Prospects for Increasing Commercial Mushroom Production in Malaysia: Challenges and Opportunities

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Abstract

One of the benefits of mushroom cultivation is their potential contribution to a more sustainable and environmentally-friendly way of farming. Mushroom cultivation using an agricultural waste as a growing medium, and the subsequent use of spent substrate has high value for horticultural activity; organic fertilizer; and potential utilise for animal feeding. The value of mushroom to diets, coupled with reported medicinal properties, can also provide valuable additional new small and medium-scale business options. This study attempts to evaluate the mushroom industry prospects in Malaysia. It also explores issues and challenges facing the mushroom industry in Malaysia by using a critical analysis and SWOT analysis. The main challenges include poor supply and the increasing price of raw material, for example sawdust; the poor quality of mushroom spawn, and the threat of diseases and pest attack. Several strategies are discussed to potentially improve the productivity of mushroom cultivation in Malaysia.

Keywords: *agricultural residues, environmentally-friendly, Malaysia, small and medium enterprise, spent mushroom substrate*

1. Introduction

The desire for greater sustainability; improving food security by increasing diversity; and developing more reliable sources of income especially for small-scale farmers, suggests mushroom farming may be one of the viable options. It provides an efficient and economically-viable biotechnology (Bradley, 2013), which can give consistent growth with high biological efficiency (Jonathan et al., 2012). Mushrooms are suitable for fresh consumption, pharmaceutical-use and cosmetic production (Ministry of Agriculture Malaysia, 2011; Mohd Tarmizi, 2013). Edible mushrooms are highly tradable commodity, and their cultivation is becoming increasingly successful in many regions because of prevailing external climatic conditions; short growing times; very low inputs requirements for production, and easy production technologies. Other attractions include where land is also a limiting factor, low investment needed, and where agricultural residues are abundantly available (Marshall & Tan, 2009; Bradley, 2013).

Asian countries produce more than 74.64% of world mushroom markets followed by Europe (19.63%) respectively in 2014 (FAO, 2015) (Figure 1). In recent years, about 40% of total world mushroom are exported from China as the world's biggest producer of mushroom. However, 95% of the total China production is for domestic consumption (Zhang

et al., 2014). In 2013, Shiitake had the best demand for mushroom consumption in China about 22.5%, followed by Grey ear mushroom 18.9% and Wood ear mushroom 16.8% (Li & Hu, 2014). With the largest markets, mushrooms widely cultivated only by small-scale farmers (Li & Hu, 2014).

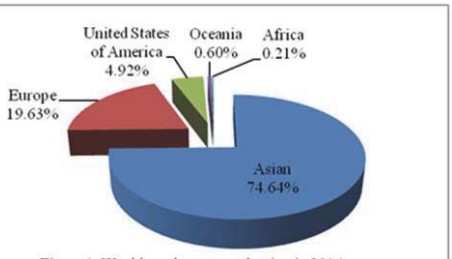

Figure 1. World mushroom production in 2014

Source: Food and Agriculture Organization, 2015

Roughly about 300 mushrooms are edible, but only 30 have been domesticated and 10 are grown commercially globally. The best-known specialty mushroom and easiest to market is Oyster mushrooms and Shiitake (Barney, n.d). Different mushrooms lend themselves to different growing systems. The most important condition for mushrooms fruiting is for the growing environment to be carefully controlled with temperature, humidity, light and sometimes atmospheric gases (Thiribhuvanamala et al., 2012, Foley & Yakushenko, n.d). Since mushrooms contain about 90% of water, it is also desirable to grow them under a relative humidity above 85-90% (Upadhyay, 2011).

For enhancing yield, appropriate bed methods; quality of spawn; suitable substrate, and a favourable season for cultivation are particularly important (Thiribhuvanamala et al., 2012, Foley & Yakushenko, n.d). Spawn culture is highly technical and requires specialized facilities and equipment (Barney, n.d). Mushrooms require also careful harvesting, attractive packaging, refrigerated storage and efficient transportation (Foley & Yakushenko, n.d).

Typical substrates which could be used including sawdust, straw of any grain crops (wheat, rice, barley and rye) (Foley & Yakushenko, n.d), logs, corn cobs, bagasse, chaff (Barney, n.d; Mamiro & Mamiro, 2011), water lily, banana leaves, cocoa bean shell, cotton straw and other agricultural by-products (Marshall & Nair, 2009; Thiribhuvanamala et al., 2012). However, commercial mushrooms production can also require high levels of management input and skill. Each species requires specialized treatment to produce a consistent yield of uniform high-quality and marketable product.

This study attempts to evaluate the mushroom industry prospects in Malaysia. It also explores issues and challenges facing the mushroom industry in Malaysia. The contribution reviews the challenges and opportunities for further developing mushroom farming in Malaysia. It also suggests more reliable ways for taking successful mushroom business enterprises forward in Malaysia.

2. Methodology

This paper is more a review and synthesis. The data are acquired from secondary sources. A critical analysis and SWOT analysis was carried out to evaluate the mushroom industry prospects in Malaysia. The analysis based on current performance such as the role and contributions of the entrepreneur; total of mushroom production currently; the growth of mushroom exports and imports; and the challenges and opportunities facing growers.

SWOT analysis consists of four quadrants. Internal survey was used to highlight the strength and weakness. Meanwhile, the external survey was used to look at the opportunities and threats faced by mushrooms industry in Malaysia.

3. The Value and Potential of a Mushroom Industry

3.1 Integrated Zero Waste Farming

In many countries, there are often large amounts of agricultural by-products with increasing agricultural production and greater demand for more food security. These were sometimes, previously, considered to be largely unusable. The

greatest challenges are also to dispose of these wastes with minimal impact on the environment. Recently, dumping in landfill and field burning openly were used to dispose of straw which contribute to serious environmental degradation such as global warming; destroying untargeted flora and fauna (Mamiro & Mamiro, 2011), and adversely affecting public health (Mantanis et al., 2000; Zhang & Jenkins, 2004; Das & Mukherjee, 2007; Yang et al., 2013; http://business casestudies.co.uk).

Crop residues such as grain crop straw are characterised by the predominance of lignocellulose with cellulose, hemicellulose and lignin as the main components (Yildiz et al., 2002; Das & Mukherjee, 2007; Mamiro & Mamiro, 2011; Jonathan et al., 2012). Using such crop residue as a mushroom substrate would subsequently convert them into a more protein-rich biomass and influence the mushroom yields (Mamiro & Mamiro, 2011). The high potential of such substrates for growing mushroom could be economically attractive and profitable for farmers and agriculture more widely. Besides, it is converting farm waste into useful products which could later help maintain the nutrient requirement of crops, soil physical and chemical condition, and also balance the ecological demands on the crop production system (Naresh, 2013).

In Tanzania, locally crop residues such as rice straw, banana leaves and juice pulp, bean trash, maize stover and peels, cotton seed oil waste and sawdust are used in considerable quantities for mushroom substrate (Mamiro & Mamiro, 2011). Prices of such crop residues depends on area, season, type of substrate, and transport. Most are currently available for free (Mamiro & Mamiro, 2011). While, in Hebei Province, China, the crop residues were used as mushrooms substrate through a development and utilization of a new culture medium for edible mushrooms research project. Results show that the quality and quantity of production were slightly increased and 15-20% of cost production was lowered. The utilization of straw rose from 2.5% to 10% after 3 years in these studies (Zheng et al., 2002).

About 5 kg of spent mushroom substrate will produce from 1 kg of mushroom's production. Spent mushrooms substrate is a valuable by-product. It contains of nitrogen, phosphorous and potassium (NPK) as major value to agricultural sector for soil fertility as an organic fertilizer (Food and Fertilizer Technology Center, 2002; Yildiz et al., 2002; Zheng et al., 2002; Taiwan Agricultural Research Institute, 2012). Spent mushroom substrate also, could be used as a growing substrate for horticultural activities (Ahlawat & Tewari, 2007; Marshall & Nair, 2009; Zhang et al., 2014). For example, the spent substrate of king oyster mushrooms still contains relatively high concentrations of nutrients. It has a high potential to be reused for commercial cultivation of mushrooms such as oyster mushrooms and shiitake (Taiwan Agricultural Research Institute, 2012). The result of mushroom crop yield increased by up to 20%, with one-third of the spent king oyster mushrooms substrate for growing shiitake than those grown without the spent substrate (Taiwan Agricultural Research Institute, 2012).

Some research reported that the fermented spent substrate had potential sources such as crude protein, nitrogen, magnesium, calcium, iron, vitamins and polysaccharides (Zhang et al., 1995; Zhu et al., 2012) (Table 1). These are granted as valuable for poultry and animal feeding (Zhang et al., 1995; Yildiz et al., 2002; Zhu et al., 2012). The other elements are magnesium, calcium, manganese, copper, zinc, and boron (Yildiz et al., 2002; Agriculture and Food Development Authority, 2013). It is also reportedly rich in the lignocellulosic enzymes such as laccase, xylanase, lignin peroxidase, cellulose and hemicellulose, which would be very useful in many biotechnological and environmental applications (Phan & Sabaratnam, 2012; Agriculture and Food Development Authority, 2013).

Table 1. Proximate composition of Button Mushroom and Paddy Straw Mushroom

Nutrient	Content (quantity/ 100g fresh mushroom)	
	Button Mushroom (*Agaricus bisporus*)	Paddy Straw Mushroom (*Volvariella volvacea*)
Protein (g)	3.30	3.90
Fat (g)	0.30	0.25
Fibre (g)	1.50	1.87
Iron	0.27mg	1.70g
Thiamin (mg)	0.025	0.14
Phosphorus	1.0mg	0.10g
Source	(Roupas et al., 2014)	(Ahlawat & Tewari, 2007)

3.2 Contributions to Livelihoods

Mushroom cultivation could directly enhance livelihoods through economic, nutritional and medicinal contributions (Marshall& Nair, 2009). The impacts of the mushroom business on livelihoods and poverty reduction are wide-spread.

Since mushroom cultivation does not require a lot of land and the business scale depends on modest to low capital investment and labour-use, it can become a viable and attractive activity for side-income and a part-time enterprise for rural farmers and peri-urban dwellers (Zhang et al., 2014). As a more labour-intensive industry, especially in filling substrate into plastic bags and harvesting, women and elders are reportedly suitable labour (Marshall & Nair, 2009; Zhang et al., 2014). This can enhance their empowerment to gain other farming skills; greater financial independence and also self-respect (Zhang et al., 2014).

In several Asian countries such as China and Vietnam, mushroom farming is closely integrated into rice farming. After harvesting, rice straw is used as a substrate for growing straw mushroom (Marshall & Nair, 2009). In China, contract farming has been emerging on a large-scale. Farmers are provided with substrate's bags and the products are collected by the integrated enterprise (Zhang et al., 2014). The government has strongly encouraged and financially supported because of the advantages to mushroom quality and greater food safety assurance. The Chinese government also reportedly considers it easier to control larger and fewer enterprises than numerous small-scale farmers (Zhang et al., 2014). It does, in addition, provide additional income to people living in the rural areas particularly those working in the agriculture sector (Yildiz et al., 2002).

3.3 Medicinal Value

Mushrooms have been appreciated for their high quality protein; excellent unsaturated fatty acids, and high content of available vitamins (Marshall & Nair, 2009; Amuneke et al., 2011; Bashir, 2014; Kumar, 2014; Valverde, 2015). Many mushroom can contain about 19-40% protein (dry weight) providing twice as much protein as vegetables and four times that of oranges, and can be a possible alternative to meat (Amuneke et al., 2011; Jonathan et al., 2012; Alexander, 2013; Bashir et al., 2014). About 6% of edible mushrooms are known have medicinal properties and widely cultivated such as Ganoderma, Shiitake and Straw Mushroom (*Volvariella Volvaceae*) (Marshall& Nair, 2009)

With high nutrients and compounds, mushrooms could be an excellent source to help counter and heal diseases (Chang & Miles, 2004; Shirur, 2011; Valverde et al., 2015). Mushrooms had important sources of bioactive compounds and metabolites (Agriculture and Food Development Authority, 2013; Valverde et al., 2015) that have been considered as anti-bacterial, have cholesterol-lowering effects (Rajapakse, 2011; Agriculture and Food Development Authority, 2013; Valverde et al., 2015); some anti-obesity, and anti-diabetic properties (Zheng et al., 2002; Agriculture and Food Development Authority, 2013); possible immune system enhancer; reported anti-tumor activity; and may be some anti-HIV effects (Shirur, 2011; Zhang et al., 2014). As a result, mushrooms extracts are sometimes used as prevention or in the treatment of Parkinson, Alzheimer, hypertension, strokes (Valverde, 2015) and also reportedly reduce the risk of heart diseases (Barney, n.d).

3.4 Mushrooms Value-Added Products

Mushrooms have a unique flavour with great nutritional value, and are considered by many as an ingredient of gourmet cuisine (Valverde et al., 2015). Fresh mushrooms should be consumed within two to four days of harvesting (Marshall & Nair, 2009; Kumar et al., 2014). Processing into profitable value-added products is an option to reduce the losses due to quality deterioration as well as gaining income and boosting consumption of mushrooms (Kumar et al., 2014). Trending mushrooms products available on markets are snacks, fried mushrooms, burger, pastry, nuggets, popcorn, pickles, biscuit, ketch-up, soup powder and candy (Kumar et al., 2014). For Malay cuisine, it can include floss (*serunding*), in curry meals and used also as satay (Mohd Tarmizi et al., 2013).

3.5 Mushrooms Farming Scenario in Malaysia

The major agricultural crops grown in Malaysia are rubber (39.67%), palm oil (34.56%), cocoa (6.75%), rice (12.68%) and coconut (6.34%) (Salman, 2015). Malaysia generates large amounts of agricultural residues, but, these are not often being currently utilizing for any further downstream operations (Salman, 2015). About 27.0% of agricultural wastes in Malaysia are used either as fuel in timber industry and manufacturing industries. The rest has to be disposed of by burning (Salman, 2015). However, around 1.0% of rice straw has diverse various uses including animal feed, compost, paper products and mushroom growth medium (MADA, 2014; Rosmiza et al., 2014).

Currently, sawdust from local rubber sawmills is used as a substrate for mushroom cultivation in Malaysia. As the proposed third engine of economic growth in Malaysia, 'New Agriculture' should be extended to analyse all of the potential of agriculture by-products. Through appropriate biotechnology, these waste materials can potentially be used as

a growing medium for mushroom (Beetz & Kustudia, 2004) (Table 2). This is in accordance with government policy to encourage agricultural activities in an eco-friendly and commercially-viable manner (Beetz & Kustudia, 2004).

Table 2. Agriculture residues as a mushroom growing medium

Growing medium	Mushroom variety
Rice straw	Paddy straw (*Volvariella volvaceae*), Oyster (*Pleurotus ostreatus*), Button (*Agaricus bisporus*)
Sawdust-straw	Oyster, Roundhead
Sawdust-rice bran	Ear (*Auricularia auricula-judae*), Shaggy mane (*Coprinus sp.*), Shiitake (*Lentinus endodes*), Nameko (*Pholiota nameko*), Enoki (*Flammulina velutipes*)
Oil palm	Paddy straw
Cocoa shell	Oyster
Banana leaves	Paddy Straw
Coffee pulp	Oyster, Shiitake

Source: Beetz & Kustudia, 2004.

Mushrooms are reported to be one of the seven high-value crops that are cultivated intensively in Malaysia (http://www.moa.gov.my, 2011). It is considered, by some, to be a new and small industry but is reportedly steadily growing (Mohd Tarmizi, 2013; Mohd Zaffrie, 2014). About 17 main types have been commercially cultivated in Malaysia, but only eight are now cultivated commercially (Ministry of Agriculture Malaysia, 2011) (Table 3). The most popular cultivated and marketed for household consumption is Grey oyster, while Shiitake and button mushroom are grown for the hotel trade and caterers (Mohd Tarmizi et al., 2013).

Table 3. Cultivated mushrooms in Malaysia, 2014

Mushrooms type	Total cultivated (%)
Grey oyster (*Pleurotus pulmonarius*)	90.89%
Ling Zhi (*Ganoderma sp.*)	1.64%
King oyster (*Pleurotus eryngii*)	1.17%
Black Jelly (*Auricularia sp.*)	1.17%
Enoki/ Golden needle (*Flammulina velutipes*)	0.70%
White oyster (*Pleurotus florida*)	0.70%
Button (*Agaricus sp.*)	0.70%
Shiitake (*Lentinus endodes*)	0.70%
Paddy straw (*Volvariella volvaceae*)	0.47%
Abalon (*Pleurotus cystidiosus*)	0.23%
Chestnut (*Agrocybe sp.*)	0.23%
Red oyster (*Pleurotus flabellatus*)	0.23%
Yellow oyster (*Pleurotus citronipileatus*)	0.23%
Fungus (*Schizophyllum sp.*)	0.23%
Shaggy mane (*Coprinus sp.*)	0.23%
Monkey head (*Hericium erinaceum*)	0.23%
Morning glory (*Citocybe sp.*)	0.23%

Source: Department of Agriculture Malaysia, 2015

The total value of mushroom production grew from RM49.1 million in 2007 to RM79.0 million in 2011. The production value had further increased to more than RM110 million in 2014 (Figure 2). The tremendous increased of production value was contributed by the increasing number of growers, land area and productivity (Department of Agriculture Malaysia, 2015). Thus, the consumption of mushrooms has increased at a relatively rate from 1.0 kg/ person in 2008 to 2.4 kg/ person in 2020 (Ministry of Agriculture, 2011). This increment being partly due to an increase of population and a reported higher concerns towards health (Mohd Zaffrie, 2014).

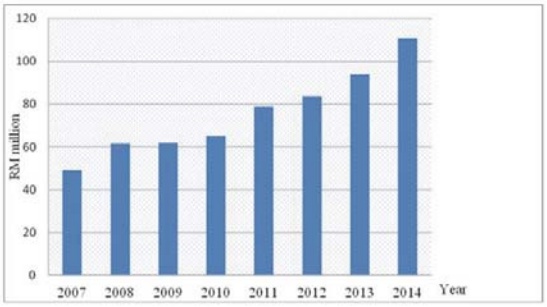

Figure 2. The total value of mushroom production in Malaysia (2007-2014)
Source: Department of Agriculture Malaysia, 2015

The main export destination for mushroom grown in Malaysia is the United States, Brazil and Singapore until 2009, but much now goes to Singapore, Thailand, Hong Kong, Taiwan and other countries (Department of Agriculture Malaysia, 2015). The largest exported mushroom is Button mushroom (49%) as fresh and chilled. The rest about 51% exported as processed such as Ling Zhi, Black Jelly and Paddy Straw mushroom. Mushroom export has increased from about 19% a year from RM12 million in 2000 to RM67 million in 2010. The exports slightly dropped from 8302.96 metric tonnes in 2008 to 3190.26 metric tonnes in 2013 (Department of Agriculture Malaysia, 2015).

However, imports have increase from more than 21 thousand tonnes in 2004 to 24.5 thousand tonnes in 2013 (Figure 3). The main exporter to Malaysia being China, Thailand, Hong Kong and Taiwan (Department of Agriculture Malaysia, 2015). The main supplier of fresh and dried mushrooms is China at about 2.71 million tonnes of fresh mushrooms and 3.11 million tonnes of dried mushrooms (Mohd Zaffrie, 2014).

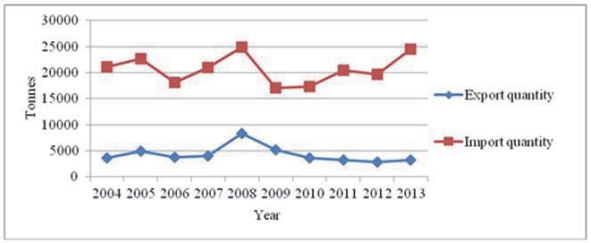

Figure 3. Import and export quantity (metric tonnes) of mushrooms industry in Malaysia (2004-2013)
Source: Department of Agriculture Malaysia, 2015

The numbers of mushroom growers in different States of Malaysia fluctuate, because of unstable production and market changes. However, the total number of growers in Malaysia has reportedly increased every year (Department of Agriculture Malaysia, 2015). Most of them (about 80%) are small growers and produce below 50 kg per hectare of fresh mushrooms a day. The medium scale (produce 50-500 kg per day) growers constitute 17% and big scale industries (producing more than 500kg per day) are around 3% only (Mohd Tarmizi, 2013). Johor, Selangor and Pahang states are leading in mushroom producers, probably because of the higher demand especially from Chinese Malaysian population (Table 4).

Table 4. Mushrooms growers by state (2007-2014)

State	Total of entrepreneurs							
	2007	2008	2009	2010	2011	2012	2013	2014
Perlis	4	4	5	4	5	4	4	5
Kedah	9	9	11	15	14	9	20	26
P. Pinang	13	13	15	17	16	13	21	24

Perak	30	31	36	38	40	30	35	40
N. Sembilan	30	36	35	25	24	30	27	24
Melaka	16	16	14	14	13	16	14	13
Johor	67	87	80	88	90	67	84	91
Pahang	50	45	50	50	47	50	50	46
Terengganu	29	29	29	28	27	29	29	35
Kelantan	22	28	35	40	41	22	38	42
Selangor	50	50	48	55	59	48	57	60
Sabah	13	14	14	13	15	15	15	15
Sarawak	6	13	6	8	7	11	8	7
Total	339	375	378	395	398	344	402	428

Source: Department of Agriculture Malaysia, 2015

4. SWOT Analysis of Challenges Facing Mushrooms Industry in Malaysia

A SWOT analysis was conducted based on the review. There are six strengths that need to be highlighted, with consideration of five significant opportunities for greater benefit. Whereas, nine scores of weaknesses and four scores of threats must also be fully addressed (Table 5).

Table 5. SWOT analysis on mushroom industry in Malaysia

Strengths	Weaknesses
❖ Crop residues such as rice straw (rice as a staple food crop); palm oil waste (palm oil as a major industrial crop); coffee pulp, cocoa shell, banana leaves, logs and other materials are easily, abundantly, and cheaply available for mushroom substrates. ❖ Crop residue contains several nutrients that can be very useful as a growth medium for mushrooms. ❖ Mushroom provides high added-value products opportunities possible for industry-use chain. ❖ Mushroom industry and has high potential for both local and global markets widely. ❖ Specialty mushrooms are gaining interest from majority races in unusual and gourmet foods. ❖ For more sustainable agriculture spent mushroom substrate can be recycled on crop land, horticulture activities and in animal feeding (when fermented).	❖ Lack of advice on establishing new mushroom enterprises. ❖ Lack of facilities to produce quality compost, casing material, spawn and processed products. ❖ Lack of new production technology and farm management practices. ❖ Unstable farm-gate prices and profit margins. ❖ Short shelf life affecting potential products to long-distance markets. ❖ Lack of enterprising spirit amongst entrepreneurs. ❖ Lack of skills worker since retail mushrooms are hand-picked. ❖ Lack of financial resources for small and medium enterprise to upgrade facilities, production methods and to invest in new markets. ❖ Un-organized production and sale particularly by seasonal farmers while demand in the local markets slightly increase.
Opportunities	**Threats**
❖ Awareness about food; health issues and medicinal values is increasing around the world creating better domestic and global market demand. ❖ Improved future sales by enhancing public awareness in environmentally-friendly farming by using crop waste and spent mushroom substrate as a value-added product. ❖ Growing mushroom is labour intensive, suitable for both rural areas and peri-urban dwellers. ❖ Creating self-employment for female empowerment and older persons. ❖ Reducing dependence on mushrooms imports in Malaysia	❖ Diseases and pests invaded affects on product quality and supply. ❖ Limited supply of organic pest control products. ❖ Competition from neighbouring countries. ❖ Increasing production costs (including labour).

5. Issues and Challenges of Mushrooms Industry in Malaysia

Several issues and challenges were identified that can hinder successful mushroom industry development in Malaysia, demanding action and strategies to boost the greater production and market-access effectiveness (Table 6).

Table 6. Issues and challenges of mushrooms industry in Malaysia

Issues and challenges	Action required
Poor supply and increasingly expensive price of raw materials, especially sawdust	❖ Explore main crop residues and others as an alternative substrate.

Poor quality of spawn	❖ Technological breeding enhancement. ❖ Improved R&D investment.
Green fungus diseases and pest attack (rats, ants, lizards, and cockroaches)	❖ Sanitation practices - keeping cleanliness in mushrooms shed. ❖ Improved skills development of Good Agricultural Practices (GAPs). ❖ Using quality of casing. ❖ Improved current production methods with pest management methods.
Lack of relevant skills and knowledge among entrepreneurs	❖ Gaining enterprising spirit through capacity building. ❖ Provide marketing skills. ❖ Joining national and international trade fairs to get exchange information about overcoming the challenges and improving cultivation techniques.
Competition from neighbouring countries	❖ Creating more variety and improving products diversification. ❖ Reduce the growing period and crop rotation lengths for more profitable production.
Unfriendly policy development to growers	❖ Promoting new investment towards becoming more competitive. ❖ Controlling market price – suitable and affordable prices (perhaps). ❖ Financial support especially for small and medium-sized enterprise (possibly). ❖ Provide continuous quality spawn supply at low cost. ❖ Provide hands-on training on site with extension workers through self-discovery activities practised in the field. ❖ Develop specific policies in trading, branding and food standard for mushroom products. ❖ Possible buy-back guarantee as an incentive for farmers, landless poor and the unemployed to get them involved in mushroom industry (maybe). ❖ Explore sustainable uses and promoting value-added uses for spent mushroom substrate.
Lack of awareness from local markets	❖ Getting the products known for local markets through special programmes and activity. ❖ Promote life-style changes through more healthy food eating.
Promotion of mushroom cooking	❖ Create more menus and new specialty mushroom products.
Shortage shelf life	❖ Explore new technology of extending product shelf life and storage thereby expanding the market. ❖ Improved transport facilities, market accessibility, and consumer preferences.
Low skills of labour	❖ Improve in mushroom harvesting skills by picker training courses.

6. Conclusion

Management from 'waste-to-wealth' is essential for more sustainable farming globally, and increasing mushroom production in Malaysia seems a viable and attractive option. Boosting the commercial value of products whether in a fresh or processed form could increase concentration of demand and encourage market orientation. The demand for mushrooms especially in the local markets is increase, but it remains quite slow in the local markets. Promoting via education and good communication among communities would intensify consumer awareness and the knowledge-base of the wellness properties and value of mushrooms. Capacity-building could also have positive knock-on effects on individual skills capabilities, especially in cultivation techniques. Access to appropriate varieties of spores, post-harvest care and marketing could also be beneficial.

Growers, stake holders and Malaysian Government could focus more on increasing markets; expanding consumer awareness; developing new products and technology; and building-up networking with other agro-food industries. Providing greater incentives perhaps, especially to new venture and small-scale entrepreneur for running business may be would ease a burden of grower's production costs. Subsidy is not regarded, however, as an appropriate market-distorting approach in the longer term. Such support could increase the scale of local markets in Malaysia and it could become a competitive and more significant agribusiness.

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