Available Online at EScience Press
Plant Protection
ISSN: 2617-1287 (Online), 2617-1279 (Print)
http://esciencepress.net/journals/PP

AN OUTLOOK OF SOCIO-ECONOMIC, CLIMATIC AND MARKETING FACTORS FOR MUSHROOM CULTIVATION IN PAKISTAN

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ARTICLE INFO

Article history
Received: 7th July, 2020
Revised: 12th August, 2020
Accepted: 20th August, 2020

Keywords
Mushroom
Production
Benefit
Environment
Medicine

ABSTRACT

Mushroom cultivation is a promising cottage industry in Pakistan because of the abundant supply of agro wastes making it feasible for mushroom growing. Cultivation of mushroom in Pakistan remained a novice industry and its development is slow as compared to other mushroom industries in the neighboring countries such as China and India due to insufficient support from the public and private sector. Mushroom is beneficial for its medicinal benefits, providing socio-economic returns as a cottage industry and eco-friendly due to biodegradation of agricultural wastes. Pakistan has been endowed with multiple climatic zones; hence almost all types of mushrooms can be grown here that will not offer a market competition to the growers. This article highlights the important factors that enable the Pakistan as an ideal country for mushroom cultivation.

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INTRODUCTION

Global Mushroom cultivation: A press release indicated that mushroom cultivation market is estimated for a value of USD 16.7 billion in 2020 and is projected to grow at a CAGR of 4.0% from 2020, to reach a value of USD 20.4 billion by 2025 (Figure 1) (OpenPR, 2020). China is now one of the top three producers and consumers of mushroom products. The United States and Netherland are two other countries who topped the exporting mushroom industry. Poland, Spain and Canada also produced mushroom in large scale (Figures 2, 3) (FAO, 2018).

EU countries prefer to export fresh mushrooms. Today, six European countries (Poland, Netherlands, Ireland, Belgium, Lithuania and Germany) are accounted as the major countries exporting fresh mushrooms in the global market. Nonetheless, China remains the largest exporter of processed mushroom in the world (Figure 4) (FAO, 2017).

China and India have considerable leeway in mushroom farming since the seventies due to its agricultural status and vast agrarian area, where the supply of materials are readily available joined with better communication, marketing of fresh produce and the capacity of the people to buy is evident. From the 60, 000 tons of mushroom production in China in 1978, it dramatically increased to 14 million tons in 2006 making China as the leader in the mushroom industry and it's thirty million people are the top mushroom consumers in the world until now (Chang, 1999, 2006a).

According to Hano (2015), mushroom cultivation is now

widely spread among hundred countries in the world including Pakistan and the production remains growing with the estimate of producing more than 12 million tons in total where *Agaricus bisporus* also known as Portobello mushroom is the most cultivated and highly sold mushroom (Delcaire, 1978; Jiskani, 2001).

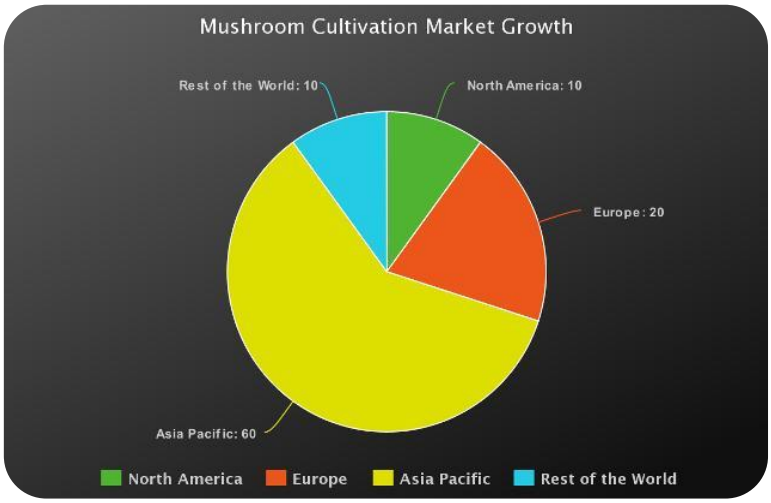

Figure 1: Mushroom cultivation market growth (OpenPR, 2020).

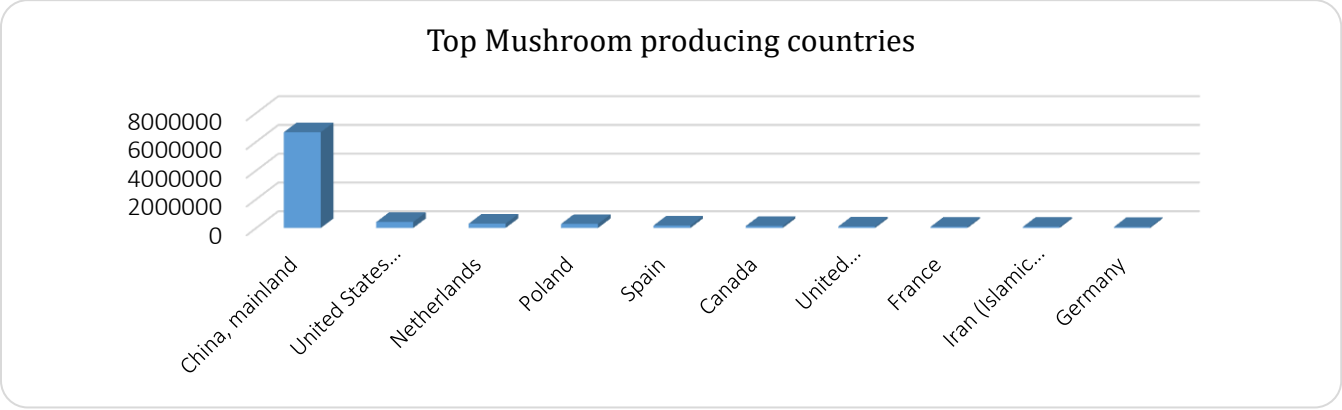

Figure 2: Top mushroom producing countries (FAO, 2018).

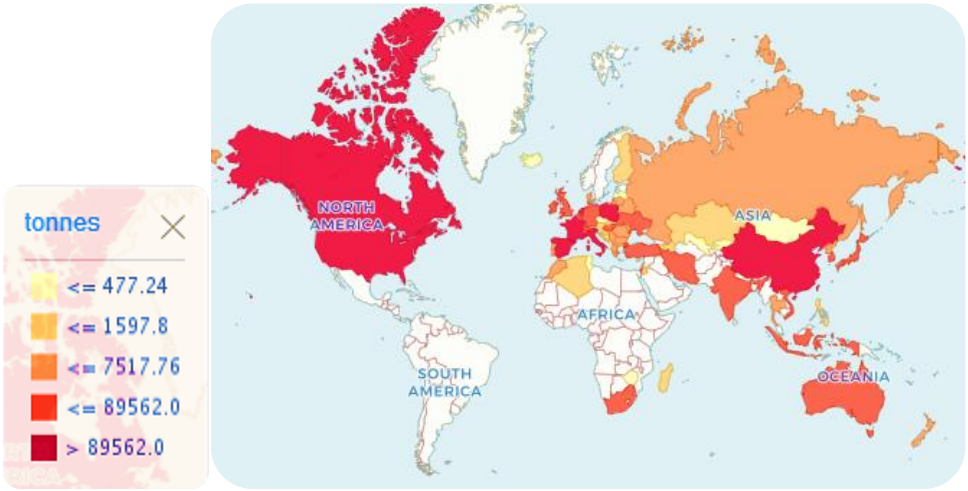

Figure 3: Worldwide Mushroom Production (FAO, 2018).

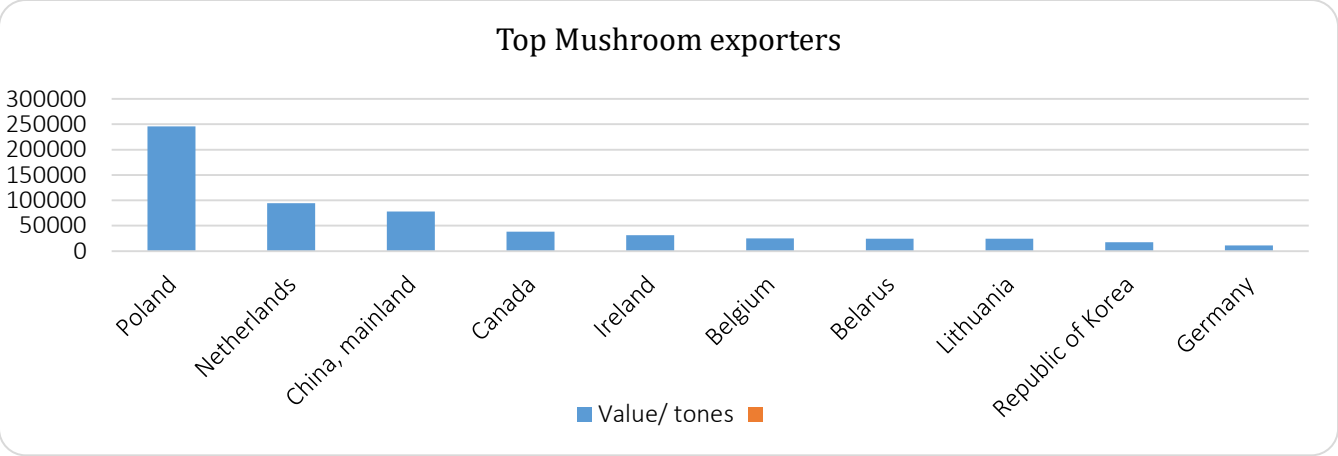

Figure 4: Top mushroom exporters (FAO, 2017).

Mushroom production in Pakistan: Some studies conducted on the economic status of mushroom showed that mushroom production relatively reaches 1.5 million tons all over the world. In comparison, Europe is reported to export about 90 tons of mushroom from Pakistan. In 2013 alone, Pakistani mushroom growers yielded an estimate of 155.6 kg per ha with a gross return of Rs. 77,800 per ha earning a total of $6.90M compared to the 79 tons of mushroom exported in 1998 to1999 which gave a value of $4.49 (Tahir and Hassan, 2013). Pakistan has recorded export of 56 edible species among these countries. However, due to the threat of extinction caused by urbanization, overhead collection and deforestation in the country, the exporting business has declined tremendously (Sultana et al., 2007). Before this, KPK produced more than 70% of mushrooms while Punjab (Faisalabad), Azad Jammu and Kashmir cultivated mushrooms where local people comprising of 54% children, 24% of the women and 22% of men harvested them in current form from the forest (Iqbal, 1991).

Commercial mushroom species of Pakistan: Some of the commercially-valued species are white button mushrooms (*A. bisporus*), Khumbhi (local desert mushroom) which are found mostly in the areas of Sindh, the desert and mountain of Thar and Kohistan. Black morels (*Morchella elata*) are found in Kashmir and Punjab as well as in NWFP and Gilgit Baltistan. Meanwhile, locals of Baluchistan are familiar with white umbrella type mushroom and have been eating the mushroom considerably. Several strains of mushroom are available in Pakistan year-round, especially after the monsoon. They include Oyster mushroom (*Pleurotus spp*), Button European mushroom locally known as white mushroom, Golden Oyster mushroom (*Pleurotus citrinopileatus*) or 'tamogitake' in Japanese, the Phoenix Oyster mushroom (*Pleurotus pulmonarius*) and the Pink Oyster mushroom (*Pleurotus djamor*) (Dawn, 2013).

Medical uses: Extracts from mushrooms are a potential treatment for cardiovascular disorders, boost the immune system and inhibit the growth of the tumor. On the discovery of *Ganoderma lucidum* as medicinal mushroom since ancient China, mushroom growing became popular in early days. On the onset of the 21st century, *G. lucidum* became more famous as it had attracted more consumers when many studies proved it promotes longevity as it contains anti-ageing prowess and paramount in nutritional value. The discovery of *G. lucidum* as anti-tumor, anti-cancer mushroom since time immemorial made mushroom coined as mushroom nutraceutical. Chang and Buswell (1999) define mushroom nutraceutical as a refined or partially defined mushroom extract which is stored in a tablet or capsules and taken as a dietary supplement, not as food, and which has implied therapeutic applications.

Due to modern technology and imposing health problems, many studies and experiments have been held on the mushroom to find its therapeutic value. In Africa, Chang and Buswell (1996) reported in their study that HIV/AIDS patients generated promising result after conducting medical trials using edible mycorrhizal mushroom which includes any of the following: truffles, morels, matsutake, porcini and chanterelles (Kaiser and Ernst, 2016).

Chang and Buswell (2008) reported in their studies that mushroom could act as a preventive measure to any

diseases by increasing the resistance of human through a balanced diet and enhancement of the immune system. Aside from Vitamin B, the mushroom is also a good source of thiamine, riboflavin, niacin, ergosterine and ascorbic acid. It is low in calorie, calcium and carbohydrates. Mushroom can also be attributed to the remedy if not cure of hypotensive and rental effects (Chang, 2006b; Tam and Tuyen, 2015), immunomodulatory and anti-tumor activities (Liu et al., 2012). especially from *G. lucidum* (Chang, 2007; Chang and Buswell, 1999) and *V. volvacea* (Yao et al., 1998).

Socio-economic benefits: It is significant to Pakistan in terms of providing an additional source of food and poverty alleviation, particularly in the rural regions. Growing mushroom as a cottage industry is also suitable to Pakistan because of its agro-climatic conditions which match the climatic requirements of mushroom hence the potential of cultivating different species in a different region is improved. This possibility is strategically beneficial to the mushroom growers to eliminate the competition.

Aside from this reason, farming of mushroom in rural areas as well as in urban regions has several advantages such as bioconversion of waste materials. Farmers usually burnt these byproducts of cereal to eliminate trash on their lands, but this practice is detrimental to our environment. Smoke from burning will cause air pollution. Henceforth mushroom farming can reduce this environmental issue and can modify disposal into commercial purpose. Cultivation of mushroom can signify labor availability, income generation and engagement of people to meaningful activity, particularly among youth and women.

Another advantage of this cottage industry is the availability of other activity for farmers during the winter season. There are mushroom species viable in cold weather condition. Therefore, source of food in vegetable form could be provided as well as the source of protein-rich food and other micronutrients such as vitamins and minerals would not be scarce particularly in rural areas where health and fitness are deficient.

Mushroom is an excellent choice for cottage industry since it has a fast return on investment. Within 3-4 weeks after spawning, species of mushroom such as *V. volvacea* (straw mushrooms) and *P. sajor-caju* (Oyster mushroom) are already being harvested because of their naturally fast-growing habit. Pakistani farmers commercially grow button mushroom as well. Aside from these three types of mushroom locally grown in Pakistan, there are 20 more popular species to choose from among 2500 identified edible species worldwide. Each of these has commercial value and is mostly found in different regions of Pakistan; thereby sourcing spawn would be feasible and would not be a problem in time.

The bioremediation of mushroom focusing on its favorable impacts on the environment are hereby addressed through the cultivation of mushroom as low scale industry. According to Chang (1999), the availability of the lignocellulosic waste products for mushroom farming such as sawdust, chips of wood, fallen logs as well as water hyacinth are infinite as long as the environment remained balanced. These substrates are rather beneficial to mushroom cultivation but pose a hazard to our health. The enzymes found in the mushroom worked as decomposer that ruptures the lignin, cellulose and hemicellulose present in these organic wastes then breaks them down into simpler substances Chang (1999). It is then that the growth and metabolism of mushroom happen in this phase where the molecular breakdown is at its best. In the pursuit of solving the underlying problems in poverty, in the environment and people's health, the integration of the various fields of sciences in this cottage industry is ultimately aimed coupled with technological processes to attain the maximum benefits entailed in this program. Recycling of organic wastes into mushroom as well as forming bio-fertilizer and biogas are the beneficial target impact in pursuing this profitable livelihood program.

Pauli (1996) and Chang (2007) suggested considering the production of mushroom, bio-fertilizer and biogas as an alternative integrated approach to mitigate the problem on the depletion of resources due to rapid population growth. The concept of "Zero Emission or Total Productivity" is highly suggested by the two authors quoting "The earth cannot produce more: Man has to do more with what the earth produces" to emphasize their suggestion.

Cultivating mushroom has also brought benefits in restoring the damaged environment by the integration of mushroom mycelia, a group of complex extracellular enzymes, in degrading and utilizing the lignocellulosic wastes. It has been known that mushroom mycelia play a vital role in reducing air pollution. Mycorestoration, as it is called, is performed in different ways such as mycofiltration, mycoforestry, mycoremediation and mycopesticides. Parasitic fungi or mushrooms, as well as

mycorrhizal, saprophytic and endophytic mushrooms, are the agents of mycorestoration. Mycofiltration helps in the filtering of water using mycelia while mycoforestry use mycelia to restore forests and everything in it. Mycoremediation is the elimination of toxic wastes using mycelia and the other one is mycopesticides which is the process to eliminate pests by mycelia too. These four methods gave an overview on how to create a cleaner, better environment by growing mushroom in the backyard where damage will be untraceable after implementation of the fungi (Stamets, 2005). Airborne contaminants like carcinogens which are released to the environment from undesirable human activities are significantly reduced upon the bioconversion of mushroom mycelia. This mycelium, aside from eliminating pollution, also aid in the healing of soil. Through mushroom cultivation, mycorestoration will play its role in resolving the balance of biological populations.

It was also observed that farming mushroom is also a means of obtaining nutrients such as carbohydrates and fats aside from the protein and antioxidant that is contained in the mushroom.

Climatic and market factors: The mushroom grows and thrives in a different environment favorable to it whether on woods, forests or rough terrain such that as in mountain or coastal areas. Mushroom prefers dump areas, so manure heaps, places with water channels and grassy grounds are places where wild mushrooms grow. People mostly cooked edible species of mushroom as vegetable soup or appetizers while others ate the preserved one. Some used it in pies and curries as well as in making mushroom ketchup (Hano, 2015).

However, it is advisable that farming must be done in areas where the market and transportation are accessible since mushroom is a perishable good. Time is essential to new mushroom marketing; hence the order of the produce (depending upon the type of mushroom) must be placed before harvesting to keep its freshness. Likewise, if the mushroom cottage industry will be pushed through, particularly in rural areas, the production site must be located near the center of the community where selling will take place.

Aside from accessibility, other factors that cause a decline in mushroom production as a cottage industry is the awareness of the people on the edible and non-edible mushrooms, lack of knowledge on the preservation technology, know-how on proper storage and lack of information on consumption. Most of all, training, guidance and financial aid from the public and private sectors are not received by the farmers (Hano, 2015).

Promoting mushroom as a cottage industry in rural areas can be drawn farmers to their resources, whether it's formal or informal. It will encourage them to reach their livelihood objectives like building networks and supporting their families, friends as well as their mushroom growers' association. Since it is a cottage industry, the landless families and those with limited land can still play a role in mushroom farming. In this industry, women and children can have worthwhile activity in the household by being involved in the livelihood program since mushroom cultivation on a small scale does not require intensive labor (FAO, 2009).

The people also know that Reishi mushroom has a higher potential in the market because of its pharmaceutical and therapeutic claim; thus a right choice for cottage industry specimen. Four countries in Asia, namely China, Malaysia, Thailand and India, are actively growing Reishi mushroom. Hence, mushroom growers in Pakistan shall also encourage the government to support them by supplying seeds and by providing the training necessary to start the project so that they could also earn foreign exchange especially today that mushroom commands a price of around $18-20 per case (Dawn, 2013).

Future trends in mushroom farming: Due to the decreasing production of these highly prized mushroom, researchers were evoked to devise methods such as artificial cultivation and semi-cultivation methods of wild mushrooms (Chang, 1999). With the development of technology, the mushroom industry has also evolved in terms of capacity to increase production, innovative technology for cultivation, development of the products including its packaging, capitalizing on further study of pharmaceutical and nutritional properties and utilization of mushroom to create a balanced environment. Cultivating mushroom as a cottage industry has a great chance in different rural areas in Pakistan since it can create livelihood on a low scale basis and thousands of youth and women would benefit from this program.

Author contribution

All the authors equally contributed in the collection of the literature, compilation of this review, write-up and editing the manuscript.

Conflict of interest

The authors declare no conflict of interest.

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