WHO recommendation 146 kg/person/year. When the Ethiopian per capita consumption is split into fruits and vegetable it is only 1.3 kg and 25.4 kg, respectively. The consumption of canned fruits and vegetables both by the rural and urban population is close to zero.

This low level of per capita consumption is accounted to: The traditional eating habits of the population which is resulted from the social and cultural pressures, the low level of per capita income, the higher price of fruits and vegetables, particularly fruits, low knowledge about production and utilization of fruits and vegetables; and supply shortage of some preferred produces.

- iii. Low/lack of concept on production technology

Mushroom production is a complicated business as it needs training and adaptation of new modern techniques for profitability. On top of poor post- and pre-harvest handling facilities,

capacity of smallholders and private sector is at its nascent stage in using pre-and post harvest handling technologies and know-how. The art and science of mushroom growing are not known in this country; rather it is a new type of technology and production system. Lack of skilled labor on production, processing, etc that can meet the demand of emerging mushroom farms; and dearth of qualified personnel in the area of production, research, and extension. And apart from the different phases of mushroom production that occur in phases, good knowledge of mycology, microbiology, biochemistry (fermentation) and environmental engineering must be well known to commercial growers (Tripathi, 2005).

iv. Mushroom cultivation has different production phases that require independent actors.

From production to marketing there are about four phases to be passed including: Spawn production; Compost production; Mushroom growing; and Mushroom processing and marketing. However, in Ethiopia because of several factors there are no specialized enterprises that produce and distribute spawn, compost or ready-spawned compost for the ultimate producers. As a result of this mushroom production at marginal and small scale level may require start up support besides producers' strong commitment.

v. Underdeveloped domestic marketing and exchange structure and system.

vi. Low infra structural development

vii. Low level of information supply both on production and marketing aspects.

3.3. The good features of mushroom cultivation in Ethiopia

- Mushroom production creates job opportunity for marginal and unemployed youth of the society;
- The mushroom production system allows the harvest of three consecutive mushroom yields within a single seeding; making the tripled use of compost, time, labor and other inputs;
- Provides food diversification and reduces malnutrition;
- It increases food production and thus contributes for the GDP of the country;
- Contribute to the country's economy as a source of foreign currency;
- Serves as an import substitution item; and
- It is technologically and environmentally friendly system of production.

4. CONSIDERATIONS AND RECOMMENDATION FOR ACTION

4.1. *Important considerations*

i. **Understand how mushrooms grow/Production process**

In nature, mushrooms appear infrequently (Robin, 1997). Fungi which can produce mushrooms do so only when nutritional and environmental conditions are right. Mushroom cultivation requires firstly the manufacture of composts and secondly management of growing environments. The cultivation of the fungus in compost and the way in which nutrition and growing environments are manipulated to force mushrooms to emerge for harvesting is the key to success.

Inoculated compost is incubated in insulated buildings equipped with environment control to maximize the rate at which *the fungus* colonizes the compost. Once the compost has been fully colonized an extra layer, usually of peat, is added to the surface. This so called 'casing' layer, this layer transforms *the fungus* to reproductive growth and finally to reproductive generation of mushrooms.

ii. **Know why you grow mushrooms**

Robin (1997), advises that you have to be sure you are entering the industry with a clear objective.

Typical reasons include the following:

- To provide full-time occupation and primary source of income.
- As a part-time occupation and secondary income.
- To utilize existing facilities such as buildings or cold stores not currently in use.
- To maximize labor efficiency in a complementary business.
- To utilize more fully existing marketing and distribution system.
- For life-style change, perhaps to 'get back to nature' growing a crop with strong natural rhythms.

If you are seeking a primary income, or to integrate your growing or marketing business, there are good precedents for you to follow. If, however, you only wish to utilize existing buildings or

provide a 'life-style' change, good advice would certainly be to look at more enjoyable ways of losing money!

iii. Work on economic feasibility and its capital requirement

Mushroom production requires considerable capital outlay. This is usually site-specific and so generalizations concerning investment costs are not likely to be helpful. There is then the question of the production system to be adopted. The choice may be of **three or four** systems but with a multiplicity of ways of approaching each. Some involve very high capital sums indeed, especially where there is a desire to produce compost in-house. The entry level of investment to produce compost is expensive. Most advisers will discourage this for small and medium-sized farms. **Only where a major farm development is envisaged should compost production be contemplated.**

Buying ready-spawned (Phase II) compost bypasses expensive capital investment in machinery and buildings necessary for the skilled Phase I and Phase II composting processes. Bought-in compost can then be grown on in bags, on shelves or as compressed blocks. Some growers buy in fully prepared compost which is ready for casing. So called 'Phase III' compost is more expensive but can yield particularly well, increasing cash flow and retained income. However, it will also require a higher level of working capital. The choice of system will ultimately reflect availability of capital, facilities and site restrictions and can be decided only in the course of a detailed financial analysis.

In all cases some working capital will be needed to grow the mushrooms.

iv. Have knowledge and training on mushroom production

Even if an economic appraisal of a proposed mushroom enterprise looks good, there are other issues about which you will need to satisfy yourself. You must plan to gain knowledge and skill to grow high quality, disease-free and pest-free mushrooms in quantities large enough to be economically viable. Your business plan must take into account the relatively low output, and therefore income, you will achieve as you learn.

v. Anticipate problems that you might face

Which production system will you choose? Some require high investment, others less, but you must exceed a breakeven yield to be profitable.

Pests and diseases can be devastating and their control in mushrooms is a constant cost which is involved and complicated. Growers cannot depend on chemical pesticides as the crop is

extremely sensitive. **A start-up program and training is essential before any new production unit will achieve economic yields.**

vi. Know the postharvest behavior and handling of fresh mushrooms and its processing

According to Bhupinder and Ibitwar (2007), freshly harvested mushrooms are highly perishable because of high moisture content, metabolism and susceptibility to enzymatic browning. Its quality starts declining soon after harvesting, rendering the produce unsalable. Hence, the development of appropriate storage and processing technology in order to extend their marketability and availability to the consumers in fresh or processed form is of great significance. Drying, canning and freezing are initially accepted methods of mushroom preservation. Drying being cheaper can be employed on commercial scale.

Hence, freshly harvested mushrooms should be immediately processed if the objective is to preserve mushrooms for long term bases.

vii. Know your target market before producing

Market outlets must be assured before beginning. These require a continuous supply which involves accurate crop programming. Having grown a crop, it needs to be harvested 'seven days a week' - and harvesting is one of the highest costs.

There is room only for top-quality mushrooms. A new producer may firstly rely on wholesale markets. Initially, due to lack of continuity, variable quality and low volume, marketing to supermarkets and high quality direct outlets cannot be contemplated. Slowly, as reputations are established, some product may go to some of the higher-value, local outlets or be bulked with other growers' produce to meet the stringent demands of supermarkets. Never underestimate the time that must be devoted to developing and servicing market outlets.

viii. Where can you go for help?

There are few governmental institutions like Haramaya University and Addis Ababa University, with people having theoretical and practical skill in the production of mushrooms. Moreover, the Haramaya University offers training on "Low Cost Production of Mushrooms" with the aim to promote the cultivation of mushrooms at marginal and small scale level.

4.2. Recommendations

- i. In other countries the majority of newcomers choose to buy the pre-prepared compost. This avoids the complexity, pollution potential and cost of compost manufacture. Therefore, establishment of a central mother unit that supplies pasteurized compost and casing soil for marginal and small scale growers in certain districts may be advisable.

In fact, the government and other pertaining bodies should give incentives and trainings to farmers, unemployed youth and other economically back-ward families for setting up units in villages close to such location.

- ii. Support to investors who would like to invest their knowledge and money is expected from the central and local government functionaries so as to promote large scale production of mushrooms both for domestic and export market.
- iii. Inculcating mushroom research programs and location trials as part of the national agricultural research endeavors is another point. The research may include compost formulation, composting and casing, pasteurization, growing environment management, nutrient contents, processing, packaging and marketing of mushrooms.
- iv. Selection of appropriate mushroom production technology apt to Ethiopia and improving through research, extension, and adaptation trial by linking universities, mushroom producing farms, and governmental research and training institutes. And introducing the food and dietary importance of mushrooms among the majority of the population, through national nutrition extension packages are advisable.
- v. Food processing in Ethiopia is not only far behind the developed countries of the world but is much less than developing countries. Linked with the issue of fostering relationship between processor and farmer is the need to develop varieties that are suitable for processing. The food-processing sector as other sectors has tremendous potential to promote direct and indirect employment.
- vi. Organizing consulting institutes in such a way that they could provide consultancy services to the emerging and already established mushroom industries.
- vii. Provision of integrated financial credit services and other supports may help to build the confidence of new comers of the industry.
- viii. Establishing mushroom growers association and promoting the industry through building Websites, organizing workshops, and sharing of practical experiences helps to promote the industry at large-scale.

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