



The Economics of Production and Marketing of Oyster Mushroom (*Pleurotus ostreatus*) in Bukidnon, Philippines

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Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

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ABSTRACT

Bukidnon, a province in Region X, is known for its high percentage of oyster mushrooms, accounting for 85.15 percent of total produce. This research aimed to determine production and marketing practices, yield per fruiting bag, marketing channels, and costs. We observed three marketing channels, and the average yield per bag was 0.18 grams per day. Variables affecting productivity included extension visits, educational attainment, culture house temperature, and substrate types. However, producers faced issues like spawn unavailability, poor development, and spoilage. The lack of government equipment support and lower prices led to many farmers stopping production, especially during the pandemic.

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1. INTRODUCTION

Oyster mushrooms (*Pleurotus ostreatus*) were among the most widely grown varieties of mushrooms worldwide. It is considered as healthy because of its richness in proteins, fiber, vitamins, and minerals [1]. They were sometimes referred to as tree oyster mushrooms or pearl oyster mushrooms. Around the world, the fungus grows naturally on and around trees in temperate and subtropical woods. Mushrooms can be grown indoors, without the need for sunlight, on a small scale because they don't require a large initial investment, and they don't require fertile land [2]. It can be a viable source of livelihood, and it can be profitably started by landless farmers, unemployed youths, rural women, and other entrepreneurs [3].

According to Chiang (2014) the nation's mushroom industry has gotten worse since 1995; in 2009, 355 metric tons were produced, which was the lowest amount [4]. Furthermore, oyster mushrooms were the third largest farmed fungus [5]. China, the world leader in oyster production, supplied over 852% of the total production worldwide. As per Cheon's report, oyster mushrooms are also produced in Korea, Japan, Italy, Taiwan, Thailand, and the Philippines [6].

Commercial mushroom farms were the source of the majority of mushrooms found in supermarkets. In rural locations with easy access to the necessary infrastructure and raw ingredients, oyster mushroom production was very easy and affordable. Because mushroom producers would profit from it, it was economically feasible due to low production costs, an abundance of inexpensive substrates made from agricultural waste, and strong demand [6]. Oyster mushroom cultivation in Bukidnon, Philippines, are not as successful or extensive as anticipated, even though the region has the highest volume of yearly mushroom production.

Bukidnon's abundant resources and agricultural system both have led to mushroom cultivation trainings in municipalities. However, issues faced by growers and marketing must be addressed for the sector to continue developing [7]. Limited government understanding and financing in the area limit current cultivation [8].

According to the results of the pre-survey, some mushroom growers have ceased to cultivate or

grow this product. Therefore, the aim of this study was to generally assess the producers' reasons for ceasing to grow oyster mushrooms in Bukidnon.

2. MATERIALS AND METHODS

Complete enumeration was considered in determining the respondents in each municipality of Bukidnon. Primary data in the study used pre-structured survey questionnaire which was tested before the conduct of field survey. Questionnaire included the socio-demographic data on oyster mushroom producers, production practices, production costs, factors affecting production and the constraints and challenges faced by the producers. Personal interview was employed in this study in which the researcher visited the places and personally met the respondents for the interview. In order to analyze the data, the researcher employed both descriptive and inferential statistics.

In order to determine the oyster mushroom production practices, and the limitations and difficulties in oyster mushroom production, descriptive statistics such as frequency counts, averages, and percentages were used.

To determine the average production yield per fruiting bag, the following formula was used:

$$\text{Average production yield/fruiting bag} = \frac{\text{Total production in (kg)}}{\text{No. of fruiting bags}}$$

A simple accounting technique was used in determining the production costs incurred and returns received in oyster mushroom production. To identify the factors affecting productivity, multiple regression was used. A statistical method called multiple regression (MR) makes use of multiple explanatory variables to forecast the response variable's result.

2.1 Multiple Regression Analysis

Modeling the linear relationship between the response (dependent) variable and the explanatory factors (independent) is the aim of multiple regression analysis. Since several explanatory variables are included, multiple regression (MR) is essentially an extension of ordinary least square (OLS) regression [9].

The study's multiple linear regression model was displayed as follows:

$$Y = \beta_0 + \beta_1X_1 + \beta_2X_2 + \beta_3X_3 + \beta_4X_4 + \beta_5X_5 + \beta_6X_6 + \epsilon$$

Where:

Y= oyster productivity (gram/fruited bag)

X₁ = age (in years)

X₂ = educational attainment (in years)

X₃ = Substrates (sawdust -1, rice bran -2, lime -3, sugarcane -4)

X₄ = Temperature (in degree Celsius)

X₅ = Extension visits (no. of days)

X₆ = Membership to organization (dummy)

ε = is disturbance error

3. RESULTS AND DISCUSSION

3.1 Socio-Economic Profile of Oyster Mushroom Farms in Bukidnon

3.1.1 Age, gender, marital status, educational attainment and ethnic origin

The results showed that 47% of all respondents were between the ages of 31 and 40, with an average age of 39. With an age difference of 23 years, the oldest respondent was 69 years old. Gender-wise, 27% of respondents were females and 73% of respondents were males. This suggests that oyster mushroom producers are generally young men. In addition, 80% of the respondents were married, and twenty percent were single. In terms of educational attainment, 97% of the respondents were college graduates and the remaining 3% were those who took vocational courses. Moreover, all of the respondents came from the Roman Catholic religion and identified themselves as Christians. Meanwhile, 83% of the respondents were Cebuano, 13% were Ilonggo, and 3% were Ilocano.

3.1.2 Source of income and number of years in Oyster mushroom production

With regards to the source of income of the oyster mushroom producers, 40% of the total respondents were engaged into vegetable and rice farming, 27% in mushroom production, 30% in government-related works, and 3% in the private company and market vendor. In addition to that, out of 30 producers only 23 of them were involved mushroom production as their additional

source of income which comprised 77% of the total percentage. With regards to the number of years in oyster mushroom production, 53% of the respondents spent 2-3 years in oyster mushroom production, 30% of them had been 4 to 5 years in mushroom production, 7% with less than 2 years' experience, 7% with 8 years and above, and 3% with 6 to 7 years in the mushroom production. Nonetheless, the years spent in producing oyster mushrooms may help broaden the expertise of the oyster mushroom producers due to the experiences the years have given them. The minimum number of years was 6 1/2 months a year. The maximum number of years reported was 14 years and the average years in oyster mushroom by the respondents was 3 years and nearly 8 months.

3.2 Production and Marketing Practices of Oyster Mushroom in Bukidnon

3.2.1 Production practices of Oyster mushroom

The preparation of spawn or procurement, substrate preparation, substrate spawning, and crop management comprised four stages of oyster mushroom development. Although oyster mushroom growers had different and unique practices in terms of growing oyster mushrooms, the production still included the preparation of mushroom culture house, fruiting bag preparation, maintenance activity, and harvesting. Mushroom culture house refers to the place where the oyster mushrooms are cultivated. Preparing the fruiting bags also includes the specific substrate used and its sources, and the required hours and temperature for pasteurization. As for the maintenance period, it pertains to the number of times the substrates are watered each day, the method of controlling pests and disease during the cultivation period, and mushroom scraping. Lastly, harvesting refers to the process of collecting the oyster mushrooms after cultivating them successfully. It includes the frequency and methods of harvesting, as well as the harvest time, quantity of harvest per day, months of fruiting bags, and physical losses incurred during the harvest.

All producers (100%) had practiced the following activities such as preparation of mushroom culture house, spawn procurement, preparation of substrates/medium, preparation of fruiting bags, planting of spawn in fruiting bags, maintenance, and harvesting.

Table 1. Socio-economic profile of Oyster mushroom producers

Particulars	Frequency	Percentage
Age (in years)		
30 below	4	13
31-40	14	47
41-50	9	30
51-60	1	3
61 above	2	7
Gender		
Female	8	27
Male	22	73
Civil Status		
Single	6	20
Married	24	80
Educational Attainment		
College level	29	97
Vocational course	1	3
Religion		
Christian	30	100
Ethnic Origin		
Cebuano	25	83
Ilonggo	4	13
Ilokano	1	3
Household Size		
3 below	8	27
4-6	21	70
7-9	1	3
Main Source of Income		
Farming (crops & vegetables)	12	40
Mushroom production	7	27
Government worker	9	30
Private company	1	3
Market vendor	1	3
Other Source of Income		
Mushroom production	23	77
No. of years in Oyster mushroom		
1 below	2	7
2-3	16	53
4-5	9	30
6-7	1	3
8 above	2	7

Table 2. Production practices of Oyster mushroom producers

Production practices	Frequency	Percentage
Preparation of mushroom culture house	30	100
Spawn procurement	30	100
Spawn making	1	3
Preparation of Substrates/Medium	30	100
Preparation of Fruiting bags	30	100
Planting of spawn in fruiting bag	30	100
Maintenance	30	100
Harvesting	30	100

3.2.2 Spawn procurement practices

Obtaining spawn was the second step in the production of mushrooms. The portion of the mushroom that reproduced, known as spawn, was obtained from either wild or farmed sources. The spawn was then collected and utilized to inoculate substrate materials, which included wood chips, sawdust, straw, and other organic materials. The substrate and spawn were mixed together in trays or plastic bags, then the mixture was incubated until the mycelium—the vegetative body of the mushroom—began to grow.

Results show that among thirty (30) mushroom producers in Bukidnon, only one respondent made their own spawn. Their basic material on making spawn was rice hull because of the unavailability of sorghum. The rice hull must first be properly cleaned, and any floating seeds must be disposed of. Subsequently, the grains were boiled for a minimum of 20-25 minutes. Third, gather the seeds and spread them out on manila or newspaper to absorb any remaining water after using a strainer to remove any remaining water. Afterward, pour the cooked grains into a recycled circular plastic bottle, cover it with fresh paper, and plug it with cotton waste. The grains should then be sterilized for an hour at 18 pounds per square inch and allowed to cool. Finally, after cooling, the sterile bottled grains were infected with pure culture stubs of the selected species of mushroom. For incubation, most mushroom kinds do best around 75–80°F (24–27°C). Depending on the strain and the surroundings, complete colonization often takes two to four weeks [10].

However, because of the unavailability of materials and equipment, the twenty-nine (29) producers preferred to buy or purchase their grain spawn from commercial producers every 3 months. Thus, twenty (20%) came from the online with a price of ₱350/350 grams and fifty (50%) were from the CMU at ₱50/pack and thirty (30%) came from Mushroom City at ₱100/bottle.

3.2.3 Marketing practices of Oyster mushroom in Bukidnon

The oyster mushroom growers sold their products fresh (100%) and (20%) processed (pickles and chicharon) with the used of Polypropylene (83%) and other various packaging materials (17%) such as cellophane, zip-lock bag, Styrofoam, and banana leaves. Before selling the products, majority of the

growers sorted the harvested mushrooms into two classifications, the marketable and non-marketable. Furthermore, only 5% of growers practiced product storage in the refrigerator.

Table 3. Production, source, price of spawn and frequency of buying spawn of Oyster mushroom producers

Particulars	Frequency	Percentage
Buying of spawn	30	100
Source of spawn		
CMU	15	48
Online at microsphere	3	10
Mushroom city	13	42
Price of spawn		
70 pesos/200g	13	42
350 pesos/350g	3	10
50 pesos/200g	15	48
Frequency of buying		
Once a month	1	3
Every 3 months	29	97

The method of selling was picked-up by the consumers (67%), and 23% of the respondents delivered the fresh mushroom to the different establishments and through courier services (10%). While, the frequency of selling of fresh oyster mushroom was daily (100%).

Additionally, the buyers paid 100% cash basis or through direct payment. And the standard customer constituted 100% of the buyer base, with consumers making up 73% of the buyer type, merchants making up 17%, and wholesalers making up 10%.

Oyster mushroom marketing strategies would be very beneficial to both producers and customers. Furthermore, it may have a major effect on the sustainability and success of oyster mushroom farming. Therefore, marketing techniques may have an impact on oyster mushroom pricing methods. The target market and profitability of mushroom producers might have a big impact on their choice to market their products as premium or value-priced.

Additionally, producers had the choice of selling directly to customers through farmers' markets, internet marketplaces, or neighborhood shops, or they could choose to distribute their products in bulk to grocery stores, eateries, and food wholesalers. Distribution channel selection could impact oyster mushroom availability and consumer reach.

Therefore, marketing positioning, profitability, and overall success were all significantly impacted by oyster mushroom marketing practices. In order to maintain the viability and expansion of their oyster mushroom enterprise, producers had to take these variables into account while formulating their marketing plans.

3.3 Production and Marketing Cost Incurred in Growing Oyster Mushroom

3.3.1 Average production and marketing cost per fruiting bag

The inputs required to generate commodities and services were referred to as the factor of production in economics. Results shows the production cost of producing one production cycle (3 months) of oyster mushrooms in Bukidnon. The average production of oyster mushrooms was 845 fruiting bags, and the majority of the producers produced 500 fruiting bags in their one production cycle. Thus, the average production cost would be based on 600 fruiting bags. Furthermore, the bulk of production

expenses for supplies and materials were comprised of 60.99% of total expenses: sawdust (2.88%), rice bran (18.47%), brown sugar (5.48%), lime (0.57%), spawn (14.43%), alcohol (2.30%), polypropylene bags (8.65%), rubber bands (4.32%), and cotton (3.89%). followed by the overhead costs, which constituted the remaining 25.96%: electricity (2.88%), water (8.65%), LPG (14.43%), and the cost of bagging (12.98%). Further, the estimated average cost of producing 600 fruiting bags was amounted to Php 6,930.00.

Oyster mushroom cultivation can be costly depending on the region and the method used, but overall, it was less expensive than other income crops. Because they require less land and cheap raw ingredients, mushrooms are less expensive to cultivate [11]. Farmers who owned agricultural plantations benefit more from oyster mushroom growing since it eliminated the need for them to purchase substrate materials and allowed them to use inexpensive buildings for seasonal mushroom cultivation. Based on the Table 5, the average cost per fruiting bag was Php 11.55.

Table 4. Marketing practices of Oyster mushroom producer

Marketing Practices	Frequency	Percentage
Types of mushrooms sold		
Fresh	30	100
Process (chicharon)	6	20
Packaging materials used		
Polypropylene (pp)	25	83
Zip-lock/styro	5	17
Grading/Sorting		
Marketable	30	100
Non-marketable	30	100
Storage		
Refrigerator	5	17
Method of selling		
Delivered	7	23
Picked-up	20	67
Courier (LBC)	3	10
Frequency of selling		
Daily	30	100
Mode of payment		
Cash	30	100
Basis in selecting buyers		
Regular buyer	30	100
Type of buyers		
Retailer	5	17
Consumer	22	73
Wholesaler	3	10

Table 5. Average production cost in producing 600 fruiting bags of Oyster mushroom

Cost Items	Unit	Quantity	Unit cost (₱)	Total	Percentage
Production cost of Fruiting bag					
Supplies and Materials					
Sawdust	Sack	20	10	200	2.88
Rice bran	Sack	80	16	1,280	18.47
Brown sugar	Kg	4	95	380	5.48
Lime	Kg	4	10	40	0.57
Spawn	Pack	20	50	1,000	14.43
Alcohol (500ml)	Bottle	2	80	160	2.30
Polypropylene bag (fb)	Piece	600	1.0	600	8.65
Rubber band	Piece	600	0.5	300	4.32
Cotton	Bag	2	135	270	3.89
Overhead Cost					
Electricity	Mo.	4 mo.	50	200	2.88
Water	Mo.	4 mo.	150	600	8.65
LPG	Psig	1	1,000	1,000	14.43
Labor Cost					
Bagging	Bag	600	1.50	900	12.98
Total Production Expenses				₱6,930.00	100.00
Cost per fruiting bag				₱11.55	

3.3.2 Average cost and return analysis of Oyster mushroom in Bukidnon

Results show the average cost and return in producing 600 fruiting bags in each production period (3 months). The harvesting of oyster mushroom was done daily and each fruiting bag of oyster mushroom produced a minimum of 0.18 grams. Thus, in a month, the producer could harvest 10 times the minimum of every harvested oyster mushroom or 108 kilograms in total per month with an average selling price of Php 200.00 per kilogram, giving a gross income of Php 21, 600.00. The bulk of expenses were for the production cost which comprised Php 6,930 of the total expenses followed by the marketing expenses of Php 2,048. The estimated total cost per 600 fruiting bags was Php 8,978 with an estimated net profit of Php 12, 622.00. The Return of Investment of 140.58%, means that in every 1 peso of investment into oyster mushroom there was 140.58% return of investment.

3.4 Factors Affecting Productivity of Oyster Mushroom in Bukidnon

Among the 6 independent variables, only four (4) showed the significant difference, at 1% level, temperature of culture house, and type of substrates while, at 5% level, number of extension visits and educational attainment. Other identified variables such as age and membership in organization found to have no significant difference to the level of productivity.

The number of extension visit was found to significantly affect oyster mushroom productivity at 5% level. This was so because the more extension services that were provided to the mushroom producers like materials and services and provide them with expert advice on mushroom production, the more they would be knowledgeable about mushroom production and profitable on their field.

Thus, this result does not affect the productivity of mushroom. In this study, only 10% of the respondents were visited by the extension agent while the remaining 90% had not been visited all throughout the year.

The greatest degree of education acquired by farmers was referred to as their educational attainment, and this was revealed to have a 5% level of substantial impact on productivity. As a result, when mushroom growers achieved the highest levels of education so it means that they would have greater access to technology advancements and market knowledge, specifically on the price. Thus, the productivity of mushroom production was negatively impacted by such a low level of knowledge. The finding further revealed that 97% (29 out 30) of the respondents had attended college and had the capacity to produced mushroom. In addition, this conforms to the result of the study conducted by Rahman [12] that education level was found to significantly influence on mushroom production.

Table 6. Average cost and return in producing 600 fruiting bags of Oyster mushroom

Cost Items	Amount (Php)	Percentage
Gross Income 108kgs at Php 200.00	21,600.00	
Production Expenses		
Supplies and Materials		
Sawdust	200.00	2.88
Rice bran	1,280.00	18.47
Brown sugar	380	5.48
Lime	40	0.57
Spawn	1,000	14.43
Alcohol (500ml)	160	2.30
Polypropylene bag (fb)	600	8.65
Rubber bond	300	4.32
Cotton	270	3.89
Overhead Cost		
Electricity	200	2.88
Water	600	8.65
LPG	1,000	14.43
Labor Cost		
Bagging	900	12.98
Total	6,930.00	100
Marketing Expenses		
Transportation	1,000	48.82
Advertisement on Online	500	24.41
Packaging materials	548	26.74
Total	₱2,048.00	100
Total Expenses	₱8,978.00	
Cost/kg	₱14.96	
Net Profit	₱12,622.00	
ROI	140.58%	

Table 7. Multiple regression result of Oyster mushroom productivity

	Standard Error	Coefficient	T	Sig - P
(Constant)	3.727		10.461	
Age	.422	1.077	3.68	
Educational Attainment	7.232	1.023	9.972*	0.000
Types of Substrates	.846	.160	2.311**	0.029
Temperature of Culture House	2.778	-.372	-4.716**	0.035
Extension Visit	11.134	3.246	39.074*	0.000
Membership in organization	-.225	-1.293	2.513	

*Significant at 1, 5% respectively

At 1% level, it had been discovered that the temperature of the culture house, which was monitored in degrees Celsius using a thermometer, had a major impact on productivity. Therefore, greater temperatures in the growing environment could promote the growth of competing microorganisms while decreasing the

productivity of mushroom development in various optimal growth tracks. because oyster mushrooms can tolerate temperatures between 18 and 30°C. This is consistent with the Australian Mushroom Growers Association's [13] study, which found that temperature affects the number of mushrooms produced.

The type of substrates used in mushroom cultivation were sawdust (78%), rice bran (20%), lime (1%) and sugar (1%). Sawdust was commonly used by producers due to its affordability and availability. It has also a greater effect on the productivity of mushroom production because sawdust provides an ideal environment for mushroom that can boost a healthy fruiting bag. And found to be significantly affect productivity at 1% level. This is consistent with Oyetayo [14].

When the respondents' age was expressed in terms of years, the coefficient value of 0.240 indicated that the difference was not statistically significant. This supports the finding of Rahman [11].

A membership in an organization could help professionals to enhance their personal growth and stay up to date on emerging concerns and opportunities. However, the result of the study had a coefficient value of -0.126, implying that as farmers organization involvement increases, productivity decreases. Hence, this is parallel to the result of the study conducted by Micabalo [15] that membership in organization was found to have no significant difference to the level of productivity.

4. CONCLUSION

The higher productivity level of oyster mushrooms in the province of Bukidnon is a result of good production and marketing practices among producers. Thus, a lack of one practice will cause lower productivity in oyster mushrooms. Growers set the majority of the prices, leading to a higher price per kilogram of fresh oyster mushrooms due to excellent marketing strategies and market coordination. The average production yield of oyster mushrooms per fruiting bag is 0.18 grams, with a minimum of 0.08 grams and a maximum of 0.40 grams per fruit per day. Thus, good production practices will affect the production yield per day.

The marketing of oyster mushrooms flows through many channels, both long and short. A shorter channel means a lower price paid by consumers, while a channel with more market players has a higher marketing margin and a higher price paid by consumers. The production and marketing costs of oyster mushrooms depend on the number of fruiting bags produced

in one production cycle. This means that the more fruiting bags produced in one production, the more profit there will be. The estimated total cost and net profit per one production cycle of oyster mushrooms are lower than the expected average cost and return. Thus, for every 1 peso of investment in oyster mushrooms, there is a 140.58% return on investment.

Among the 6 independent variables, only four (4) show the significant difference, at 1% level, temperature of culture house, and type of substrates while, at 5% level, number of extension visits and educational attainment. Other identified variables such as age and membership in organization found to have no significant difference to the level of productivity.

The number of extension visit is found to significantly affect oyster mushroom productivity at 5% level. Because the more extension services that will be provided to the mushroom producers like materials and services and providing them with expert advice on mushroom production, the more they will be knowledgeable about mushroom production and profitable on their field.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of this manuscript.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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