FINANCIAL PROFITABILITY AND RESOURCE USE EFFICIENCY OF MUSHROOM CULTIVATION IN SOME SELECTED AREAS OF SAVAR UPAZILA IN BANGLADESH

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JUNE, 2021

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REGISTRATION NO. 19-10106

A Thesis

Submitted to the Department of Agricultural Economics,

Sher-e-Bangla Agricultural University, Dhaka,

in partial fulfillment of the requirements

for the degree of

MASTER OF SCIENCE (M.Sc)
IN
AGRICULTUTAL ECONMICS

SEMESTER: JANUARY-JUNE, 2021

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CERTIFICATE

This is to certify that thesis entitled, "**FINANCIAL PROFITABILITY AND RESOURCE USE EFFICIENCY OF MUSHROOM CULTIVATION IN SOME SELECTED AREAS OF SAVAR UPAZILA IN BANGLADESH"** submitted to the Department of Agricultural Economics, Sher-e-Bangla Agricultural University, Dhaka, in partial fulfillment of the requirements for the degree of **MASTER OF SCIENCE** in **AGRICULTURAL ECONOMICS**, embodies the result of a piece of *bona fide* research work carried out by **Mst. FAHIMA AKTER**, Registration No.**19-10106** under my supervision and guidance. No part of the thesis has been submitted for any other degree or diploma.

I further certify that such help or source of information, as has been availed of during the course of this investigation has duly been acknowledged.

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Gratitude to my parents, husband

and those in-laws beloved people

who are continue to mean so much to me

LIST OFACRONYMS AND ABBREVIATIONS

AVDRC	Asian Vegetable Research and Development Center
BBS	Bangladesh Bureau of Statistics
BCR	Benefit Cost Ratio
BFVAPEA	Bangladesh Fruit, Vegetable and Allied Products Exporters' Association
BWDB	Bangladesh Water Development Board
DAE	Department of Agricultural Extension
HVAPs	High value Agricultural Products
MDI	Mushroom Development Institute
MFC	Marginal Factor Cost
MVP	Marginal Value Product
NAMDEC	National Mushroom Development and Extension Center
SDSN	Sustainable Development Solutions Network
SPSS	Statistical Package for Social Science
UN	United Nations

ACKNOWLEDGEMENTS

All commendations are devoted to the most merciful Allah, who enabled me to carry out thesis paper portrayed on the theme "Financial Profitability and resource use efficiency of mushroom cultivation in some selected areas of Savar upazila in Bangladesh" for the program M.S. in department of Agricultural Economics at Sher-e-Bangla Agricultural University.

Now,I would like to confer deep gratitude to my respected supervisor **Dr. Rokeya Begum**, Professor, Department of Agricultural Economics, Sher-e-Bangla Agricultural University, for her enthusiastic supervision and constructive suggestions all over the research work and paper decoration. Without her apposite outlines, this work would never accomplish in time.

A indebt respect to my respected Co-supervisor, **Dr. Bazlul Ameen Ahmad Mustafi,** Former Director, Bangladesh Rice Research Institute, for his utmost support and decisive suggestion to conduct the study task precisely.

I am highly grateful to **Ripon Kumar Mondal**, Chairman, department of Agricultural Economics as well as all amicable departmental personnel for facile co-operation during the apprentice period.

Moreover, the author acknowledges to the 60 producers for their invaluable facilitation during data collection process without which it would not be credible to prepare this thesis.

Finally, sincere respect is not enough to expresses deep appreciation to my parents, siblings and in laws relatives for their ever-ending blessings and supports.

June 2021

Mst. FahimaAkter

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FINANCIAL PROFITABILITY AND RESOURCE USE EFFICIENCY OF MUSHROOM CULTIVATION IN SOME SELECTED AREAS OF SAVAR UPAZILA IN BANGLADESH

ABSTRACT

The study was undertaken to explore socio-economic profile, financial profitability and resource use efficeincy analysis of mushroom producing households. Primary data collection was carried out from Savar Upazila adjacent to Dhaka along with eighteen key queries. This research was based on field data purveyed from 60 farm house following purposive and simple random sampling technique. Cobb-Douglas production function was applied to determine the effects of premediated cost factors on mushroom commercialization. Test tube specimen/ mother, substrate/ growth medium and accessory materials cost factors had positive significant impact on mushroom turnover. Negative regression coefficient of labour indicated that excess use of labour both type of producer. Fresh mushroom (BCR 3.21) was explored more profitable than mushroom mother (BCR 2.6). The average market prices were attained BDT 200.10/kg (fresh mushroom) and BDT 72.24/kg (mushroom mother). Resource use efficiency of sample mushroom growers was analysed by comparing the marginal value product(M.V.P) of an input with its factor cost. The overall M.V.P of specimen is 11.21 implying that addition of one unit of specimen would have increae gross income by 11.21 taka. The ratio of MVP and MFC of labour wage, prepation of growth medium and accessory materials input resources are greater than one it implies that the resources are overutilized. Finally, some problems were distinguished including environmental stress, mushroom disease & insect outbreak, market price fluctuations, societal superstition and fanatism and higher wage of technical cognizant labor. Introducing different agricultural term loans to the mushroom cultivators, motivating and training the cultivators to produce mushroom, introducing advanced storage facilities, operating as a combined force both producer and government authority, more engagement of women will flourish the mushroom production.

CHAPTER I

INTRODUCTION

1.1. **Background of the study**

Bangladesh is one of the most densely populated countries of the world. Agriculture is the dominate sector of the country where over 70% people are related to the agricultural work. In our GDP, agricultural sector contributes almost 12.10% (BBS, 2022). The growth rate of Bangladesh is about 7.25 and GDP is $2824 (FY-2022). But about 15 million people are ultra-poor and another 30 million people live under the poverty level (The Daily Sun, 2022). As a result government has to consider not only increasing food production in an intensive method but also to assure a balanced diet to the people at a lower price and fulfillment of SDGs goal 2. Mushroom production is getting a very popularity on the basis of nutritional point of view. Mushroom production comes into consequence as it has been considered as nutritious and delicious food since earliest time and recognized as distinct source of vegetable protein. Protein content of edible mushrooms ranges from 1.75 to 3.63% of their fresh weight and 20 to 35% as dry matter. Two essential amino acids that are deficit in cereals are rich in mushroom. It also provides significant number of vitamins (B1, B2, B12, C, D and E). Different trace materials such as zinc or selenium are also provided by mushrooms (Banglapedia, 2004). Besides, Mushrooms are benefitted for the treatment of different diseases like cancers, diabetes, blood pressure, immunity and weight management issues.

In Bangladesh mushroom cultivation was initiated in 1979 with the assistance of Japanese Overseas Cooperative Volunteer (JOCV) whereas the commercial mushroom cultivation was introduced by Bangladesh Agricultural Research Council (BARC) and Mushroom Culture Centre at Savar in early 1980s. Presently, numerous private spawn mother and fresh mushroom producing units are coming forward to enrich this potential market.

There are many methods of mushroom cultivation but bag cultivation, bottle cultivation, log cultivation and shelf cultivation are usually common. Rice straw, wheat straw, sugarcane waste, banana leaves, grass and sawdust are the major fibrous residues important for mushroom cultivation substrates.

It can be grown in the small space of a farmer’s own house for small scale production and generate income that aids in the family support. This is an exclusive crop for our

land shortage territory that doesn't require arable land as it can be grown in room by racking vertically with the help of crop leftovers. This farming requires little capital, short time, low technology and no chemicals. Therefore, it may be entitled as the most appropriate job for the poor landless both men and women farmers in Bangladesh. Farming it requires no extra land and can be grown in room by racking vertically on locally available cheap substrate materials.

Local government and NGOs can play vital role to develop mushroom agriculture to arise at industrial level which can create ample employment opportunities both in semi-urban and rural areas.

The lack of research work in this sector is the main hindrance of the growth of mushroom production. Very little economic study on mushroom cultivation at farmers' level has been conducted in order to satisfy the demand of extension workers, policy makers, research personnel, Non-Government Organization officials and the farmers. This is a study on the economic potential of mushroom production particularly on the large and marginal farmers. This study is expected to reveal the economic potential and problems of mushroom cultivation in Bangladesh. Considering the above importance of mushroom this research aims to estimate the profitability of the mushroom farming (both large and marginal scale); to analysis the resource use efficiency of mushroom cultivation and to assess the major factors affecting the mushroom production.

1.2 Research pertinent statement

1.2.1. Mushroom

The term ‘Mushroom’ was conceived from the French word ‘*Mousseron*’ (Rambottoom,1945). Mushrooms are quite exclusive and scientifically luscious organisms. These are entitled neither plant nor animal, but are still creatures as they operate all the life processes depending on other organisms. However, Hawksworth and Lücking (2017) speculated such fleshy spore-bearing fruiting substance as ‘Fungi’ has 2.2 million to 3.8 million species. Cho and Kang (2004) outlined mushroom as an idiosyncratic fruiting form which can be either epigeous (growing on or close to the ground) or hypogeous (growing underground). Its life span may be drawing from a spore which evolves to form a mass of branched hyphae of mycelia which colonize a substrate under favorable conditions (Dike et al., 2011). Mushroom is one of the most diverse organisms on earth and since primitive times have played a vital role in human welfare (martínez-ibarra et. al 2019). A mushroom is the fleshy and spore-bearing fruiting body of a fungus and belongs to the class Basidiomycetes under the order Agaricales in fungal classification, typically produced above the ground on soil or on its food substrate. It has been universally used as a food and medicine by different civilizations since ancient time due to its delicious taste, flavor, dietetic qualities and several medicinal properties(. ng’etich et. al 2013).

1.2.2. Mushroom intake and nutritional point of view

To fulfill the SDG requirement governments around world, explore new ways time to time. To ensure food adequacy and diminish hunger, a full package of nutrition diet is crying need for the welfare of rank and file. Regular intake of mushrooms could contribute a functional or medicinal influence within the individual’s diet.

Mushroom is apposite for all age groups, child to aged people because of plentiful in protein, dietary fiber, vitamins and minerals. The digestible carbohydrate profile of mushroom includes starches, pentoses, disaccharides, amino sugars and sugar acids (Manikandan, 2011). The total carbohydrate content varied from 26-82% on dry weight basis in different mushrooms. Minerals (Na, K, P) are higher in fruit bodies along with other essential minerals (Cu, Zn, Mg) (Sawyerr, 1991).

Aforementioned biochemical compounds in mushrooms are responsible for improving human health in many ways including promote immune function; boost health; lower the risk of cancer; inhibit tumor growth; help balancing blood sugar; ward off viruses, bacteria, and fungi; reduce inflammation; and support the body's detoxification mechanisms (Manikandan, 2011).

Therefore, the consumption rate is escalating day by day. Presently per capita consumption is 4.7 kg compared to about 1 kg/person/year in 1997 (Royse et al., 2017)

1.2.3. Commercial mushroom farming

Though the cultivation of this mushroom was prominent in the western hemisphere in early phases of its growth (Atkins, 1974) but it is steadily making inroads into the eastern part of the globe in the recent past. More than 200 species of mushrooms have been concluded as edible sustenance worldwide (Kalac, 2013), nevertheless about 35 species have been commercially conducted (Aida et al., 2009; Xu et al., 2011). Current commercial edible mushroom production amounts to approximately 34 million metric tons, representing a 30-fold increase over the last three decades (Royse, Baars, & Tan, 2017). Presently, China is the leading breeder of white mushroom contributing around 54% (2.37 million tons) of the total world production followed by Italy, USA and Netherlands (Royse et al., 2017).

The growing demand for nutritious food and increasing demand of processed food products has propelled the growth of the mushroom market in the Asia-pacific region. The mushroom market was valued at US$ 38,665.0 Mn in 2018 and is projected to be worth US$ 66,195.0 Mn by 2027, growing at a CAGR of 6.3% during the forecast period (Insight partners, 2019)

1.2.4. Degree of mushroom varieties

Environmental considerations must take into account the entire cycle of mushroom cultivation. Mushrooms prefer a cool environment with temperature about 20^{o}C and grow well at relative humidity levels of around 95–100% (Chang et al. 2004).

Mushrooms are sub-grouped into **three** groups according to economic status including edible, toxic and medicinal mushrooms (Ganopedia, 2011).

However, based on growing substrate medium, Dzomeku (2009) classified mushrooms into cellulolytic, lignocellulolytic and termitomyces categories.

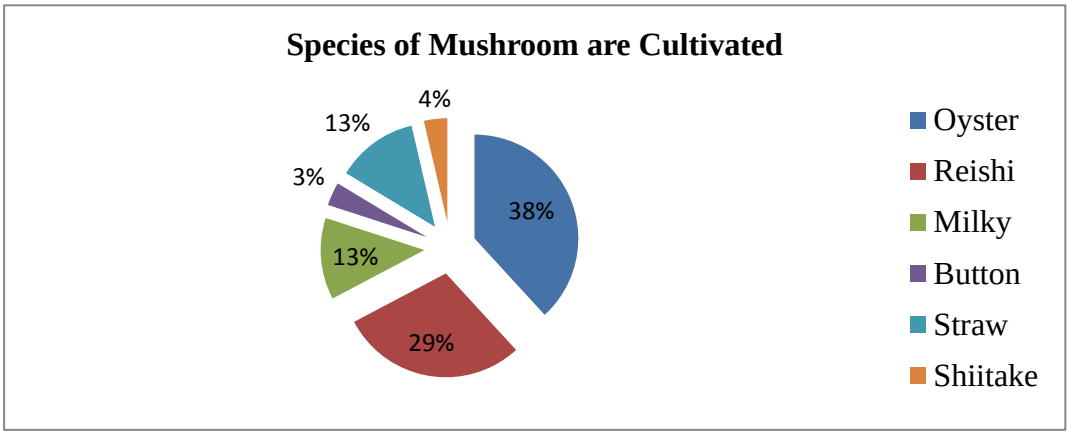
The cellulolytic mushrooms (including *Agaricusbisporus*) grow mainly on straw cellulose whereby the lignocellulolytics (including *Pleurotusostreatus*) escalate well on both straws and decaying wood as well as straw dust.

Table 1: All varieties of mushroom were registered in 2012

Mushroom Species	Variety name	Features
Oyster	NOM-1 (NAMDEC Oyster Mushroom 1), NOM-2, NOM-3, N0M-4, NOM-5, NOM-6	Biological efficiency (BE) more than 100% and can grow throughout the year
Shitake	NAMDEC Shittake Mushroom 1	High nutritional and medicinal value, BE more than 70%
Reishi	NAMDEC Reiishi Mushroom 1	High medicinal value and BE 28%
Milky White	NAMDEC Milky Mushroom 1	Very nutritious and tasty mushroom, BE 100%
White button		Grown in summer season and BE 30%
Straw		Year-round and rich in iron and vitamin B1 and B2
Wood Ear		Highly rich in vitamins and minerals
Enoki		Highly rich in vitamins and minerals
Monkey Head		High medicinal value can improve nervous system

There are several mushroom species and varieties, which have so far been produced or attempted for production in Bangladesh. MDI has already been released 9 varieties

of different mushroom species suitable for different seasons of Bangladesh (Table 1).



Source: (Ferdousi et al. 2020).

A study on mushroom growers in Savar upazila of Dhaka district revealed that farmers preferred oyster mushroom followed by reishi, straw, milky, button and shiitake for cultivation (Fig. 3)

Mainly oyster mushroom has been commercially adopted and extensively produced across the country due to its high market demand and suitability under Bangladesh condition (Amin et.al 2007). There are also some natural mushrooms like oal and Harin bash oal available in Chittagong Hill Tracts, and very popular to hill dwellers due to its aromatic fragrance (Mahmud MA 2016.).

1.2.5. Mushroom farming in Bangladesh

Mushroom is a very nutritious, delicious and fully 'halal' vegetable having medicinal qualities. Mushroom cultivation in Bangladesh began in 1979 with assistance from Japanese organization JOCDV. Later, Japan International Cooperation Agency (JAICA) came up in 1987 with its assistance. Mushroom cultivation slowed down in 1990 following withdrawal of JAICA's support. In 2003, the government introduced a Mushroom Development Project under Agriculture Extension department. Different research works are being conducted under the project in addition to providing, training on mushroom cultivation. 8 Apart from Savar, this project has activities in Dinajpur, Jessore, Barisal, Chittagong, Sylhet, Comilla, Khulna Mymensingh, Bandarban, Rangamati, Chapainawabganj and Rangpur fomotivating people to cultivate mushroom. Currently 13 species of mushroom are cultivated in Bangladesh

of which yester Mushroom is produced commercially to a large extent. Mushroom fanning is in fact a very easy job. There is an opportunity to make good profit by investing a little amount of capital and labor. One can earn Tk 4-5 thousand a month by investing only Tk 10- 15 thousand. The foremost rationale of this drift is due to the congenial role of the Government of Bangladesh and frequent proficient efforts of National Mushroom Development and Training Institute, Savar under the leadership of the Department of Agricultural Extension. As capacity enhanced in research and extension wing, now this institute is gradually meeting up the country climate viable spawn as well as mother specimen requirement. In Bangladesh, the inhabitants of hilly zones consume mushroom from early time. Although mushroom cultivation in Bangladesh has incredible prospect but due to unawareness, misconceptions, fanatism, deficient knowledge on nutrition and a flimsy idea against this food, mushroom is yet not to be familiarized widely in this country territory. Since then, after a lot of trauma and tragedy, farming of mushroom is picking up speed in Bangladesh day by day as evident by almost four times higher mushroom is produced in 2018-19 compared to 2009-10 (MDI, 2019).

Table 02: Mushroom production in Bangladesh

Year	Production (Metric ton)	% Change	Year	Production (Metric ton)	% Change
2009-10	10500	-	2014-15	32000	+6.67
2010-11	14500	+38.10	2015-16	34000	+6.25
2011-12	18000	+24.14	2016-17	36000	+5.88
2012-13	22000	+18.18	2017-18	37000	+2.78
2013-14	30000	+36.36	2018-19	40000	+8.11

(Source: MDI, 2019)

National Mushroom Development and Training Institute preserves strains under commercial terminology named WS, PO2, Flo, POP, PSS, PO-10, Hk-51 etc. Eight mushroom research laboratories have been allocated at eight districts under Integrated Horticulture and Nutrition Development Project (Siddique, 2006). Presently, numerous private spawn and mushroom producing units are coming forward to enrich this potential market.

1.2.6. **Oyster mushroom production technology outline**

Flowchart of mushroom production steps

Type of producer

Collecting mother specimen from NAMDEC

⇩

Choosing and sterilizing growth medium, covering with transparent polythene, inserting mother, and observing 10-15 days

⇩ ⇩

Assuring the spawn for marketing

Nominating spawn further into substrate for own farm purpose

⇩

Purchasing ready-made spawn from market or familiar farm house

⇩ ⇩

Selecting, preparing and sterilizing suitable growth substrate and adding accessory objects

⇩

Implanting crumbled spawn into the packaged substrates

⇩

Time to time observation and sprinkling water to check temperature and humidity up to harvesting moment

⇩

Harvesting fresh mushrooms by twisting carefully

⇩

Repeating the antecedent step after 7-10 days

⇩

Throwing away the leftover substrates or using these onto arable land

solo mushroom mother producer

Solo fresh mushroom producer

Figure 01: Flowchart of mushroom production technology (Sources: Ranasingh et al. 2010; Satankar et al. 2018; Pardo et al. 2013)

In Bangladesh three generic mushroom farmers may be distinguished including solo mushroom spawn producer, producer pertinent with both spawn and fresh harvest and only fresh mushroom producer.

1.2.7. Problems in mushroom production and marketing

Mushroom farming proved a lifeboat for grass root level individuals, but this group people confront various form of traumas. Major complications were identified including lack of proper cultivation house, unavailability of good spawn, capital shortage, lack of equipment's, lack of available market and promotion in local level, lack of storage facilities (Ferdousi et al. 2020). Bashar (2006) added two more problems counting price fluctuations at market and insect as well as disease infestation. Sharma et al. (2015) put more emphasis on quality spawn as well as mother specimen deficiency and climate as well as environmental stress aspects.

1.3. **Research questions**

Following specific and rational questions are incarnated to illustrate the present study.

a. What are the present socio-economic conditions of mushroom householders?
b. What profit level in the research area farmers obtain to?
c. How effective the resources have been utilized?
d. Which problems affect the farmers most in the cultivation?

This paper is magnified with a sequential step to depict the queries with pertinent and reasonable setups.

1.4. **Objectives of the study**

From the above lookouts, the current study portrays the ensuing objectives in accordance with the research queries:

1. To know the socio-economic profile of mushroom cultivators.
2. To measure the financial profitability of Mushroom cultivation.
3. To analysis the resource uses efficiency of Mushroom cultivation.
4. To find out the major problems arises in the Mushroom cultivation.

1.5. **Justification of the study**

In Bangladesh, horticultural crops play captivating sustainable roles in economic and social compass for enriching income and nutritional status, food and economic security. Therefore, its government attempts to enthuse farmers with several stimulus schemes and conscious farmers are grasping such chances for the sake of financial as well as environmental points of view. In the context of Bangladesh, mushroom is a promising crop and has a great importance as it is nutritious, tasty, major medicinal food. In densely populated rapidly growing Bangladesh the demand for food is increasing but the supply is facing imbalance. Besides, huge quantities of mushroom can be produced in a small fellow land. Moreover the climate of Bangladesh is favorable for the cultivation of mushroom throughout the year. It's an eco-friendly crop at the same time disasters tolerant. At present about 40,000 tonnes of mushroom valued ($ 92.3 million) are being produced every year. About 1.5 lakh people are involved in the production and marketing of mushroom (Asian news 2021). Almost all the economically developed countries of the world import mushroom, so there have great opportunity to export the food items. Further, hope that the country will move forward towards extensive mushroom cultivation and the government will take the necessary steps for its betterment.

This study will able to generate knowledge about efficient use of resources to enhance productivity. Explore information to the government that cultivation and development of mushrooms can positively generate equitable economic growth, reduce environmental pollution, and have an important social impact by increasing the possibilities of employment for women, youth and disabled, particularly in rural areas of Bangladesh. The study will also aid extension workers to learn the production problems of the mushroom and therefore they will able to give suggestion to the farmers related to various aspects of mushroom cultivation.

1.6. **Research framework**

This study encompasses seven principal chapters. Chapter 1 entitles the intro of the study. It is ornamented with an initial outline and objectives relevant to research questions. Next, chapter 2 carries on literature review that will reveal the antecedent study with compiled outcomes and deficits. Subsequent that, the materials and methods section in chapter 3 will present the roadmap of the entire study including data collection technique, regression model build up and related variable design, ethical matters and limitations. Chapter 4 & 5, naming description of the study area and socio-economic profile of sample proprietors, will delineate the entire community and environmental scenario. Chapter 6, financial profitability & resource use efficiency analysis of mushroom cultivation, will combine research consequences and explanation. Finally, chapter 7, the conclusion and summary will packet the research and portray the key findings. Furthermore, well-suited suggestions, study boundaries and pathways for further research will be portrayed.

CHAPTER II

REVIEW OF LITERATURE

A literature review is entitled as a study or, more accurately, a survey involving scholarly material, with the aim to debate published information a couple of precise topic or research question. Attempts had been made to accumulate secondary data for constructing an inclusive literature review from numerous sources keeping pertinent with research purposes.

2.1. Mushroom farming related antecedent studies

Barmon *et al.* (2012)in their study titled as 'Economics of Mushroom (Agaricusbisporus) production in a selected upazila of Bangladesh' observed the benefit cost ratio (BCR) was 1.55 and average family household income was BDT 43,731 generating from mushroom cultivation. Usually, three intermediaries (mushroom office, wholesalers and retailers) are involved in the marketing channels of mushroom. The marketing margin of mushroom for farm-gate to wholesalers and wholesalers to retailers were taka 50 and 70 per kg, respectively. They revealed that rich and middle-income group people were the main mushroom customers.

Ferdousi *et al.* (2020) with their 'Mushroom production benefits, status, challenges and opportunities in Bangladesh' study revealed that mushroom production required technical knowledge that entailed lucrative benefit cost ratio (BCR) of 1.55-4.25. Therefore, considering the country's limited land and over unemployed population,strengthening the mushroom production could be one of thesustainable options for the development of rural economy. Although, they explored unavailability of good spawn, capital shortage,lack of available market and lack of storage facilities as major constraints in doing business.

Hajaj and Pavlik (2014) in their study 'Profitability assessment of the Oyster mushroomcultivation on chosen wood species in conditions of the forestry practice' explored large-scale experiment on different growth substrates. This study entailed profitability index of 2.52 and 2-years discounted payback period on an average.

Imtiaj*et al.* (2009) asserted that the cultivation of mushroom is one of the lucrative agricultural job. The profitability of mushroom cultivation was found comparatively higher (almost double) than that of rice and wheat. Exploration further suggested that the potential of mushroom cultivation could be a possible offer to alleviate poverty and develop the life style of the vulnerable people in Bangladesh.

Jongmen*et al.* (2015) conducted *Pleurotusostreatus*crossing with *Pleurotusflorida*in their 'Economic profitability of oyster mushroom production in Botswana' research to calculate cost-profit analysis. The experimental yield was obtained a maximum profit level of 208%. They recommended such mushroom for small-scale farmers and unemployed youth as a whole.

Kader L.L.(2003) through his 'Impact on mushroom culture on farmer's livelihood in a selected area in Bangladesh' explored that mushroom farm BCR was 1.98 (total expenditure basis) and 3.28 (total variable cost basis). He found several constraints including lack of capital, high input price, low quality spawn packet, religious taboo and insufficient promotional activities that hindered mostly.

Khan *et al*. (2015) applauded the nutritional and financial points of mushroom species. They found that gross cost, gross returns and undiscounted BCR per year of mushroom production per season were BBT 2.84 lac, 4.63 lac and 1.63 respectively. They clearly stated that lack of research work in this sector is the main hindrance of the growth of mushroom production. In addition, their study indicated that per year gross returns were significantly influenced by the level of education, use of human labor and number of spawn (seed) packets of the farmers.

Kangotra and Chauhan (2013) in their study reported that inadequate supply of spawned compost bags, quality spawned compost material, lack of remunerative prices and incidence of disease were reported the major constraints requiring immediate attention of policy makers. For improving productivity, the study recommended the adequate supply of quality spawned compost bags at the doorsteps of growers at appropriate time and reasonable prices in addition to encouraging them to grow at least two crops in a year. Sale of mushroom under co-operative ambit especially by small growers may help them in fetching better price.

Mkpado and Mbadiwe (2013) also supported that that low-cost artificial substrate mushroom production and marketing hold some potential to create wealth and reduce poverty among small-scale farmers as well as improve nutritional status of households' members. It offered a way to mitigate the effects of climate change on availability of endangered forest species like mushroom.

Ranasingh*et al.* (2019) steered a survey on 231 household in Orissa mushroom cottage. They investigated that 4000 Indian rupees might be earned only from 100 beds of oyster mushroom. Low local price made this nutritious substance as a common food item.

Shakil *et al.* (2014)with their 'Mushroom as a mechanism to alleviate poverty, unemployment and malnutrition' exploration asserted that average 4-5 thousand BDT could be earned investing only 15-20 thousand BDT in a month period. It could create employment opportunities for marginal, educated and uneducated youth, person with disabilities and adolescent men and women respectively as mushroom does not require any cultivable land and can grow in room by racking vertically**.**

Singh *et al*. (2010) has analyzed the cost, returns and break-even point of mushroom production on different categories of farms. The study revealed that the fixed capital investment was more than double in large and medium farms as compared to small farms. The use of compost has a positive relationship with the farm size. Large farmers have lowest cost of mushroom production as compared to small and medium farms due to efficient utilization of fixed farm resources.

Uddin *et al.* (2011) transacted a study of four species of oyster mushroom: *Pleurotusostreatus*, *P. florida*, *P. sajor-caju* and P. high king cultivated in every season (January to December) in Bangladesh to perceive the environmental feasibility as well as economic efficiency. Among the mushroom realm, Oyster is one of the versatile mushroom due to its a broad spectrum of colors (including white, yellow, brown, tan and pink) and an exclusive scent. Production confronted at peak point in December to February and minimum during August to October time period.

Therefore, mushroom cultivation can reduce vulnerability to poverty and strengthens livelihoods through the generation of a profligate yielding and nutritious source of food and a consistent source of income.

2.2. **Prior study gaps**

Numerous pragmatic evidence and significant researches had been observed to enumerate the profitability and resource use efficiency of mushroom. However, most of them ignore the two common sub-types of producer (mother mushroom producer

and fresh mushroom producer) behavior currently exists in country border. As cultivation is spreading outside Savar upazila rapidly, investigation or research might be allocated across central part of Dhaka. Therefore, an attempt has been made to study the profitability level of two generic of producer end and observe which mode of farming is more time as well as cost efficient for beginners.

CHAPTER III

MATERIAL AND METHODS

Research methodology is the precise techniques or procedures used to classify and evaluate any study. Therefore, methodology along with valuable informative questionnaire (counting most of the quantitative data) has performed the role of pathway for this wide-ranging study. The methods and materials tracked in pointing this rational research are being described underneath: Farm management research depends on the proper methodology of the study. Proper methodology is a prerequisite of a good research. The design of any survey is predominantly determined by the nature, aims, and objectives of the study. It also depends on the availability of necessary resources, materials and time. There are several methods of collecting data for farm management research. A farm business study usually involves collection of information from individual farmers; collection of data for farm business analysis involves judgment of the analyst in the selection of data collection methods within the limits imposed by the resources available for the work (Dillon and Hardaker 1993).

In this study, "survey method" was employed mainly due to two reasons:

i. Survey enables quick investigations of large number of cases; and
ii. ii. Its results have wider applicability.

The major disadvantage of the survey method is that the investigator has to rely upon the memory of the farmers. To overcome this problem, repeated visits were made to collect data in the study area and in the case of any omission or contradiction the farmers were revisited to obtain the `missing and/or correct information. The design of the survey for the present study involved the following steps.

3.1. **Study Site observation**

The selection of an area fulfilled the particular purpose which was set for the study and also the possible cooperation from the farmer. Even mushroom is not grown all over Bangladesh, but the Dhaka is one of the important districts where it is grown quite extensively. So, on the basis of higher concentration of mushroom production, Savar upazila under Dhaka districts were purposively selected for the study.

The main reasons in selecting the study area were as follows:

a) Availability of a large number of mushroom growers in the study area;

b) These upazila had some identical physical characteristics like topography, soil and climatic conditions for producing mushroom.

c) Easy accessibility and good communication facilities in these upazila; and

d) Co-operation from the respondents was expected to be high so that the reliable data would be obtained.

In this study region almost 56% of the working people is engaged in agriculture (BBS 2020).

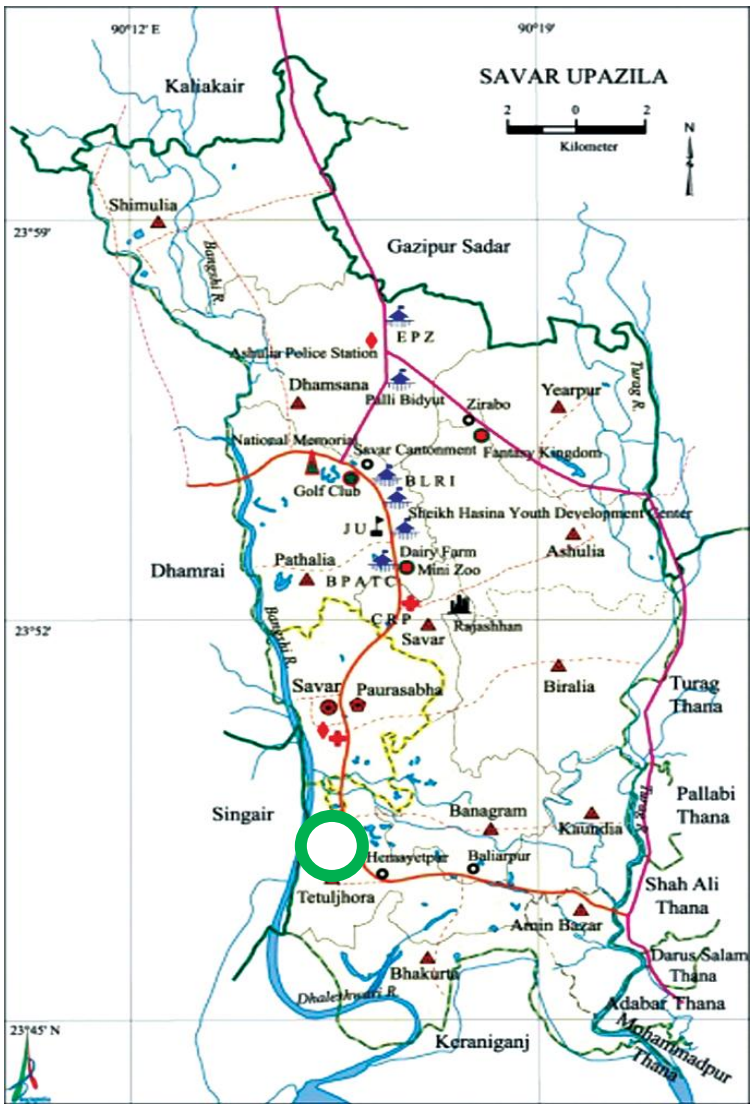


Figure 03: Survey locations at Savar Upazila (Signified with inner white and bold green colored circumference)

3.2. Sampling Procedure and Sample Size

In selecting samples for a study two factors need to be taken into consideration. The sample size should be as large as to allow for adequate degrees of freedom in the statistical analysis. On the other hand, administration of field research, processing and analysis of data should be manageable within the limitation imposed by physical, human and financial resources (Mannan 2001). However, because of diversity in the technical and human environment, it is necessary to sample several numbers of the population before any conclusion can be drawn. Therefore, the purpose of sampling is to select a sub-set of the population that is representative of the population (Rahman 2000). It was not possible to include all the farmers of the study area due to limitation of time, money and personnel.

Purposive sampling design was pursued to assemble sample farm house for this study. At the initiative stage, Survey locations were selected of which mushroom may be easily as well as swiftly delivered to the desired places. Sample was selected by simple random sampling according to the objective of the study. Sample size for this study was found out based on the statistical significance of this study and the following formula was used:

$$N = \frac{Z2\ p\ (1-p)}{d2}$$

Where: N= the desired sample size

Z= the standard nor10al deviate at the required confidence level, at 5% Type I error (which is z=1.65).

p= the proportion in the target population estimated to have characteristics being measured. (40%)

d= the level of statistical significance test,

at 10% level of significance sample size is: $\frac{(1.65)2\times.4\ (1-.4)}{(.10)2} = 44$

The minimum sample size was 44 respondents. However more than 44 samples data was collected. The research utilized a sample of 60 respondents. After that, Savar

upazila from Dhaka was selected for precise data collection. Finally, 60 growers were randomly selected for interview in terms of data accessibility, convenience and facile logistic supports. A purposive random sampling technique was followed in the present study for minimizing cost, time and to achieve the ultimate objectives of the study.

Producers were segmented into two categories:

Large scale grower (producing more than 1000-kilogramfreshmushroom / mushroom mother in a season)

Marginal scale grower (producing less than 1000-kilogramfresh mushroom / mushroom mother in a season)

Season extended from Late October to Early March consists of average 150 days

Table 03: Sampling framework of the mushroom grower in the study area

Location	Type of proprietors	Large scale grower	Marginal scale grower	In total
Savar (Dhaka**)**	Mushroom mother producer solely	10	8	18
	Fresh mushroom producer	12	30	42

(Source: Field study, 2021)

3.3. **Sources of data and data collection**

Secondary data sources of this study are:

- BDHS report 2017-18
- Articles
- Journals
- Websites and online documents
- Books
- and other documents.

Collected secondary data helped to conduct a detailed exploratory research based on previous study on the relevant topic which formed the literature review section of this study and this helps to select important variable needed for this study

3.4. **Period of Study**

Operative time management allows the researcher to affix the research efficiency (Chase *et al.* 2012).Thus, a precise time schedule was designed to purvey the relevant information .The data collection period was November 2020 to January 2021.

3.5. **Survey questionnaire Preparation**

A set of multi facet deliberate sample survey was possessed to collect fixed plotted information succeeding with the objectives of the study. Close-ended enquiries were explored according to the survey tactic. The required adjustments were adapted for a conclusive survey nature.

3.6. **Data collection method**

The basic data were assembled by face-to-face straightforward interview with the respondents according to survey nature. It was troublesome to collect detailed data since most of the households did not hold any chronicles of their diurnal activities in black and white. Some rejected to depict all the hidden fact as well as exaggerated about own selves. To overcome such jumbles, all practical efforts were applied. Before the interview start, each respondent was told about researchers' Master's study purpose.

3.7. **Processing of Data**

Strategies were employed during the data collection to lessen the plausible errors. The composed data were manually revised, shortened and examined prudently. Data were processed to transfer to facilitating tabulation to meet the study's objectives. Moreover, data entry was provided in computer and analyses were done using the concerned software Statistical Package for Social Science (SPSS). After obligatory checking local units was converted into standard worldwide units including kilogram, decimal.

3.8. **Analytical Technique**

To meet certain study objectives, several analytical methods were applied.

3.81. **Descriptive analysis**

Tabular and graphical analysis strategies were commonly used to expose the socio-demographic profile of the respondent and to demark the profitability of mushroom along with the incurred variable cost. Chronicle and descriptive techniques were followed to evaluate the complied data by using software named SPSS.

The farm economic analyses which include revenue, cost, gross margin and net farm profit were utilized for the estimation of cost and return of fresh mushroom or/and mushroom spawn production in the location. Total Revenue (TR) and the Total Variable Cost (TVC) was utilized to estimate the profitability of mushroom production in the area.

The gross margin model is expressed as:

GM = TR – TVC

Where, GM = Gross Margin; TR = Total Return; and TVC = Total Variable Cost.

After this, the BCR was estimated as a ratio of gross revenue and gross variable costs. The formula of calculating BCR (undiscounted) is shown below:

Benefit Cost Ratio = Total revenue / Total variable cost

Meanwhile, Efficiency ratio is used in analyzing a farm house's ability to effectively employ its resources, such as capital and assets, to generate revenue. Marginal value product (MVP) and Marginal Factor Cost (MFC) are required to measure this resource use efficiency.

Resource use efficiency (RUE) = MVP / MFC

MVP= $\boldsymbol{bi\frac{Gm\,(Y)}{Gm)(Xi)}}$

Here,

bi = value of coefficient of Cobb-Doglas production

Y= gross return

Xi= value of inputs (Gm means geometric mean)

MFC= Marginal factor cost = per unit price of output

Table 04: Value of RUE & its meaning

Value of RUE	Meanings
RUE=1	Optimal use of resources
RUE < 1	Over utilized of resources
RUE > 1	Underutilized of resources

3.8.2 .**Empirical analysis**

3.8.2.1. **Hypothesis procreation**

Research regression need to have hypothesis for acknowledging the significance.

Null hypothesis, H_o = Multi facet incurred costs had no influence on mushroom gross return/output,

Alternative hypothesis, H_1 = Multi facet incurred costs had significant level influence on mushroom gross return/output.

3.8.2.2. **Contextual framework of the study**

Under methodological study, selection and estimate of variables is a key task. The contextual framework of Rosenberg and Hoveland (1960) was rationalized while possessing layout for the dependent and independent variables that is delineated in Figure 02.This rational study focuses on two lime-light: the first, the exclusive factors influencing producer revenue and the last one, problems met due to such cultivation.

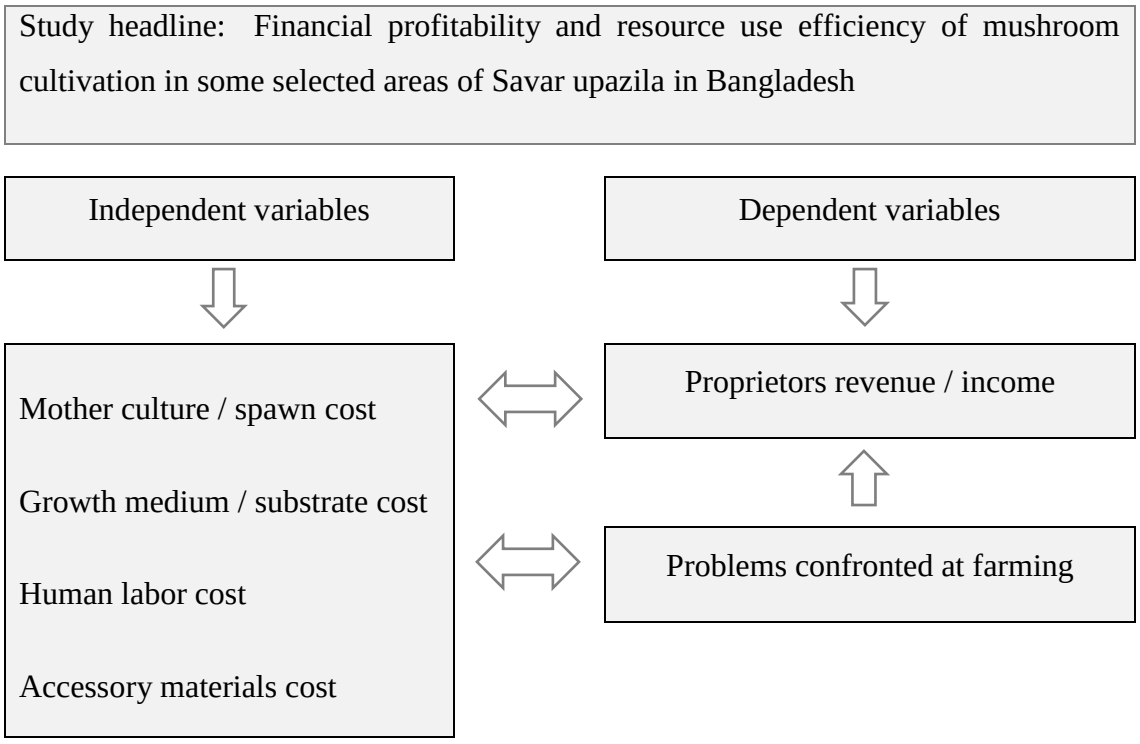


Figure 02: Background framework of research
(Source: Researcher's own strategy, 2021)

3.8.2.3. **Regression model fitting**

A mathematical concept of Cobb-Douglas production function may be expressed to weigh the factors affecting the level of revenue outcome. The specification of the Cobb-Douglas production function for mushroom production was as follows:

$$\mathbf{Y = \alpha X_1^{\beta 1} X_2^{\beta 2} X_3^{\beta 3} X_4^{\beta 4}}$$

By taking log in both sides the Cobb-Douglas production function was transformed into the following form because it could be solved by the ordinary least squares (OLS) method.

$$\mathbf{\ln Y = \ln \alpha + \beta_1 \ln X_1 + \beta_2 \ln X_2 + \beta_3 \ln X_3 + \beta_4 \ln X_4 + e}$$

Where,

Y = Gross income (BDT per kilogram production)

X_1 = Cost of mother culture / spawn (BDT per kilogram production)

X_2 = Cost of growth medium / substrate (BDT per kilogram production)

X_3 = Cost of human labor (BDT per kilogram production)

X_4 = Cost of accessory materials (BDT per kilogram production) [It includes polythene, chalk powder, any chemical substances]

α = Intercept

β_1, β_2 --------- β_4 = Regression coefficients of the respective variables to be estimated

e = Random error

3.9. **Measurement of independent variables**

Independent variables under this study were six selected features, namely: cost of mother culture / spawn, cost of growth medium / substrate, cost of human labor and finally, cost of accessory materials.

3.9.1. **Cost of mother culture / test tube specimen**

In study, three generic farmers were identified. In case of solely mushroom mother or sub-mother producer, his/her input cost would be only for test tube specimen. However, solely fresh mushroom producer, his/her incurred input cost would be only ready-made mother / sub mother spawn purchased from others. Meanwhile, farmer pertinent with A to Z mushroom production, his/her chief cost would be incurred for mother culture and partially for spawn in instance situation.

3.9.2. **Cost of growth medium / substrate**

Oyster mushrooms are saprophytes, decomposers in an ecosystem growing on organic matters like wood, leaves and straw in nature. Raw materials as substrate including rice straw, saw dust, sugarcane bagasses can be used in commercial fresh mushroom cultivation. Meanwhile, spawn producer would require unhusked paddy/maize/wheat seed for the growth medium purpose of mycelium spread.

3.9.3. **Cost of human labor**

Human labor ship is provided into three forms including personal/own family labor, fixed labor (monthly based salary) and daily labor (daily wage). Mushroom grower needs technical cognizant as well as physically active labors to operate diurnal performances. Multi facet labor produce diversified costs.

3.9.4. **Cost of accessory materials**

Major accessory materials used during cultivation include polythene, chalk powder, any chemical substances (such as fungicide or bactericide or growth agent). These materials seem to be tiny but entail a mediocratic high cost.

3.10. **Study variability and reliability**

The survey was 60 farm houses oriented at Savar upazila. Market survey as well as discussion with mushroom specialist at MDRI was made for precise estimation. Information purveyed from these later two sources were 90% similar the collected data from farmers. Therefore, data accuracy and reliability can be legitimately ensured. Moreover, researcher made consistency with the seasonal and community aspects for better data compilation.

3.11. **Ethical perception of research**

Appointments were accepted before farmer interviews and each respondent was well informed about the nature and purpose of the study. No exaggerated or misleading questions were asked which might violate the confidentiality or privacy aspects. Transparent responses were chronicled and farmers consent was occupied.

3.12. **Limitations in data compilation**

The primary constraints were the time boundary. Moreover, ceaseless expedition was not plausible due to Covid-19 pandemic situation. Additionally, unexpected interference from the side-talkers while accumulating data from the target

CHAPTER IV

DESCRIPTION OF THE STUDY AREA

A short description has been presented in this chapter to know the overall features of the study area. It is essential to know the agricultural activities, possible development opportunities and potentials of the study area. Location, area, population, monthly average temperature and rainfall, agriculture, occupation, communication and marketing facilities of the study area are discussed in this chapter. However, for the production of mushroom, it is very essential to know the climate and topography of the study areas.

4.1 Location

The selected sample farmers are located in four villages of Savar upazila is under the Dhaka district. These four villages are located from 10 to 15 km of the upazila headquarters. The locations of the upazila are presented in the Map 4.1

4.2 Area and Population

The total area, population and density of population of the selected upazilas are presented in Table 4.1 .The highest population density (4948 per sq.km) is Savar .

Table 05: Population Size of Upazilas under the Study Areas

Upazila	Area(square kilometer)	Population	Population density	%Male	%Female
Savar	280.11	1385910	4948	52.27	47.73

4.3 Climate, Temperature and Rainfall

The climate, temperature and rainfall are very important factors for production of any other crops. There was no local arrangement of meteorological center for recording temperature and rainfall in the study area. It is basically warm and humid in Dhaka. Maximum temperature of the study areas varies from 41.8°C to 32.2°C and minimum temperature varies from 6.0°C to 14.8°C (Table 4.2). The annual total rainfall of the study areas varies from 893mm to 2040mm (Table 4.4).

Table 06: Average Maximum and Minimum Temperature (°C) in Selected Station

Name of Station	2015		2016		2017		2018	
Savar	Max	Min	Max	Min	Max	Min	Max	Min
	38.5	14.8	35.5	12.8	32.4	12.2	40.82	14.8

Table 07: Annual Total Rainfalls in Millimeter & Humidity in Selected Station

Name of Station	2015		2016		2017		2018	
Savar	Rainfall	Humidity	Rainfall	Humidity	Rainfall	Humidity	Rainfall	Humidity
	2197	62%	1181	72.5%	2490	66%	2490	70.42%

Source: BWDB report on Summary of Rainfall in Bangladesh for the period of 2017 & 2018

CHAPTER V

SOCIO-ECONOMIC PROFILE OF MUSHROOM PROPRIETORS

This chapter delineates the socioeconomic characteristics of the sample proprietors. Such numerous interrelated and constituent attributes characterized an individual farming pattern profoundly.

5.1. **Socio-economic profile**

The socio-economic profile was essential to have an overall idea about the present farm activities and farm enhancement possibility. Therefore, info regarding respondents age structure, gender, level of educational and technical knowledge, family size with family labor support, occupation nature, capacity of production level, marketing feasibility were recorded as discussed below:

5.1.1 **Age distribution**

The influential proprietors (81.33%) were in the age group of 35-50 years followed by the age group less than 35 years. Low percent was 8.3% under the age group more than 50 years (Table 03). As this is technical efficiency related old aged proprietor generally showed apathy in mushroom farming.

Table 08: Age distribution of respondents in study area

Categories (years)	Responded farmers			
	Large	Marginal	Total	% in total
Young aged (up to 35)	1	5	6	10
Middle aged (35-50)	19	30	49	81.33
Old (above 50)	2	3	5	8.33

(Source: Field study, 2021)

5.1.2. **Level of educational and technical knowledge**

More than 21 percent farmers had higher education and majority of the respondents (65%) were secondary. However, about 13% proprietors were literate or basic educated who also showed interests in mushroom farming.

Table 09: Respondents education level in study area

Categories (class)	Responded farmers			
	Large	Marginal	Total	% in total
Primary or basic (1 – 5)	0	8	8	13.13
Secondary (6 – 10)	14	25	39	65
Higher (over 12)	8	5	13	21.67

(Source: Field study, 2021)

5.1.3. **Family size and family labor availability**

The average family size comprised four members per family, which is less than national statistics (4.7) (BBS, 2020). About 74% members of a family are available as a family labor for mushroom farming.

Table 10: Responded proprietors family size and family labor availability

Categories	Responded farmers			% family labor in respect to members
	Large	Marginal	Mean	
Family members	3.8	4.3	4.05	74
Active earning member	2.1	2.7	2.4	
Available family labor for mushroom	2.9	3.1	3	

(Source: Field study, 2021)

5.1.4. **Occupation nature**

Considering their household revenue sources, the respondents were classified into several sorts: agriculture, business, transport service provider, remittance privileged, official job (public/private), apprentice and other earning sources. Table revealed that the highest proportion of the respondent (31.7%) had income from business solely while 26.7% had to earn livelihood through agrarian activities directly.

Table 11: Earning source of respondents in study area

Categories	Responded proprietors			
	Large	Marginal	Total	% in total
Agriculture	2	8	10	16.7
Business	12	7	19	31.7
Transport service provider	0	3	3	5
Remittance privileged	2	0	2	3.2
Official job (public/private)	4	12	16	26.7

(Source: Field survey, 2021)

5.1.5. Agricultural Training:

Among the respondent farmers in Savar upazila, its 75% percent farmer's got training of mushrooms farming (Table 4.3). These training have improved their perceptions of good seed use, use of resistant varieties, application of insecticides and pesticides, water management, and so on.

Table 12: Agricultural training scope

Training Received	Responded farmers			
	Large	Marginal	Total	% in total
Yes	15	30	45	75%
No	5	10	15	25%

5.1.6. Membership of any social organization

Among the respondent farmers in Savar upazila, 90.00 percent mushroom producers were found to have membership in different NGOs and/or farmers' organizations

Table 13: Membership of any social organization

Training Received	Responded farmers			
	Large	Marginal	Total	% in total
Yes	18	30	48	80%
No	5	7	12	20%

4.1.7. **Women participation/assistance**

Women involvement was found significantly in labor sources under the survey zones. Women community was engaged with crop caring as well as post-harvest practices and these proportionate were enriching day by day. Overall medium level participation rate was higher (56%) in this area. However, their participation in sale and marketing was less found.

Table 14: Women participation at responded proprietor's farm

Categories (score)	Responded farmers			
	Large	Marginal	Total	% in total
Low participation	3	5	8	13.3
Medium participation	14	20	34	56.7
High participation	5	13	18	30

(Source: Field survey, 2021)

4.2. **Nature of mushroom production and marketing**

5.2.1. **Capacity of production level**

It denoted the nature of cultivation house and the accommodation pattern of spawn as well as packetized substrate inside farmhouse. Table 08 depicted that most of mushroom structures were built at own house yard and hanging pattern system.

Table 15: Nature of production house and its accommodation pattern

Categories	Respondent farmhouse									
	Large				Marginal				Total	in %
	a.	b.	c.	d.	a.	b.	c.	d.		
Inside residence	2	1	2	0	3	1	4	5	18	30
Infrastructure at yard	2	5	2	0	6	2	7	0	24	40
Set-up on rented place	2	5	1	0	2	4	2	0	16	26.7
Public place	0	0	0	0	1	0	1	0	2	3.3

(Source: Field survey, 2021)

a. bamboo macha , b. iron & PVC pipe combining rack, c. hanging pattern and d. plain floor system respectively

5.2.2. **Types of mushroom producer**

Basically, two generic mushroom proprietors may be distinguished including solo mushroom mother/sub mother producer & fresh mushroom producer in survey area.

Table 16: Nature of mushroom producer

Nature of producer	Responded farmers			
	Large	Marginal	Total	in %
Mushroom mother producer solely	10	8	18	30
Fresh mushroom producer	12	30	42	70
Total	22	38	60	100

(Source: Field survey, 2021)

5.2.3. **Marketing feasibility**

Proprietors followed several ways to provide the mushroom on customers plate. Previously, most of the harvested mushrooms were sold through contractual production. Presently, internet and ICT development entailed 36.6% sales via home delivery.

Table 17: Ways of marketing mushroom

Marketing place	Responded farmers			
	Large	Marginal	Total	% in total
Farmhouse display store	2	2	4	6.7
Public institute premises	4	12	16	26.7
Local market	2	6	8	13.3
Direct to central Dhaka – Home delivery	10	12	22	36.6
Contractual production	4	6	10	16.7
Total	22	38	60	100

(Source: Field survey, 2021)

5.4. **Concluding remarks**

5.4.1. **Socio-economic context of household and vicinity**

Study found active age group ranged 31-50 years majorly up to 67% followed by the age group over50 years. Exploration also exposed that about 46% were secondary literate. About 63% household labors were available for mushroom farming activities. Mainstream income earning of proprietors (46%) was non-agrarian business which portrayed mushroom farming a side business to the respondents under study area. 75% of respondent participated in various training programs that improved their perceptions of good seed use, use of resistant varieties, application of insecticides and pesticides, water management. About 80% of respondent had membership in various social organizations.Medium level women participation (including crop caring and harvest) was found significantly. High women involvement feasibility depicted less labor cost and met up SDG target five ultimately.

Most of time mushroom farm infrastructures were built at home yard with hanging pattern model for cost solvency. Major two type proprietors were explored including mushroom mother/sub mother producer (27%) and fresh mushroom producer (73%). Presently, ICT cognized farm owners operated their harvest market through online home delivery (33%) as well as contractual method (26%). However, most of the proprietor at Dhaka or near Mushroom Development Institute (MDI) desired to sale their product at MDI premises.

CHAPTER VI

FINANCIAL PROFITABILITY AND RESOURCE USE EFFICIENCY ANALYSIS OF MUSHROOM CULTIVATION

This chapter includes benefit cost analysis of mushroom, resource use efficiency measurement during farming and constraints behind this crop cultivation pattern.

6.1. **Comparative profitability analysis of mushroom farming**

Participants were inquired about their variable and gross return. Both variable cost and return are brought under consideration to measure the BCR. Fixed cost was considered as a rent cost of different infrastructure and enumerated concisely. Meanwhile, variable costs were mentioned due to continuous expenditure mainly influence the mushroom revenue. The cost of mushroom varies depending on producer nature, mushroom variety, time and place.

Table 18.A: Comparative analysis of variable costs and returns of per kilogram Oyster mushroom farming in Bangladeshi Taka

Particulars (per kilogram BDT)	Solely mushroom mother producer	Fresh mushroom producer
A. Gross return		
Mushroom mother/ sub-mother	70-75	0
Fresh Mushroom	0	200-250
B. Variable cost		
Test tube (100ml)	50	0
Mother/ sub mother (1 packet)	0	20
Labor salary / wage (1 day)	450	450
Substrate / growing medium		
1kg rice or wheat seed	45	0
1 kg Straw	0	15
Cotton & plastic Neck (100 pcs packages)	350	350
Polythene 1 kg	100	100
Chalk powder/ Chemical substances 1 kg	50	50
Chemical substances 1kg	250	250
Utility charges(1 month)	1500	3600

Table 18.B: Comparative analysis of variable costs and returns of per kilogram Oyster mushroom farming in Bangladeshi Taka

Particulars (per kilogram BDT)	Solely mushroom mother producer	Fresh mushroom producer
A. Gross return		
Mushroom mother/ sub-mother	72.24	0
Fresh Mushroom	0	200.1
B. Variable cost		
Test tube	1.05	0
Mother/ sub mother	0	20.1
Labor salary / wage	7.36	22.4
Substrate / growing medium	16.61	15
Cotton & plastic Neck	1.5	1.5
Polythene	.50	.50
Chalk powder/ Chemical substances	.50	1
Utility charges	.33	1.9
Total variable cost =	27.83	62.4
C. Fixed Cost		
Cultivation site rent and arrangement	3.15	4.2
Spray and weight machine	0.6	0.7
Total fixed cost =	3.75	4.9
D. Total Cost	31.58	67.3
E. Gross margin (A-B)	44.39	137.5
F. Net margin (A-D)	40.7	132.8
G. BCR (on TVC)	2.6	3.21
H. BCR (on TC)	2.29	2.97

(Source: Field survey, 2021)

Pointedly, BCR of mother/ sub mother production was found significantly lower than fresh mushroom cultivation. However, cognizant proprietors desired to produce more mother/sub mother due to short time cycle and easy market capturing. Meanwhile, new enterprises were fresh mushroom cultivation oriented as they had less technical materials than the antecedent mother manufacturing proprietors.

6.2. **Factors affecting the Oyster mushroom production**

Cobb-Douglas production function was established to find the variable significance as well as relevance statistics to find out the pertinent efficiency.

Table 19: Estimated Values of Coefficient and Related Statistics

Explanatory variables	Estimated Coefficient	Standard error	T value	P-Value
Cost of mother / test tube specimen (X_1)	0.425*	0.063	6.786*	0.001
Cost of growth medium /substrate (X_2)	0.435*	0.109	3.986	0.001
Cost of human labor (X_3)	- 0.465**	0.177	-2.629	0.011
Cost of accessory materials (X_4)	0.635*	0.121	5.265	0.000
Intercept	3.103	0.281	11.056	0.000
Return to scale	1.03			
R^2	0.984			
Adjusted R^2	0.981			
F-Value	425.49			

*,**,*** indicates the 1%, 5%, 10% level of significance

(Source: Field survey, 2021)

6.2.1. **Co efficient interpretations**

Cost of mother / test tube specimen (X_1) was found positive association representing 0.425at 1 percent significant level for mushroom production. It implies that 1 percent increase in the cost of mother / test tube specimen, keeping other factors constant, would increase gross revenue by0.425 percent.

In addition, the regression coefficient of growth medium / substrate (X_2 = 0.435) was also positive and significant for mushroom revenue. It implies the 1 percent increase in the cost of substrate/growth medium, keeping other factors constant, would aggrandize gross returns by 0.435 percent.

Meanwhile, cost of human labor (X_3) had a negative liaison with mushroom output revenue Estimated coefficient of human labor cost was 5 percent significant with value (-0.465). It implies that 1 percent increase in the cost of labor as additional expenditure would decrease gross returns by 0.465 percent.

Finally, accessory materials cost (X_4) was found positive impact on mushroom output. Estimated co-efficient 0.635 indicated that 1 percent rise in the cost of accessory materials for mushroom commercialization, remaining other factors constant, would increase gross returns by 0.635 percent.

6.2.2. **Adjusted R^2, F value and Return to scale**

The adjusted R^2 for mushroom commercialization was found to be 0.981 which indicated that about 98.1 percent of the variations of the output were described by the explanatory variables included in the model.

Meanwhile, The F-value for the mushroom production was measured at 375.22 which were highly significant at 1 percent level. It means that the explanatory variables included in the model were vital for interpreting the variation in gross revenue of mushroom farming.

From the table we show that summation of coefficient is 1.03 it implies that increasing return to scale. If a farmer invested 1 taka in mushroom farming he will get 1.03 taka as a return.

6.3. **Resource Use Efficiency in mushroom production**

The ratio of MVP and MFC of mother specimen (0.82) for mushroom production was positive but less than one, which indicated that in the study area mother / test tube specimen was over used (Table 20). Therefore, proprietors should increase the use of test tube specimen/ mother or sub-mother to attain efficiency considerably.

Table 20: Resource Use Efficiency measurement in Oyster mushroom farming

Explanatory variables	coefficient	Gm	MVP	MFC	MVP/MFC	Comment
Cost of mother / test tube specimen (X_1)	.425	7.58	11.21	12.86	0.871	Overused
Cost of growth medium /substrate (X_2)	.435	8.90	9.77	8.61	1.13	Underused
Cost of human labor (X_3)	-.465	8.7	-10.68	9.15	-1.16	Overused
Cost of accessory materials (X_4)	.635	7.45	17.04	35.23	.483	Overused

Table 20 showed that overall MVP for specimen is 11.21 it implies that addition of one unit of specimen would have increased gross income by 11.21 tk. Table 14 also showed that the ratio of MVP and MFC of growth medium/substrate (1.13) for mushroom farming was positive and greater than one, which indicated that growth medium/ substrate was underused. Need to be efficiently use resources to develop growth medium for mushroom cultivation.

Further, table portrayed that ratio of MVP and MFC of test tube specimen (.873) for mushroom farming was positive and less than one, which indicated that specimen are overused.

In addition, table portrayed that ratio of MVP and MFC of human labor (-1.16) was negative and less than one, which indicated that human labor was over used.

Finally, ratio of MVP and MFC of accessories materials used in mushroom farming (.483) was positive and less than one, which indicated that this resource was over used.

6.4. **Problems confronted at mushroom production**

Mushroom production evidenced a spring for root level individuals, but this group people confront most of trauma. The crucial complications were environmental stress

(90%) and mushroom disease & insect outbreak (85%) and market price complexity (77.5%). Furthermore, societal superstition and fanatism (90%),

Higher price of technical cognizant labor (80%) and lack of quality test tube specimen/ mother (67.5%) were also cited at farm house levels.

Table 21: Problems confronted at mushroom production and marketing activities

Particulars	% of proprietors responded		Mean	
	Large	Marginal		Rank(th)
Lack of quality test tube specimen/mother	60	75	67.5	6
Disease and insect infestation	80	90	85	3
Environmental stress complexity	88	92	90	1
Lack of credit feasibility	50	60	55	7
Market price complexity	75	80	77.5	5
Lack of transport conveniences	20	25	22.5	8
Societal superstition and fanatism	90	90	90	2
Non-availability and higher price of labor	76	84	80	4

(Source: Field survey, 2021)

6.5. **Concluding remarks**

6.5.1. **Comparative profitability analysis mushroom farming**

Labor wage and substrate/growth medium were the most expensive inputs in the production mushroom. Together these formulated over 50% of total variable cost.

Four cost items: mother/test tube specimen, substrate/growth medium, human labor wage and required accessories materials (including cotton & plastic neck, polythene, chalk powder / chemical substances, utility charges) were considered as variable expenditure. For instance, mushroom mother producer required test tube specimen, growth medium, human labor wage and required accessories materials expenditures were BDT 1.05/kg; BDT 16.61/kg; BDT 7.36/kg; BDT 26.06/kg and BDT 3.83/kg by

correspondingly (Table 14). Meanwhile, in fresh mushroom production, per kilogram mushroom variable cost including mother/sub-mother, substrate, human labor wage and required accessories materials were BDT 20.10;BDT 15; BDT 22.4and BDT 4.90 separately.

The average per kg gross return in mushroom mother and fresh mushroom were BDT 72.24 and BDT 200.10 respectively (Table 14). Benefit cost ratio was estimated at 2.6 and 3.21. However, BCR in mushroom mother manufacturing were little bit less than fresh mushroom, technical cognizant proprietors incited to produce the basic mother/sub mother due to less production cycle and less market competition mainly.

Therefore, household were easily enthused with mushroom commercialization and made this seasonal revenue generation on its peak point.

6.5.2. **Explanation of regression function estimated values**

After exploring information, Cobb-Douglas production function was designed. The values of adjusted R^2 and F asserting 98.1%, and 375.22 specified the variance of explanation in the dependent variable with respect to independent ones and ultimately represented the suitable data fitness of model.

Cost of mother / test tube specimen was found positive association representing 0.425 at 1 percent significant level for mushroom production. It implies that 1 percent increase in the cost of mother / test tube specimen, keeping other factors constant, would increase gross revenue by 0.425 percent. In addition, the regression coefficient of growth medium / substrate (0.435) was also positive and significant for mushroom revenue.

Meanwhile, cost of human labor had a negative liaison (value – 0.465) with 10 percent significant in mushroom output. It implies that 1 percent increase in the cost of labor as additional expenditure would decrease gross returns by 0.465 percent. Finally, accessory materials cost was found positive impact on mushroom output with estimated co-efficient 0.635 indicated that 1 percent rise in the cost of accessory materials for mushroom commercialization would increase gross returns by 0.635 percent.

6.5.3. **Explanation of resource use efficiency units**

Study explored that substrate/growth medium was underutilized as their RUEs were over one. Meanwhile, mother specimens and other accessory materials RUE score were under one denoting overutilized. Therefore, there was an immense opportunity to aggrandize farm productivity by utilizing resource efficiently.

6.5.4. **Problems confronted at mushroom farming**

Although mushroom farming was reasonably profitable, household confronted multi facet difficulties during production stages. Financial damage due to environmental stress, mushroom disease & insect outbreak, market price fluctuations, societal superstition and fanatism, higher wage of technical cognizant labor (80%) and lack of quality test tube specimen/ mother were found from alpha to omega in signature mushroom farming.

Therefore, a well-established management would curtail such problems and attain a promising financial turnover in all grass root level.

CHAPTER VII

SUMMARY AND

CONCLUSION

This is the compressed chapter of the entire paper. Now, time to cover up the research's key findings into concise. Section 6.1 portrays a summary of this exclusive study. Recommendations, conclusion, limitations of the study and further research opportunity are depicted in sections6.2, 6.3, 6.4 and6.5.

7.1. **Summary**

Entire thesis paper was furnished with four apposite objectives.

First objective delineated the socio-economic scenario of mushroom proprietor's household status. Survey stated that farming mushroom upgraded their living standard.

After that, second objective portrayed the profitability of oyster mushroom farming including mushroom mother solely and fresh mushroom production. Study asserted that a good turnover surveyed from the mushroom culture blessed by advanced technology.

Third objective of the paper was resource use efficiency measurement. This depicted that how the input resources were effectively utilized. Research found that labor and substrate resources underutilized and mother/test tube specimen and accessory materials were over utilized.

Finally, the last objective dealt with the problems arises during oyster cultivation and marketing of harvest. Multi-facet problems were chronologied with severity. Some suggestions are awaiting in the following section to overcome such hindrances.

7.2. **Recommendations**

On the basis of the results of the explorations it is apparent that mushroom is profitable enterprises and can generate more incentives & employment prospect to the grass root level. Therefore, under mentioned apposite strategies may be employed for ensuring more production willingness of mushroom in one hand and higher profit of the household on the other.

i. Operating as a joint force to support the production

Research organizations, Academic institutions, extension authorities and trade associations should support producers as a multi force. With systematic intervention of extension activity, producers will be familiar with sustainable farming profitability and highly encouraged to further signature crop cultivation.

ii. Amplifying efficient operations of DAE in outlying locations

Exploration reveals that more promotion to advanced technology, more growers are enthused to cultivate the superior ones. Now, DAE may aggrandize a one-stop service center for the outlying producers with support of local government agency. In the interest of the national broadcasting of mushroom, market information through radio and television should be empowered.

iii. Ensuring more engagement of women than before

Empowering women is not only beneficial for their own socio-economic well-being but also imperative for sustainable livelihoods of communities. The extension staffs should provide regular visit to build and strengthen the networks among women community. Finally, socializing the concept of gender awareness by community and religious leaders will influence rampantly.

iv. Enacting propitious timely policy

The government should enact synergism approach for the producers, traders and consumers. Authorities should provide competent certification schemes to match standard qualifications. Finally, establish fair market price for the product will stabilize farm houses' income.

7.3. **Conclusion**

On the basis of the findings of the present study it can be concluded that, significant scope apparently exists in the study area to increase the productivity of mushroom and to raise income, employment and nutritional status of the people and for national growth. Mushroom cultivation upgraded the socio-economic status of the househods and exposed positive results. Though Bangladesh does not have enough land acreage

to feed the people, she is blessed with a low cost labor, plentiful supply of raw material and other inputs, technical know-how suiting our favorable climate conditions. Specifically, this study acknowledged the factors affecting the farm house revenue as well as the resource use efficiency. The results portrayed that cost of mother/ test tube specimen, labor, substrate/growth medium and accessory materials significantly stimulated the oyster mushroom production. Meanwhile, farm resources were not efficiently utilized including underused mushroom mother/specimen and accessory materials, substrate/growth medium and labor are overused. Production inputs were not optimally allocated. This exploration also suggested introducing advanced marketing facilities supervised by DAE, introducing different agricultural term loans to the mushroom cultivators, motivating and training the cultivators to produce not only the raw mushroom but also produce variety mushroom products, introducing advanced storage facilities, letting more women community engagement and formulating policies aimed at efficiently addressing producers problems would boost the mushroom cultivation at grass root level. Finally, minimizing the existed farming problems with effective measures could facile more farm investment and ultimately lead toward nutrition self-effieientas well as as accelerate welfare procession. The government authority should prioritize the project to promote mushroom cultivation as a weapon of poverty alleviation and fulfill SDG goals through generate income, employment opportunity and improve environmental sustainability.

7.4**. Limitation of the study**

Considering money, time and other obligatory resources accessible to the researcher, it was necessary to levy some margins as stated below:

i. The study was kept to sixty selected households for the exploration.

ii. Only four major variable cost factors were brought for exploration in this study.

iii. The researcher counted on the data furnished by the respondent limited within the heads of farm houses with their memory during interview.

iv. Various blocks during cultivations are likely to be faced by the grassroot farmer. However, only eight difficulties had been reflected for investigation in this study.

7.5. **Scope for further research**

Original motive behind this research was to enumerate oystermushroom profitability and efficiency ratio with respect to some premeditated factors across country. However, considering time and capital inadequacy, it was not credible for the researcher to explore other locations far from the central Dhaka. Hence, onlys elected area of Savar upazila under Dhaka district was brought under exploration. Additionally, small sample survey was occupied during Covid-19 pandemic situation as continual expedition was also challenging. Thus, this specified research findingmay not rationalizethe efficiency ratio as a whole. Therefore, a multi facetscope of further survey to estimate the associationbetweenother correspondingcost factorsand cultivation feasibility on other region equivalent with this study area is plausible for take a broad viewof the result.

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APPENDICES

Appendix I

Department of Agricultural Economics

Sher-e-Bangla Agricultural University

An Interview Schedule for a research study entitled

"**FINANCIAL PROFITABILITY AND RESOURCE USE EFFICIENCY OF MUSHROOM CULTIVATION IN SOME SELECTED LOCATIONS OF SAVAR UPAZILA IN BANGLADESH**"

(Please response the following questions and put-check mark whenever application)

01**. Preliminary information of farmer**: Sample no:……

Name: …….. Village: ……..……..

Upazila/Thana: ……..… District …….

02. **Age:**How old are you? ..... Years.

03. **Educational qualification**: Primary/Basic (1-5) / Secondary (6-10) / Higher (over 10)

04. **Revenue sources**: Agriculture / Business / Transport service / Remittance / Official job / Student / Others (more than one may be applicable)

05. **Family economic condition:** **5.1**. Family member: ……..

5.2. Family earning member: …… **5.3**. Available member for mushroom farm: …..

06. **Farming experience**: **6.1.** Nature of farming: Seasonal / Year-round

6.2. How many years are you associated with agrarian activities? ……

07.**Nature of mushroom production**

(A) Solely mushroom mother producer **(B)** Fresh mushroom producer

08. **Cultivation housesite**

Inside residence	Infrastructure at yard	Set-up on rented place	Public place

09. **Cultivation house pattern**

Bamboo macha	Iron, PVC pipe combining rack	Hanging pattern	Plain floor

10. **Production cost:**

Particulars	Cost (BDT/season)	Particulars	Cost (BDT/season)
Mother / Test tube specimen		Cotton & plastic Neck	
Substrate / gr. Medium		Chemical substances	
Labor salary / wage		Chalk powder	
Polybag		Utility charges	
Cultivation site rent		Sprayer & weight machine	

12. **Mushroom marketing place**

Marketing place	% of sale	Marketing place	% of sale
Farmhouse display store		District level wholesale market	
Public institute premises		Direct to central Dhaka customer – home delivery	
Local market		Contractual production	

13. **Revenue portion**

Sl. No.	Name of the crops	Production (kg)	Market price at harvest (Tk.kg-1)	Sl. No.	Name of the crops	Production (kg)	Market price at harvest (Tk.kg-1)
i.	Fresh mushroom			ii.	Mushroom mother		

15. **Women participation**

15.1. Number of women participations: …….

15.2. Women participation score: (put-check mark the degree of participation)

Sl no.	Technologies	Degree of participation		
		Frequently (2)	Occasionally (1)	Never (0)
i.	Crop cultivation and take care			
ii.	Crop harvesting and sorting out			
iii.	Crop sale and marketing			

Women participation range: Low (0-2), Medium (3-4) and High (5-6)

16. **Impact on mushroom household socio-economic scenario**

(put-check mark on the right side)

Daily nutritious food consumption		Infrastructure development	
Social security and entertainment		Social sanitation	
Sending offspring to school		Social community participation	

17. **Problems throughout production & marketing**

(put-check mark on the right side of the preferred options)

Key hinderances	Present	Absent	Key hindrances	Present	Absent
Lack of quality spawn			Market complexity		
Disease and insect infestation			Lack of transport conveniences		
Environmental stress complexity			Societal superstition and fanatism		
Lack of credit feasibility			Non-availability and higher price of labor		

15. Household own perception / opinion / expectation: ……

……

Thank you for your warm co-operation

…… ……

Signature of Responded participant Signature of Interviewer

APPENDIX II

Summary output of socio-economic classification of survey proprietors

Categories		Respondent proprietors		Total	% in total
		Large	Marginal		
Age distribution	Young aged (up to 35)	1	5	6	10
	Middle aged (35-50)	19	30	49	81.33
	Old (above 50)	2	3	5	8.33
Earing sources	Agriculture	2	8	10	16.7
	Business	12	7	19	31.7
	Transport services	0	3	3	5
	Remittance privileged	2	0	2	3.2
	Official job (public/private)	4	12	16	26.7
	Institutional apprentice	2	8	10	16.7
Education level	Primary (1-5 class)	0	8	8	13.13
	Secondary (6 – 10 class)	14	25	39	65
	Higher (over 10 class)	8	5	13	21.67
Household labor	Family members	3.8	4.3		
	Active earning member	2.1	2.7		
	Available family labor for mushroom farming	2.9	3.1		
Women involvement	Low participation	3	5	8	13.3
	Medium participation	14	20	34	56.7
	High participation	5	13	18	30
Farm size	Mushroom mother producer solely	10	8	18	30
	Fresh mushroom producer	12	30	42	70

APPENDIX III

Summary output of Cobb-Douglas production function analysis of mushroom household revenue influenced by selected factors

Model Summary

Model	R	R^2	Adjusted R^2	Std. Error	Change Statistics				
					R^2Change	F Change	df1	df2	Sig. F Change
1	.992[a]	.984	.982	.08765	.984	425.49	4	55	.000

a. Predictors: (Constant), Ln_accesories, Ln_mother, Ln_substrate, Ln_labor

ANOVA[a]

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	25.369	4	6.342	425.49	.000[b]
	Residual	0.423	55	0.008		
	Total	25.793	59			

a. Dependent Variable: Ln_revenue

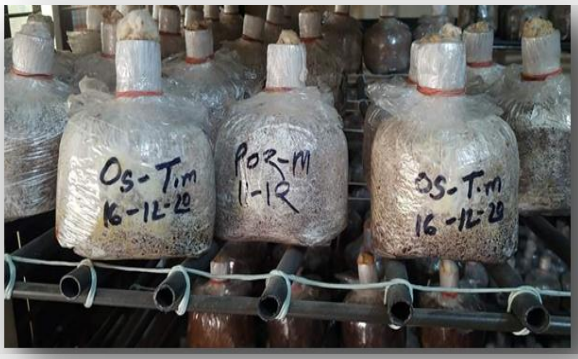
b. Predictors: (Constant), Ln_accesories, Ln_mother, Ln_substrate, Ln_labor

Co-efficient

Model	Unstandardized Coefficients		T	Sig.
	B	Std. Error		
(Constant)	3.103	0.281	11.056	0.000
Ln_mother	0.425	0.063	6.786	0.001
Ln_substrate	0.435	0.109	3.986	0.001
Ln_labor	-0.465	0.177	-2.629	0.011
Ln_accesories	0.635	0.121	5.265	0.000

APPENDIX IV

Some key moments during survey period



… … … Fi Amanillah … … …