




## AGRIPRENEURS' LEVEL OF READINESS FOR ENVIRONMENTALLY-FRIENDLY MUSHROOM CULTIVATION WASTE MANAGEMENT



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### ABSTRACT

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Mushrooms are considered as an environmentally-friendly crops by using agricultural waste as substrate, while spent mushroom substrate (SMS) is reusable. However, mushroom cultivation waste (MCW) to be managed in environmentally-friendly is not much practiced by agripreneurs that led impact to the environment. Therefore, this study attempts to evaluate the level of agripreneurs' readiness on environmentally-friendly management in post-harvest stage. It also evaluated the method of obtaining information regarding MCW management. Survey and interview were conducted involving 40 agripreneurs who were participants of the Young Mushroom Agripreneur Project Package Course. The results showed that agripreneurs knew and aware of caring the environmental quality when dealing with MCW, but most of them did not manage in a proper way, despite received advices from agency. Expanding agripreneurs awareness, skills capabilities in post-harvest techniques, and building-up networking with agencies and small-scale entrepreneur could essential strategies to manage MCW. This potentially increased agripreneurs' income by reducing the input cost, generating side income and improve the environment.

**Contribution/ Originality:** The paper's primary contribution is finding that mushroom cultivation waste should manage in an environmentally-friendly ways. Therefore, agripreneurs need to be exposed, given training and skills in reusing and developing substrate wastes into potential products. This could increase agribusiness and improve the environment.

## 1. INTRODUCTION

The mushroom industry is widely produced especially in the Asian continent which is dominated by China as the world's largest producer, besides the USA and Europe. Mushroom cultivation is an industry that is environmentally-friendly in its production process [1, 2]. The substrates for this crop use other agricultural wastes such as wood dust, grain straws, banana leaf, cotton waste, corn cob [2] and cocoa husk as a crop substrate or

media [3-6]. In fact, tea waste [7] sugarcane bagasse, legumes and grain straws [3] have also been used as substrates for mushroom cultivation. Therefore, its nutrient content is high because it contains lignocellulose consisting of cellulose, hemicellulose and lignin [2, 3] pectin, polysaccharides as well as other nutrients. However, the product and quality of mushrooms depend on the chemical and nutrient content of the substrate [8]. The availability of these high nutrient values gives the spent mushroom substrate (SMS) a high chain value throughout its entire production process [2].

However, the potential of this source is often overlooked. Agripreneurs often choose the simplest and cheapest method of SMS management. The most commonly practiced methods in Malaysia are to openly burn it and pile it up or dump it in other dumpsites. The management of spent mushroom substrate is a major challenge that mushroom agripreneurs must face in practicing environmentally-friendly crop management [9]. Therefore, this study was focused on assessing the level of knowledge and awareness of agripreneurs on environmental preservation with regard to mushroom cultivation waste (MCW) management involving SMS and mushroom bag by observing the management practiced. In addition, the study also evaluated the method of obtaining information on MCW management. This is important for generalizing the level of awareness and knowledge of agripreneurs on the preservation of environmental quality in the management of SMS.

## 2. LITERATURE REVIEW

Spent mushroom substrate contains high nutrient content as its cultivation media is composed of agricultural waste of other crops [1] containing lignocellulose which includes cellulose, hemicellulose and lignin [2, 3] pectin, polysaccharides and other nutrients [10]. A study by Ahlawat and Sagar [11] showed that the substrate was able to maintain the source of nutrient and quality of the organic matter in addition to containing nitrogen content (1.9%), phosphorus (0.4%) and potassium (2.4%). According to a study by Kumbhar, et al. [12] SMS has a hydraulic conductivity of 6.22 m/h, while the electrical conductivity is 0.28 ds/m. They also stated that the chemicals found in the button mushrooms' SMS were nitrogen (1.51%), phosphorus (3.77%), and potassium (0.61%). The availability of these high nutrient values makes SMS to have a high value chain throughout its production process [2, 13]. However, the product and quality of mushrooms depend on the chemical and nutrient content of the substrates [8].

According to Rosmiza, et al. [5] as much as five pounds of SMS is produced by harvesting one kilogram of mushrooms. Therefore, an effective SMS management and optimization of its potential should be practiced by agripreneurs. As an agricultural waste, it has a high potential to promote sustainable crop management by developing downstream industries such as biomass, while reusing the waste as a compost and substrate for horticultural crops [13, 14]. Generally, various methods are used by agripreneurs to manage SMS and mushrooms bag including open burning, dumping in certain areas and buried in the ground [9, 15]. However, this method is not environmentally-friendly and if not managed properly, it can result in an adverse effect on the environment [16, 17] affecting the health of the population [5, 18, 19] emission of unpleasant odor; and contamination of nearby water sources [16].

The opportunity to develop downstream activity involving substrate waste is high as they contain high nutrients; high cation exchange capacity and low mineralization rate. Therefore, the substrate waste is able to maintain the quality of the organic matter or its nutrient sources which are nitrogen (N), phosphorus (P) and potassium (K) [16]. This high NPK content makes the reuse of SMS in agricultural development proven to improve soil fertility [20-22] as well as increase agricultural productivity. Spent mushroom substrate is also capable of improving the physical and chemical content of soil and soil structure [12, 17, 23] improving soil texture; strengthening the water holding capacity; strengthening soil fertility levels; as well as neutralizing soil acidity [16]. According to Kumbhar, et al. [12] the water holding capacity of SMS is 95.03 percent. In addition, the spent substrate is able to maintain the nutrient requirements of the plant and balance the ecological demand of the crop production system [16]. For example, a study by Liang and Chiu [24] has discovered the use of SMS of

oyster mushrooms as fertilizers for wheat crops during the dry season. The results, normal plant growth and products, in addition to improving soil quality after harvesting, improving soil organic matter, maintaining the soil alkaline level and increasing the overall farm capacity.

Thus, SMS has the potential to be used as a compost fertilizer for horticultural crops [Ahlawat and Sagar \[16\]](#). [Ashrafi, et al. \[25\]](#) conducted a study on the reuse of spent mushroom substrate as a compost for milky white mushrooms. The study showed that there was a decrease in the pollution issues involving waste dumping into the environment. In terms of the plant, its use can increase the production of spores and make the growth of the fruit body more effectively, increase the plant's biological growth and expand downstream economic opportunities. For example, the use of 25 percent of SMS together with 75 percent of cow dung as composts for the Indian mustard plant has increased the plant's height, leaf amount and wet weight per plant [\[26\]](#).

From a socioeconomic point of view, environmentally-friendly SMS management is capable of generating main income as a result of the production of mushrooms as well as a side income generated from its downstream activities. As these crops use only agricultural waste as a medium of growth, limited use of space and low technology use, this provides the opportunity for rural people to grow the small-scale industry and farm at the local level [\[27\]](#). This expansion will generate side income and reduce poverty among farmers [\[28\]](#).

This has opened up job opportunities from home, in addition to small and medium enterprises to the surrounding population, especially women and young people [\[29\]](#). The economic expansion in the rural areas has the potential to enhance the socioeconomic status of the rural population [\[30-32\]](#). In addition, it is able to offer organic local food sources, as well as increase the awareness on food safety and quality through an increase in production and diversification of upstream and downstream products [\[29\]](#).

With regard to agricultural expansion services involving advisory services (including briefings, courses, training, farm demonstrations and visits), institutions play an important role in enhancing farmers' knowledge, understanding and skills leading to improved farm production and management [\[33\]](#). In addition, agricultural expansion acts to spread information on farm technology, support and assist rural farmers to learn in the process of development and farm management skills [\[34\]](#).

Close relationships between the government's sensitivity, the management of agricultural institutions and the spirit of entrepreneurship among agripreneurs have enabled an efficient farm management as well as competitive farm trade [\[33, 35\]](#) based on the concept of green economy towards a more efficient management of farms. The agripreneur's high dependency on advisory services from agricultural institutions in the farm management and the expansion of farms both upstream and downstream are seen as capable to limit the competitiveness in the agricultural sector.

A study by [Baloch and Thapa \[36\]](#) found that small farmers who had the advisory service from the development officials managed to improve their production. However, the limited and less knowledgeable development officials being offered to provide specific information on the problem of pest attack are among the obstacles faced by farmers. [Rosmiza, et al. \[33\]](#) also found that lack of institutional support; policies that do not focus on environmental management, lack of knowledge and skills among institutional officials; the bureaucracy and the inefficiency of institutional management have hindered the development of farm trade.

Similarly, [Forleo and Palmeiri \[37\]](#) found that motivation and strong relationships between farmers and institutions were a strength in improving farmers' skills. However, weaknesses in terms of small farm size, poorly skilled institution staff, inadequate learning methods and limited profitability have become the constraints of farm development programs. In line with environmental legislation, the agricultural sector should be able to address the problem of pollution in the farming environment through an environmentally-friendly management of agricultural waste. This calls for institutional involvement through development programs in collaboration with agripreneurs to carry out an efficient and environmentally-friendly farm management.

### 3. STUDY METHODS

A combination of quantitative (survey) and qualitative (interview) study design was implemented. A descriptive analysis was performed to assess the agripreneurs' level of knowledge and awareness on the MCW management involving SMS and mushroom bag by looking at the management methods being practiced. In addition, the study also evaluated the method of obtaining information on MCW management. This demonstrates agripreneurs' capabilities in environmentally-friendly mushroom management, as well as the method of obtaining the information regarding spent mushroom management. A data triangulation method was done by incorporating the questionnaire, interview and observation methods. Interviews with agripreneurs and observation method were conducted at the location of mushroom cultivation farm to thoroughly study the methods of MCW management (SMS and mushroom bag) practiced by agripreneurs.

The sample for this study involved 40 agripreneurs who were the participants of the Young Mushroom Agripreneur Project Course Package throughout Malaysia organized by the Department of Agriculture Malaysia. The course was launched on 26<sup>th</sup> June 2014. The sample involved in this study comprised only the participants of the Young Mushroom Agripreneur Project Package Series 1/2014, Series 2/2015 and Series 3/2016. The participants of the Young Agripreneur course comprised only those who were 40 years of age and below. A total of 40 respondents were involved in the series of this study. The selection of samples was done by the Department of Agriculture by selecting those who are active and have the potential after taking the course. These participants were also selected because they were the early participants of this package and had been started on mushroom cultivation. Therefore, feedback on the level of knowledge and methods of management of mushroom waste is necessary for further improvement of course organized by agricultural agencies. However, there were two respondents who were over 40 years of age at the time of this study. Their selection was because during the time they took part in the course, they were below 40 years old and the selection was based on the fact that these participants were among those who had successfully continued on with the mushroom project after taking the course.

### 4. RESULT AND DISCUSSIONS

#### 4.1. Agripreneurs Profile and Enterprise Status

The study involved 40 mushroom agripreneurs who had successfully completed the Young Mushroom Agripreneur Project Package course. The project is a special package developed by the Young Agripreneur Unit, Ministry of Agriculture and Agro-based Industry (MOA) in collaboration with the Department of Agriculture and other agencies under the MOA. The package has been developed to gain the interest of the young generation to get involved in the mushroom industry as a career choice with a potential return on investment of RM5,000 a month.

The majority of the respondents were between the ages of 26 and 35, which was 60.0 percent, with a fraction of 42.5 percent (17) was male and 17.5 percent (7) was female. There were 10 agripreneurs aged between 36 and 45, while the remaining six (15.0%) were 25 years old and below. All participants were Malays only [Table 1](#).

**Table-1.** Agripreneurs' ages.

Age	Male		Female	
	Respondent	Percent (%)	Respondent	Percent (%)
25 years and below	4	10	2	5
26-35 years	17	42.5	7	17.5
36-45 years	6	15	4	10

Source: Fieldwork, 2018.

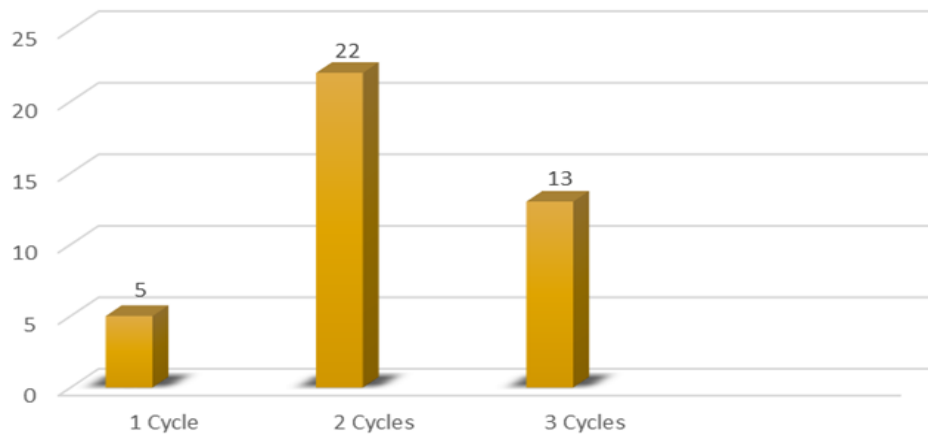
The mushroom enterprise status comprised 95.0 percent (30 people) self-owned, and 5.0 percent (2 people) partnership. Grey oyster mushrooms were the agripreneur's choice in running a mushroom business which was 95.0 percent. This was based on the Young Mushroom Agripreneur Project Course Package which solely focused

on the production of grey oyster mushrooms. In addition, the cultivation was only focused on the grey oyster mushroom due to the high demand among the different races in Malaysia, especially the Malays, Chinese and Indians. However, some agripreneurs cultivate several varieties of mushrooms at a time because there were also demands for other varieties of mushrooms. Grey oyster mushroom and white oyster mushroom were cultivated by four agripreneurs, two agripreneurs cultivated the grey oyster and split gill mushrooms, while the other one cultivated the grey oyster, white oyster and abalone.

The results showed that 22 agripreneurs (55.0%) were growing two crop cycles a year, while 13 agripreneurs (32.5%) were growing three crop cycles a year. The other five agripreneurs were growing only one crop cycle a year **Figure 1**. Interviews discovered that crop rotation was only done once a year due to the lack of capital to obtain the blocks to continue with the next crop cycle.

“...There is insufficient capital to grow that many cycles. Enough for once a year only” (Informant 4).

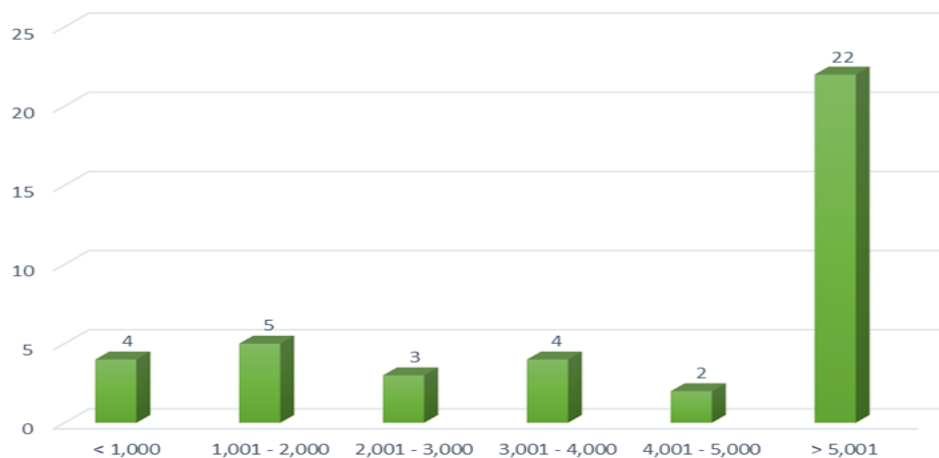
“...The mushroom house is not that big because there is not enough capital. So only grow one cycle a year. Moreover, I'm still new to this field” (Informant 7).



**Figure-1.** The cycle of mushroom production (A year).

Source: Fieldwork, 2018.

A total of 22 agripreneurs (55.0%) were growing more than 5,001 mushroom grow bags or blocks per month. Only four agripreneurs (7.5%) grew less than 1,000 grow bag per month **Figure 2**. The production quantity that exceeded grow bags per month indicates that young agripreneurs had achieved the target set by the Department of Agriculture, which was to produce more than 5,000 grow bags per month.



**Figure-2.** The quantity production of mushroom grow bags/ blocks (A month).

Source: Fieldwork, 2018.

#### 4.2. Agripreneurs' Level of Readiness for Environmentally-friendly Mushroom Cultivation Waste Management

The study found that 90.0 percent (36 people) of the respondents had knowledge about environmental protection during the management of SMS and mushroom bag waste. Meanwhile, 10.0 percent (4 people) of the respondents stated that they had no basic knowledge on how to manage MCW, while sustaining the environmental quality. However, agripreneur's readiness to manage spent substrate in an environmentally-friendly way also depends on the factors of the condition of the blocks, weather and agripreneur's own attitude. According to the interviews, the major constraints in the environmentally-friendly management of spent substrate and mushroom bag waste were due to the condition of the spent substrate, which is either damaged by disease and insect attack, as well as agripreneur's attitude. If the blocks are attacked by diseases and pests, they should be removed immediately. The best way to do this is by burning to prevent the attacks from spreading to other plants. This is in line with a study by Rosmiza and Hussin [9] who found that the management of MCW in an environmentally-friendly manner depends on the condition of blocks attacked by pest and disease, weather and the attitude of the agripreneur.

In general, SMS could potentially be reused as substrates for mushroom cultivation or compost for vegetables, flowers and fruits [16, 25, 26]. According to a study on agripreneurs' level of knowledge on the potential reuse of SMS, it was shown that all respondents (40 people) were aware of the potential of SMS to be used as compost. In addition, 87.5 percent (35 people) knew that spent substrate could be reused as a substrate for the next cycle of mushroom cultivation. Even though most of the agripreneurs knew very well that SMS had a potential to be reused as substrates for the next cultivation of mushroom and as compost, the study showed that the agripreneurs had still not exploiting its potential. Table 2 shows the various methods practiced by agripreneurs in the management of SMS and mushroom bag waste. The results showed that the management method depends on the condition of the spent substrate whether it was attacked by disease or pest, the weather and agripreneur's own attitude. Most respondents chose non-environmentally-friendly methods of managing SMS and mushroom bag waste after harvesting. Among them included open burning and piling it in the dumping area.

The study showed that the choice of open burning method (40.0%) was often done if the substrate had been attacked by diseases and pests. This was to ensure that the pests and diseases were completely destroyed so that they would not spread to the next crop. Meanwhile, the burning of mushroom bag waste was 37.5 percent. Piling in the dumping area was also chosen by the agripreneurs in SMS management practices with 27.5 percent, and 60.0 percent of mushroom bag waste Table 2. Both of these methods have a negative impact towards the environment which are air pollution through spreading of burning smoke, odor pollution and water source pollution as well as ruining the surrounding views. The negative impacts of this ineffective management of MCW towards the environment and humans have been proven by studies conducted by Ahlawat and Sagar [16]; Ehtesham and Vakili [17]; Josephine and Sahana [18]; Rinker [19] and Rosmiza, et al. [5].

**Table-2. Methods of mushroom cultivation waste management.**

Methods of Mushroom Cultivation Waste Management	Spent Mushroom Substrate	Mushroom Bag Waste
Composting	17 (42.5%)	-not related-
Open burning	16 (40.0%)	15 (37.5%)
Dumping in the dumping area	11 (27.5%)	24 (60.0%)
Burying into the ground	3 (7.5%)	2 (5.0%)
Selling to the certain parties	2 (5.0%)	-not related-
Reuse for the next mushroom cultivation	-	-not related-

Source: Fieldwork, 2018.

A total of 17 (42.5%) respondents frequently reused SMS as compost for their own use in horticultural crops. There was only one respondent who had started a compost business using SMS as a source of side income. Similarly, two respondents (5.0%) also made use of SMS to generate additional income by selling it directly to



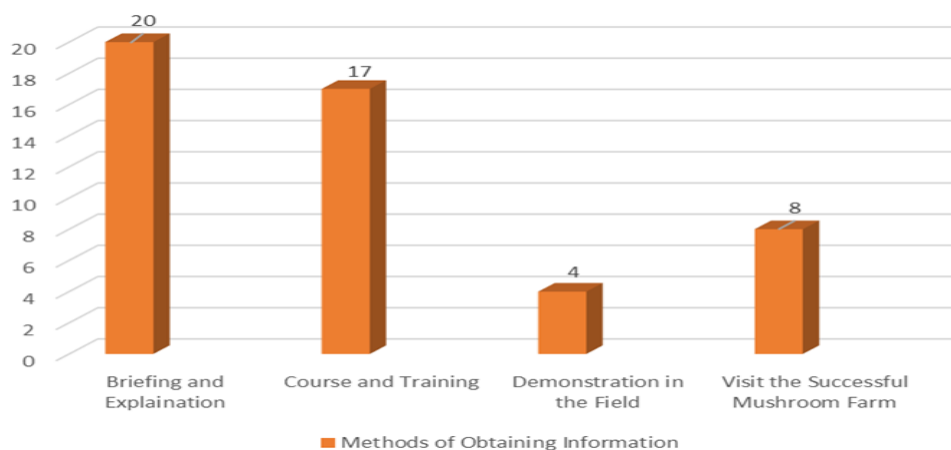
compost entrepreneurs. According to the interviews, these sales could generate an income for the agripreneurs. This is in line with the studies by Jegadeesh, et al. [27] and Thuc, et al. [28] who found that the use of SMS could increase farmers' income and the economic status of the rural population [30-32]. The study found that even though 87.5 percent (35 people) knew that SMS could be reused for the next mushroom cultivation, yet none of the agripreneurs practiced it. This situation indicated that the agripreneurs did not optimize the potential of the waste, instead, they preferred non-environmentally-friendly methods for managing agricultural waste.

The interview results showed that based on the experience of other fellow agripreneurs, the reusing of SMS for the next mushroom cultivation will promote better fruiting body growth. This is in line with a study by Ashrafi, et al. [25] that has successfully proven that the fruit body grew more effectively when SMS were used as the substrate for the next mushroom cultivation.

#### 4.3. Methods of Obtaining Information on Mushroom Cultivation Waste Management

The study showed that the agripreneurs gained information and encouragement from agricultural agency regarding the MCW management. A total of 62.5 percent of the respondents said that the agricultural agency had encouraged the use of SMS, while 15 respondents (37.5%) said they had not received any information regarding the reuse or managing it. Even though the agripreneurs had been encouraged to reuse the SMS, only a small number of the agripreneurs practiced it based on the results in Table 1. This shows that the agripreneurs had the level of knowledge regarding the environmentally-friendly management of MCW, but did not practice it in their business operations. This has resulted in pollution towards the environment. The agripreneurs were of the opinion that they had not yet been motivated to reuse SMS and manage the rest of the mushroom bags in an environmentally-friendly way. In addition, the environmentally-friendly management is trivial and somewhat time-consuming, in addition to policies that do not place too much emphasis on environmentally-friendly methods of management. This fact is consistent with several studies that found that agripreneur's attitude [33, 35] motivation and close relationships between agripreneurs and institutions [37] policies that focus on the environmentally-friendly management [33] would enhance agripreneurs' capabilities towards environmentally-friendly farm management.

Most agripreneurs obtained information on the MCW management through briefings and explanations (20 respondents) as well as courses and trainings (17) organized and delivered by the Department of Agriculture. Courses and trainings had also been delivered by successful agripreneurs in the industry by sharing their experiences, especially in terms of crop management and marketing. The Department of Agriculture had also held a demonstration in the field and brought young agripreneurs to visit a successful mushroom farm Figure 3. This could give a true picture of good agricultural management/practices in mushroom cultivation business in addition to marketing.



**Figure-3.** Methods of obtaining information from the department of agriculture on mushroom cultivation waste.  
Source: Fieldwork, 2018.

Interviews showed that the agripreneurs had gained experience in MCW management by participating in various programs organized by the Department of Agriculture.

“...It became clearer to me after having participated in the course besides visiting a successful farm” (Informant 9).

“...The successful entrepreneurs were generous enough to share their knowledge with us. They had a lot to share, especially on how to manage plant diseases and pest attacks. Methods of managing the mushroom cultivation waste were also able to be learned. This is important because one's experience which is the practical is very helpful in solving this problem rather than theory. So far as I've learned, there was one entrepreneur who practiced reusing for the next mushroom cultivation and some of them resold it. This could generate income” (Informant 18).

“...Courses and farm visits have really helped me in managing the crop and marketing process. I learned a lot from it” (Informant 15).

However, some informants also stated that the development officials sometimes lack the knowledge and skills in providing information on post-harvest management of crops. As a result, the briefings presented were less effective in encouraging agripreneurs to manage their farms in an efficient and environmentally-friendly way. Experienced agripreneurs were seen as having a higher level of knowledge than the development officials. This has given a bad impression among new agripreneurs who were just joining the mushroom cultivation. This has also been proven by the studies done by [Baloch and Thapa \[36\]](#); [Forleo and Palmeiri \[37\]](#) and [Rosmiza, et al. \[33\]](#) who found that development officials were less skilled in helping agripreneurs manage their crops efficiently.

## 5. CONCLUSION

Generally, mushroom cultivation is a kind of cultivation that practices environmentally-friendly methods in the early stage with the use of organic materials, such as agricultural waste as a substrates or growing medium and during the cultivation stage in order to get quality products. However, agripreneurs do not adopt the environmentally-friendly practices by preferring the simple and inexpensive methods of farm management, which are open burning and piling in the dump site. This is contradictory because most agripreneurs are aware of and know about the need for environmental protection in the post-harvest stage. Therefore, agripreneurs need to be exposed and given training and skills in reusing and developing substrate wastes into potential products. In fact, the role of stakeholders is important in disseminating the potential and importance of environmental protection in the management of farm wastes. In addition to preserving the environment, agripreneurs can also create side income, develop upstream and downstream activities, as well as reduce farm management costs through the reuse of SMS as a substrate for mushroom growth.

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