Potential development of oyster mushrooms in the lowlands of Bantul Regency, Special Region of Yogyakarta, Indonesia

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Abstract. Oyster mushroom cultivation is best done in the highlands, while Bantul Regency is included in the lowlands with an altitude of 0 - 500 meters above sea level with an average annual temperature of 30°C. Climate change is causing the development of oyster mushrooms farming in the lowlands requires special treatment in the production process. This study aims to analyze the costs, income, profits, and feasibility of oyster mushroom farming in Bantul Regency. The determination of the location of the study was done purposively. The respondents were determined using the census method according to bag logs ownership. A total of 21 farmer respondents were classified into three groups, namely Group 1 (farmers own < 1,000 bag logs), Group 2 (1,001-3,000 bag logs), and Group 3 (> 3,000 bag logs). The feasibility of oyster mushroom farming was analyzed using Revenue Cost Ratio (R/C), capital and labor productivity, respectively. The results showed farmers in group 3 had the largest revenue, income and profit. Oyster mushroom farming is feasible because the R/C >1, capital productivity > capital interest, and labor productivity > labor wages. Bantul Regency has the potential to develop oyster mushrooms even though it is located in the lowlands.

1. Introduction
The purpose of mushroom production in Indonesia is not only to meet the population’s need but also for export, so it can contribute to the country’s foreign exchange. Mushrooms are exported in various forms, namely fresh, dried or powdered. The destination countries for mushroom exports from Indonesia are Singapore, Malaysia, Vietnam, Hong Kong, Korea, the Netherlands, Russia, Kuwait, Qatar, Bahrain and the United Arab Emirates [1].

Java Island is the center of mushroom production in Indonesia and one of them is the Special Region of Yogyakarta with a production of 1,431,573 quintals in 2015. Bantul Regency is the second-largest mushroom producer in the Special Region of Yogyakarta after Sleman Regency with a production of 31,412 quintals. This situation is influenced by the geographical location of Bantul Regency at an altitude of 0-500 meters above sea level, with an average annual temperature of 30°C and humidity of 50 - 80% [2]. The environmental factor, like temperature and air humidity, is very important for oyster mushroom production [3]. The mushroom cultivation is best carried out in areas with elevations greater than 700 meters above sea level with temperatures of 14 - 27°C and air humidity of 70 - 90% [4].

The types of mushrooms that are widely cultivated in the Bantul Regency are oyster mushrooms because based on their biological aspects, oyster mushrooms are not easily attacked by diseases or pests and relatively easier to process [5]. The development of oyster mushrooms does not require a large area and the production period of oyster mushrooms is relatively faster so that the harvest time is shorter and can be continuous.
Oyster mushroom farming carried out in the highlands can produce high profits as practiced by farmers in Lampung Province [6] and in Pekan Baru City [7]. Climate change promotes oyster mushrooms farming in the lowlands to require special treatment. Farmers in Bantul Regency have to watering the mushroom several times when the weather is very hot in order to maintain the temperature and humidity. The oyster mushroom productivity in the lowlands is generally lower than in the highlands. The purpose of this study is to analyze the costs, income, profits and feasibility of oyster mushroom farming in lowlands, Bantul Regency.

2. Methods
The study was conducted in Bantul Regency because it is a lowland that develops oyster mushroom farming. Respondents as many as 21 farmers were taken by census, which took all the oyster mushroom farmers in Bantul spread across Bambanglipuro, Pandak, Jetis, Piyungan, Sedayu and Banguntapan Districts [2]. All respondents were divided into 3 groups based on the number of bag logs ownership, namely group 1 with the number of bag logs ≤ 1,000 by 9 farmers, group 2 with the number of bag logs 1,001-3,000 by 8 farmers and group 3 with the number of baglogs > 3,000 by 4 farmers. Primary data including respondent identity, use and the price of production facilities, use and wages of labor, production and prices of oyster mushrooms are obtained through interviews with questionnaire guidelines. Secondary data was obtained by documenting data from Central Bureau of Statistics, the Agriculture Office and the Sub-District Office.

Data analysis was done descriptively and quantitatively by calculating the average cost of oyster mushroom farming, which includes explicit and implicit costs, revenues, income and profits. The feasibility of farming is analyzed using the R-C ratio, labour productivity and capital productivity [8]:

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TC = TEC + TIC
\]

\[
TR = P \cdot Q
\]

\[
NR = TR - TEC
\]

\[
\pi = TR - TC
\]

\[
R/C = TR / TC
\]

Labour Productivity = \( \frac{(NR - Own \text{ land rent cost} - Own \text{ capital interest})}{\text{Number of workers in the family}} \)

Capital Productivity = \( \frac{(NR - Own \text{ land rent cost} - \text{Cost of labour in family})}{\text{Total Explicit Costs}} \)

Information:
TC = Total Cost
TEC = Total Explicit Cost
TIC = Total Implicit Cost
TR = Total Revenue
P = Price of product
Q = Quantity of product
NR = Net Revenue (Income)
\( \pi \) = Profit
3. Results and discussion

3.1. Respondent characteristics

Table 1. Characteristics of oyster mushroom farmers in the lowlands of Bantul Regency

| Description            | Number (people) |
|------------------------|-----------------|
|                        | Group 1 | Group 2 | Group 3 |
| Age (years)            |         |         |         |
| 27 – 45                | 2       | 7       | 2       |
| 46 – 64                | 6       | 1       | 2       |
| >64                    | 1       | 0       | 0       |
| Level of education     |         |         |         |
| Primary school         | 2       | 0       | 1       |
| Junior high school     | 1       | 1       | 0       |
| Senior high school     | 4       | 4       | 2       |
| College                | 2       | 3       | 1       |
| Farming Experience (years) |    |         |         |
| ≤ 2                    | 2       | 2       | 0       |
| 3 – 6                  | 4       | 4       | 2       |
| 7 – 10                 | 3       | 2       | 2       |

Table 1 performs almost all oyster mushroom farmers are in productive age (< 64 years). Productive age is a potential group in carrying out an activity. In the productive age range, a person is in prime physical condition and responsive to every change or innovation. The education level of oyster mushroom farmers in Bantul is more than 75%, they have already senior high school and college. Higher education levels make farmers more open to new technologies [9]. Oyster mushroom farmers in Bantul Regency have an average experience of 5 years for groups one and two while in group three the average experience is 8 years.

3.2. Production cost

Oyster mushroom farming costs are the costs incurred by farmers to meet inputs during the production process in one growing season, starting from preparation to post-harvest pleasure. The period in one period in Bantul Regency is for four months starting from the bag log compiled in the mushroom house, and bag log has been overgrown with mycelium almost by 100% which is marked by color change of the bag log (turn in to white). In a study, [10] revealed that one period of the oyster mushroom growing season in the ACC company in Cianjur Regency is for 4 to 5 months. The same thing also happened in Karangpandan District, Karanganyar Regency, that maintenance of oyster mushrooms from seedling planting on bag log media until the last harvest takes between 4 -5 months [11].

Oyster mushroom farming costs consist of explicit costs including costs of production facilities, costs for the use of labor outside the family, depreciation costs from the use of equipment, and the cost of land rent. The implicit costs including the cost of using labor in the family, land rent, and capital interest. The cost of production facilities is the most significant in farming oyster mushrooms, and the largest component is the cost for purchasing bag logs and seeds. Farmers buy bag logs with the condition that the seeds have grown into mycelium, which is marked by a portion of the bag log or 50% to 75% of the bag log has turned white. This is to determine the level of success of the development of the bag log itself to minimize losses to the farmers. Oyster mushroom farmers buy bag log from other farmers in Bantul and Sleman Regency. The price of the bag log ranges from IDR 1,900 to 2,200. Based on research by [12] farmers in Metro City, which is one of the centers of oyster mushroom production in Lampung Province bought bag log for IDR 2,500.
Table 2. Total costs of oyster mushroom farming in the lowlands Bantul Regency

| Description                  | Group 1     | Group 2     | Group 3     |
|------------------------------|-------------|-------------|-------------|
| Explicit cost:               |             |             |             |
| Costs of production facilities| 1,824,486   | 4,868,531   | 14,056,500  |
| Costs of labor outside the family | 25,000     | 60,000     | 641,429     |
| Cost of depreciation         | 16,678      | 276,220    | 804,478     |
| Land rent cost               | 0           | 0           | 101,667     |
| Total                        | 2,016,164   | 5,204,751   | 15,604,073  |
| Implicit cost                |             |             |             |
| Cost of labor in the family  | 900,101     | 1,204,940   | 1,752,344   |
| Own land rent cost           | 19,158      | 39,061     | 33,017      |
| Own capital interest         | 60,485      | 156,143    | 468,122     |
| Total                        | 979,744     | 1,400,144   | 2,253,483   |

Labor outside the family costs incurred by farmers is classified as small in one growing season. This is because the oyster mushroom farming in Bantul Regency is still on a small scale, so farmers prefer to use labor in the family to minimize costs incurred. The labor in the family is widely used in watering, harvesting, and post-harvest activities. Watering is an activity that must be carried out by oyster mushroom farmers due to climate change in order to maintain the temperature and humidity of the cultivation area in accordance with the required standards. Watering by farmers depends on weather conditions. Regular watering is done by farmers as much as one to two times a day, namely in the morning and afternoon. However, during the dry season, watering can be done three times a day.

3.3. Revenue, income and profit

Revenue is a multiplication of the number of residents and the price, while income is the difference between revenue and the total explicit cost. The profit is the difference between total revenue and total costs consisting of explicit and implicit costs [8].

Table 3. Revenue, income and profit of oyster mushroom farming in the lowlands Bantul Regency

| Description              | Group 1     | Group 2     | Group 3     |
|--------------------------|-------------|-------------|-------------|
| Production (kg)          | 284         | 800         | 2,975       |
| Price of product (IDR/kg)| 11,557      | 12,733      | 11,126      |
| Revenue ( IDR)           | 3,278,417   | 10,186,688  | 33,100,000  |
| Explicit cost ( IDR)     | 2,016,164   | 5,204,751   | 15,604,073  |
| Implicit cost ( IDR)     | 979,744     | 1,400,144   | 2,253,483   |
| Income ( IDR)            | 1,262,253   | 4,981,936   | 17,495,927  |
| Profit ( IDR)            | 282,509     | 3,581,793   | 15,242,444  |
| R/C                      | 1.09        | 1.54        | 1.85        |

Oyster mushroom farming in Bantul Regency, in one planting season, an average of one bag log produces 0.38 kg of fresh oyster mushrooms, in group one produces mushrooms as much as 0.35 kg, group two as much as 0.36 kg, and group three as much as 0, 43 kg. This situation is no different from that produced by the ACC Company in Cianjur Regency, where each bag log produces 0.35 kg of fresh
oyster mushrooms [10]. Oyster mushroom production in Bantul district is higher than production in Merapi SMEs Agro Media post-eruption Merapi Mout is 0.15 kg/bag log [13].

Oyster mushroom farmers in Bantul Regency sell their harvests to markets, stalls, and traders who come directly to the farmer’s house. The selling price of farmers to traders ranges from IDR 10,000 to IDR 12,500 and the selling price of farmers which is IDR 12,500, is the sale of oyster mushrooms using packaging. One package of mushrooms weighing 2 ounces is sold at an average price of IDR 2,500 per package to stalls and markets. However, in one village in the Piyungan sub-district, farmers sold fresh oyster mushrooms in 2.5-ounce packages at IDR 4,000 per package. Farmers who sell oyster mushrooms without packaging to traders who come to the house get the lowest price of IDR 10,000/kg and the highest IDR 12,000/kg. The price received by mushroom farmers in Bantul is the same as the price in Karanganyar but is lower than the selling price of oyster mushroom farmers in Pekanbaru, [7]. However, it is higher than the price of oyster mushrooms in Pataruman District, Banjar City [14] and Jember Regency [15].

The income and profits of oyster mushroom farming in group one with the number of bag logs < 1,000 at least compared to groups two and three. The higher number of bag logs, the more mushroom production, so that the income and profits received by farmers are getting bigger, as happened in Pekanbaru District [7] and Karanganyar Regency [11].

3.4. Farming feasibility
The feasibility of mushroom farming can be analyzed using R/C, labor productivity and capital productivity. Oyster mushroom farming is feasible to be developed if R/C > 1, labor productivity is greater than labor wages, and capital productivity is higher than the loans interest rate. Based on table 3 the amount of R/C can be calculated which is the ratio between total revenue and total cost, for group one of 1.09 which means that for every IDR 100 costs incurred by the farmer for oyster mushroom farming, an revenue of IDR 109 will be obtained. R/C in group two is 1.54 and group three is 1.85. Based on the R/C value, the oyster mushroom farming is feasible to be cultivated even though Bantul Regency is at an altitude of 0–500 meter above sea level, with an average annual temperature of 30°C and humidity of 50–80% which is not in accordance with the requirements for growing oyster mushrooms. This situation is not much different from the study of Adhiyana at al. [16] that the R/C of oyster mushroom farming in Karanganyar Regency in the lowlands with an altitude of less than 200 meters above sea level is 1.45. The results of the experiment were conducted at the NEH region AP center Basar, Arunachal Pradesh shows that the cost-benefit ratio is 1.22 to 1.45 [17]. A similar thing happened in oyster mushroom cultivation experiments conducted in a room with a controlled environment, which is the ratio between revenue and costs of 1.4 [18].

**Table 4.** Capital productivity and labor productivity of oyster mushroom farming in the lowlands Bantul Regency

| Description                             | Group 1   | Group 2   | Group 3   |
|-----------------------------------------|-----------|-----------|-----------|
| Net Revenue (IDR)                       | 1,262,253 | 4,981,936 | 17,495,927|
| Own land rent (IDR)                     | 19,158    | 39,061    | 33,017    |
| Cost of labor in family (IDR)           | 900,101   | 1,204,940 | 1,752,344 |
| Own capital interest (IDR)              | 60,485    | 156,143   | 468,122   |
| Total explicit cost (IDR)               | 2,016,164 | 5,204,751 | 15,604,073|
| Labor in family (workday)               | 18.00     | 24.10     | 35.05     |
| Labour productivity (IDR/workday)       | 65,701    | 198,620   | 484,873   |
| Capital productivity (%)                | 17.01     | 71.82     | 100.68    |

Based on Table 4 it is known that labor productivity in group one is IDR 65,701/workday, group two is IDR 198,620/workday and group three is IDR 484,873/workday which means oyster mushroom farming is feasible to be cultivated in the Bantul Regency, because labor productivity resulting from
oyster mushroom farming is greater than the labour wages of IDR 50,000/workday. The capital productivity of oyster mushroom farming is 17.01% group one, 71.82%, for group two and 100.68% group three. Meanwhile, the BRI bank loan interest rate in Bantul Regency is 9% per year or equal to 3% in one growing season, which means oyster mushroom farming is feasible. If farmers borrow capital from financial institutions to develop oyster mushroom farming, the farmer is able to return the loan along with the interest.

4. Conclusion
The best location to cultivate oyster mushroom is in the highlands, while the Bantul Regency is included in the lowlands with an average annual temperature of 30°C and air humidity 50-80%. Oyster mushroom farming in Bantul Regency requires special treatment in the production process i.e. frequent watering, once to twice a day to maintain the temperature and humidity of the cultivation area in accordance with the required standards. Oyster mushroom farming can provide high benefits, where R/C analysis indicated labor and capital productivity are feasible. The third group of farmers with the number of bag logs ownership > 3,000 has the greatest potential to be developed. Despite climate change, oyster mushroom farming has great potential to be developed in the lowlands of Bantul Regency.

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