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Research Paper

Initiating a Mushroom Farming Startup and its Future Potential in Bangladesh

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ABSTRACT

This study explores mushroom farming in Bangladesh, covering production, performance, challenges, and prospects. The paper aims to provide practical insights for potential entrepreneurs, as the mushroom industry gains momentum due to rising domestic demand and export potential. In 2018-2019, Bangladesh yielded 40,000 metric tons of mushrooms, with oyster mushrooms notably cultivated year-round among other varieties. Because of the possibility for profit, mushroom farming is becoming more and more appealing to educated young people and rural women. The research highlights its straightforward nature, requiring minimal technical expertise, and a favorable benefit-cost ratio, indicating its viability as an agricultural pursuit. However, challenges persist, including limited cultivation space, spawn supply, finances, skilled labor, marketing channels, and infrastructure. Despite these hurdles, the potential for nationwide mushroom cultivation is significant. Developing this sector could foster sustainable rural growth, crucial amid limited land, overpopulation, and unemployment. Additionally, expanding the industry could diversify business opportunities and employment in semi-urban and remote areas.

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1. INTRODUCTION

Mushroom cultivation, tracing its roots back to ancient civilizations, has evolved from a mystified practice into a thriving industry with immense potential for addressing nutritional deficiencies and poverty in countries like Bangladesh. Since ancient times, mushrooms have been a source of intrigue, revered as food fit for gods and symbols of immortality. Over millennia, the cultivation of mushrooms has progressed from mere collection to sophisticated, controlled methods [1]. The journey of mushroom farming from prehistoric foraging to modern cultivation represents a fascinating blend of tradition and innovation. The cultivation of mushrooms is relatively new in Bangladesh, having started in the 1980s [2]. Thanks to the efforts of various individuals and initiatives, mushroom cultivation has become a growing industry, contributing to poverty reduction and enhanced nutrition. This paper delves into the history, present status, and future prospects of mushroom farming in Bangladesh, highlighting its significance as a promising sector for economic growth and well-being.

1.1. Evolution of Mushroom Cultivation

From the era of primitive hunting and gathering to the present day, mushrooms have transitioned from enigmatic and supernatural entities to valuable sources of nutrition and medicine. Ancient cultures, such as the Egyptians and Romans, revered mushrooms for their perceived mystical qualities [3]. The Chinese and Japanese utilized mushrooms for medicinal purposes, with some species boasting immune-boosting and anti-tumor properties. Mushroom cultivation methods developed differently across cultures. In Western cultures, Agaricus bisporus, the iconic "button mushroom," found its place in melon crop compost in Paris during the 17th century [4]. This practice eventually moved underground into caves and tunnels, a method still used in France today. The United States embraced mushroom cultivation in the 19th century, cultivating variants like Portobello and Crimini. While truffles were once elusive treasures, efforts in the 20th century led to their successful cultivation, offering delicacies like the Perigord Truffle and White Truffle.

2. RELATED WORK

2.1. Mushroom Cultivation in Bangladesh: A Brief Historical Overview

The initiation of mushroom farming in Bangladesh took place throughout the 1980s, with the first assistance provided by the Japan Overseas Cooperative Volunteers (JOCV) under the Japan International Cooperation Agency (JICA). Mr. Azizul Hoque, the Ministry of Agriculture's Agricultural, Advisor, began the venture by introducing straw mushroom seedlings, drawing inspiration from mushroom cultivation practices in Thailand [5]. In 1981-83, a mushroom growing laboratory was established, where Mr. Nakano (JICA) and then Mr. Kakizaki (JOCV) brought Japanese methods [3].

Numerous programs have been implemented in the past to promote mushroom cultivation, such as the Bangladesh Mushroom Cultivation Pilot Project (1988–1990), which included collaboration between the Bangladeshi government and JICA [5]. Following a decrease in financial support after 1990, the government assumed responsibility for encouraging mushroom growth. This was done via various efforts, such as the Mushroom Centre Development Project (2003-2006), as well as succeeding programs focused on increasing awareness and improving the spread of technology [6].

Notable activities during the 1990s include:

- The Mushroom Center Development Project (2003-2006).
- The project on mushroom development (2006-2009).
- Expanding the Mushroom Development Initiative (2009–2013).
- The 2013–2015 Mushroom Development and Extension Program.
- The Department of Agricultural Extension's (DAE) Horticulture division established the Mushroom Development Institute in July 2015.

2.2. Present Status and Future Prospects

Mushroom cultivation in Bangladesh has gained traction over the years, attracting an increasing number of farmers and producing a substantial quantity of mushrooms. Its adaptability, nutritional value, and ability to be cultivated in small spaces make it an attractive option for addressing malnutrition, poverty, and unemployment [7]. Given the country's population density and limited arable land, mushroom farming offers a sustainable solution for economic growth and enhanced nutrition. It holds the potential to empower diverse groups, including women and youth, in a low-tech, low-investment industry. As Bangladesh looks towards the future, mushroom cultivation presents itself as an opportunity to transform its agricultural landscape. By harnessing the country's suitable climatic conditions and utilizing locally available substrates, the mushroom industry could contribute to poverty alleviation, job creation, and improved nutrition [5]. The growing interest in mushrooms, their versatile application, and the ongoing initiatives to promote this industry underscore the promising future prospects of mushroom farming in Bangladesh. In this research paper, we will delve into the historical evolution of mushroom cultivation, examine the establishment and progress of mushroom farming in Bangladesh, explore the industry's present status, and assess its potential to shape the country's economic and nutritional landscape in the years to come. Through a comprehensive analysis of its past, present, and future, we aim to highlight the transformative power of mushroom farming in Bangladesh's pursuit of a healthier, more prosperous future [8].

3. METHODOLOGY

3.1. The Species of Mushroom

Mushroom Varieties Suitable for Cultivation in Bangladesh and Their Environmental Compatibility: The cultivated mushroom species in our nation primarily fall under the category of Basidiomycetes fungi [9]. The roster of mushrooms currently under cultivation in Bangladesh, along with their scientific nomenclature, is presented below:

Table 1. The Varieties of Mushroom

Sr. No.	**Name in English**	**Scientific Name**
1	(Oyster)Mushroom	Pleurotus ostreatus
		Pleurotus sajor-caju
		Pleurotus florida
		Pleurotus highking 51
		Pleurotus flabellatus
		Pleurotus sapidus
		Pleurotus gray
2	(Milky- white) Mushroom	Calocybe indica
3	(Straw)- Mushroom	Volvariella volvacea
4	(Shitake)- Mushroom	Lentinus edodes
5	(Button)-Mushroom	Agaricus bitorquis
		Agaricus bisporus
6	(Shimaji)-Mushroom	Hypsizygus tessulatus
7	(Enoki)- Mushroom	Flammulina velutipes
8	(Reishi)- Mushroom	Ganoderma lucidium

Based on their seasonal availability, these mushrooms can be categorized as follows:

1) Warm-weather Mushrooms – Comprising Milky, Reishi, and Straw varieties.
2) Cold-weather Mushrooms – Covering Shitake, Button, Enoki, and Shimaji types.
3) Cultivation Throughout the Year – Mainly Oyster mushrooms.



Figure 1. The Varieties of Mushrooms Suitable for Cultivation in Bangladesh

3.2. Environmental Appropriateness for Mushroom Cultivation in Bangladesh

Table 2. Environmental Appropriateness for Mushroom Cultivation in Bangladesh

SL. No.	Name of the Mushroom	Required Temperature for Mycelium Growth (In Degree Celsius)	Required Temperature for Mushroom Growth (In Degree Celsius)
I.	(Oyster)-Mushroom	20 to 25	15 to 30
II.	(Milky)-Mushroom	25 to 35	27 to 35
III.	(Straw)-Mushroom	25 to 30	28 to 36
IV.	(Shitake)-Mushroom	22 to 28	15 to 22
V.	(Button)-Mushroom	24 to 30	15 to 24
VI.	(Reishi)-Mushroom	22 to 28	25 to 35

3.3. Medicinal and Nutritional Benefits of Mushrooms

3.3.1. Nutritive Worth

In terms of nutritional value, mushrooms stand out as a top-tier option. They encompass essential components crucial for our daily dietary requirements, such as Protein, Vitamins, and Minerals [10]. Interestingly, mushrooms strike a balance by containing these vital nutrients while being notably low in detrimental elements like Fat and Carbohydrates. Particularly, 100 grams of dried mushrooms reveal the following nutritional composition:

Table 3. Nutritive Worth

Nutrient Content in 100 Grams of Dry Mushroom		
Nutritive Worth	**Material (In Gram)**	**Remarks**
Expands	25 to 35	Mature and well-fleshed.
Vitamins & Minerals	57 to 60	Incorporates a wide array of vitamins and minerals.
Carbo-hydrates	5 to 6	Capable of dissolving in water.
Fats	4 to 6	Unprocessed fat.

Here, a comparison of the mushroom and other protein sources is provided.

Table 4. Protein Worth

Protein Content of 100 Grams of Edible Food	
Food's Name	**Grams of Protein**
Meat	22 to 25
Fish	16 to 22
Egg	13
Peas	22 to 40
Mushroom	25 to 35

Below illustrates the essential daily requirement of vitamins and minerals for our body, along with the corresponding quantities present in 100 grams of dried mushrooms

Table 5. The Amount of Vitamins and Minerals

The Amount of Vitamins and Minerals that the Average Person Needs Each Day and How Much is Present in 100 Grams of Dry Mushrooms		
Name of the Essential Minerals and Vitamins	**Daily Need (In Milligram)**	**Present in Mushrooms (In Milligram)**
Thymine (B1)	1.4 – One point four	4.8 to 8.9
Riboflavin (B2)	1.5 – One point five	3.7 to 4.7
Niacin	18.2 – Eighteen point two	42 to 108
Phosphorus	450 – Four hundred fifty	708 to 1348
Iron	9 – Nine	15 to 17
Calcium	450 – Four hundred fifty	33 to 199
Copper	2 – Two	12 to 22

3.3.2. Medical Benefits

Hygienists are considering mushrooms as potential preventives and remedies for a range of troublesome illnesses due to their nutritional content [11]. The factors through which mushrooms function as both preventive and curative agents for diverse serious diseases are outlined as follows:

Table 6. Medical Benefits

Disorders that Can be Recovered	Facts that Lead to Healing
For developing the immune system	Mushrooms provide a fantastic blend of meat, sugars, fat, vitamins, and minerals.
Diabetes	High nutrition, low fat, and carbohydrate content.
Heart disease, high blood pressure, and cholesterol	Antadenin, Iritadenin, Lovastatin and Niacin.
Composition of teeth and bones	Vitamin D, phosphorus, and calcium.
Anemia	Folic acid as well as iron.
Jondish, Hepatitis B	Jai-8 and folic acid link.
Tumor, Cancer	Beta-D-Glucon, Benjopyrin Organic Germanium, Tarpinoyed Group, and Lamptrol.
HIV/AIDS	The Triterpin.
Colitis	iludin-S and iludin-M.
Sexual Inability	Calcium, phosphorus, glycogen, and vitamin E.
Dengue Fever	Adinocin
Hyper Tension and Backbone	Vitamin B-12 and sphingolipids are both anti-oxidants.

Stomach Pain	Enzyme.
Kidney and Allergy	Nucleic acids and allergens.
Hair Falling and Hair-Grizzles	Copper, selenium, and sulfur amino acids.

3.4. Return and Total Investment for Newcomers

Small-Scale Farming: Starting with minimal expenses within one's home space, small-scale mushroom farming requires only spawn packets from NAMDEC and personal effort [12].

Commercial Farming: Developing a commercial mushroom farm demands a significant investment. This includes land acquisition, constructing cultivation rooms, and procuring essential equipment.

Total Fixed Costs: For commercial mushroom farming, the total investment sums up to around 480,000 takas. In summary, small-scale mushroom farming requires minimal investment, while commercial farming involves substantial costs for land, construction, and equipment. Careful consideration of scale and costs is vital for informed decision-making [13].

3.5. Fixed Costs for Commercial Farming

- **Land:** Leasing a 5-decimal land for 10 years costs approximately 80,000 taka.
- **Cultivation Room:** Constructing bamboo-fenced rooms, a Lab room, and shelves add around 220,000 takas.
- **Equipment:** Air-conditioning (AC), inculcation box, and autoclave machine amount to about 180,000 taka.

3.6. Variable Costs in Mushroom Farming

- **Cost of Labors:** At the beginning of farming, there must be a minimum of two laborers required. The spawn packets must be prepared, cared for, and harvested while labor is also required for mushroom cultivation [14]. Thus, it may cost at least 9,000 Taka per worker each month based on market demand. 18,000 Taka in total for using two laborers.
- **The Production of Commercial Spawns:** Some raw ingredients are required on a daily basis for the production of commercial spawn packets. These are the Water, Calcium Carbonate, Paddy Chaff, Powdered Wood, and Wheat Roughage. Ingredients required to make 400 spawn packets weighing 500 grams:

Table 7. Ingredients Need for Cultivation in Percentage

Ingredients	Volume	Percentages
Wood Powder	Seventy-seven kilograms. (77 kg)	38.5% - Thirty-eight point five percent
Wheat husk	Thirty-five kilograms. (35 Kg)	17.5% - Seventeen point five percent
Paddy Chaff	Four kilograms. (4 kg)	2% - Two percent
Calcium- Carbonate	Four hundred grams. (400 g)	0.2% - Zero point two percent
Water	Eighty-four liters. (84 lit.)	42% - Forty-two percent

One may only get 1 bag of powdered wood, weighing 77 kg and 200 takas, from a saw-mill that is nearby. The cost of a single 35-kilogram bag of wheat roughage is 1,500 taka. A 20-kilogram bag of paddy chaff may be purchased for about 200 taka. Calcium carbonate costs 40 takas per kilogram to purchase. So it will cost: to prepare the 400 packets [15].

Table 8. Ingredients need for Cultivation

Ingredients	Volume	Price
Wood Powder	Seventy-seven kilograms. (77 kg)	Two hundred taka (200 tk)
Wheat husk	Thirty-five kilograms. (35 Kg)	One thousand five hundred takas (1500 tk)
Paddy Chaff	Four kilograms. (4 kg)	Forty taka (940 tk)

Calcium- Carbonate	Four hundred grams. (400 g)	Sixteen takas (16 tk)
Water	Eighty-four liters. (84 lit.)	Sourced from the personal home supply.

To build a 500-gram weighted box, additional materials include brown paper, rubber bands, absorbent cotton, a 7-by-10-inch P.P. bag, and a wooden stick. For about 250 takas, these materials may be bought and utilized to make 400 parcels. For 400 spawn packets, the total cost of raw ingredients will thus be about 2,000 taka [16]. Therefore, a package will only cost (2,000/400) = 5 taka. It is possible to get spawn packets from other reputable mushroom initiatives or the National Mushroom Development and Extension Centre, although doing so will cost per packet 10–12 taka, about twice as much as producing spawn packets on one's own [17]. Therefore, if a businessperson wants to grow mushrooms properly, he or she must produce the spawn packets themselves as doing so may cut the cost of production in half. Preparing to spawn will cost 10,000 Taka every month for the five occasions [18].

3.7. Profitability and Return on Investment

For daily 5 kg of mushroom production, using 1,000 spawn packets, monthly profit can reach around 17,000 taka after covering variable costs (28,000 taka). Selling compost from remaining mushrooms adds potential earnings of 20,000 taka, while producing extra spawn packets for 5,000 taka yields 15,000 taka [19].

3.7.1. Enhanced Monthly Profit

- **Compost Sales:** "20,000" taka.
- **Additional Spawn Sales:** "15,000" taka.
- **Variable Costs:** "28,000" taka + "5,000" takass (extra spawn).
- **Enhanced Monthly Profit:** "47,000" taka.

3.7.2. Annual Profit Projection

- Enhanced per-month profit of "47,000" taka could lead to an annual profit of "564,000" taka.
- With "740,000" taka fixed costs, investment recovery might take about 3 years. Adding seasonal cultivation and product expansion can expedite profits and recoup the investment within 2 years [20].

3.7.3. Break-even Analysis

- **Annual Profit:** "360,000" taka
- **Monthly Profit:** "30,000" taka
- **20 Days' Profit:** "20,000" taka
- **"Investment", Recovery:** About 2 years and 20 days.

3.8. Marketing Strategies for Mushroom Farming Business

3.8.1. Advertising Mix

- **The Four Ps of Marketing Mix:** product, place, price, and promotion.
- **Product:** A variety of mushroom products to meet different customer needs.
- **Place:** Markets, restaurants, cafeterias, and hospitals in both urban and rural areas.
- **Price:** Providing value while taking into account dietary and medical advantages.
- **Promotion:** Emphasizing the health benefits and nutritional worth of mushrooms.

3.8.2. Extended Marketing Mix (7Ps)

- **People:** Staff plays a crucial role in customer experience.
- **Procedures:** Ensure prompt and effective service.
- **Physical Evidence:** Realistic features of service provision.

3.8.3. STP Process Implementation

- **Segmentation:** Geographic (urban focus), demographic, behavioral, psychographic.
- **Size:** profitability, reach, and accessibility.
- **Positioning:** Symbolic, practical, and experiential.

3.8.4. Comprehensive Digital Marketing Approach

- Immediate tracking and engagement.
- Cost-effective lead generation.
- Broad reach and real-time results.

3.8.5. Social Media and Beyond

- Social media's role in B2B and B2C marketing.
- Webinars, podcasts, email marketing, content marketing, paid search, and organic search.
- The significance of content production for brand awareness.

3.8.6. Strengths

- **Microbiology Expertise:** Our team's background in microbiology gives us an edge in tackling germ-related issues.
- **Distinctive Benefits:** We provide unique advantages not offered by competitors.
- **Credibility:** Our professional association enhances customer trust.
- **Cost Efficiency:** We deliver cost-effective solutions compared to rivals.
- **Personalized Approach:** Our preference for face-to-face interactions sets us apart.

3.8.7. Weaknesses

- **Brand Awareness:** Insufficient brand recognition and reputation.
- **Market Competition:** Existing competition already occupies the market.
- **External Factors:** Vulnerability to macro-environmental conditions.

4. RESULTS AND DISCUSSION

The findings reveal that while Bangladesh has a substantial market for button mushrooms, it lags globally due to outdated practices and resource constraints. The absence of government initiatives for new mushroom varieties and modern techniques is evident. Despite growth in output, cultivation methods remain unchanged. The Mushroom Development Institute (MDI) is attempting to train growers and develop new varieties, yet adapting to local conditions is a challenge. Dr. Ahmed Imtiaz notes that outdated practices and inadequate facilities hinder progress. A lack of supervision, support, and modern techniques led many farmers to abandon mushroom farming. To meet rising demand and tap into global markets, modernizing mushroom farming is crucial. Public awareness about the potential of this industry is also lacking.

4.1. Future Scope

To assess strengths and weaknesses, the internal aspect of strengths and weaknesses is tasked with pinpointing available or lacking resources. Armed with this knowledge, a marketing manager can devise strategies that capitalize on the identified opportunities and strengths from the SWOT analysis. Opportunities denote the potential to introduce novel products into the market, potentially yielding heightened profits [21]. Market shifts can unveil fresh opportunities, unveiling prospects for growth and gain through external environment scrutiny. Distinguishing itself from competitors, Paradigm stands out by delivering Mushrooms at a reduced cost and with enhanced safety measures. However, intensified competition compounds this scenario. The looming threat revolves around combating pervasive pollution. While it may appear straightforward to a technical expert, the actual landscape could be markedly different.

5. CONCLUSION

In Bangladesh, mushrooms are both a healthy food choice and an extra source of protein. Recent years have witnessed a mushroom output surge, reaching an impressive 40,000 metric tons. Among the diverse array of mushrooms in the country, oyster mushrooms particularly thrive year-round. Despite the challenges linked to processing and marketing, Bangladesh's mushroom industry holds substantial promise, given the nation's substantial unemployment and malnutrition rates. Mushroom cultivation on a small scale has the potential to swiftly alleviate poverty among individuals with limited land, resources, or technical expertise. This includes landless individuals, rural women, youth, and those with physical disabilities, all of whom can find livelihoods through mushroom cultivation. The expansion of mushroom-based enterprises also offers the prospect of exporting mushroom products, potentially generating fresh employment opportunities for the unemployed. Based on the aforementioned insights, several recommendations can be formulated. Strategies for advancing the Bangladeshi mushroom industry involve enhancing the accessibility of quality spawn, establishing an efficient marketing framework, introducing mushrooms to new areas, constructing storage facilities, and bolstering the institutional capacity of the Mushroom Development Institute (MDI). To bolster mushroom production and consumption, the government's Department of Agricultural Extension (DAE) should consider implementing additional outreach initiatives.

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Author Contributions Statement

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Shariful Islam	✓	✓	✓	✓		✓		✓	✓	✓	✓		✓	✓
Saiful Islam Tuhin	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓
Md. Al Araf		✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	
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C : **C**onceptualization
M : **M**ethodology
So : **So**ftware
Va : **Va**lidation
Fo : **Fo**rmal analysis
I : **I**nvestigation
R : **R**esources
D : **D**ata Curation
O : Writing - **O**riginal Draft
E : Writing - Review & **E**diting
Vi : **Vi**sualization
Su : **Su**pervision
P : **P**roject administration
Fu : **Fu**nding acquisition

Conflict of Interest Statement

The authors declare that there are no conflicts of interest regarding the publication of this paper.

Informed Consent

All participants were informed about the purpose of the study and their voluntary consent was obtained prior to data collection.

Ethical Approval

Not Applicable.

Data Availability

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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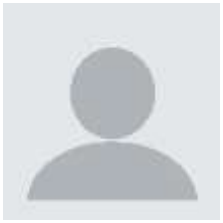
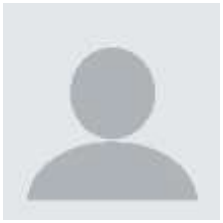
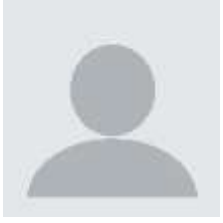
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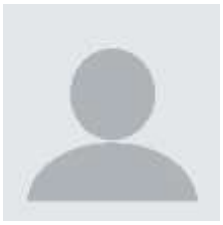
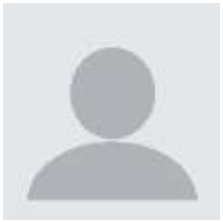
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