PAPER • OPEN ACCESS

Potensial Use of Backyard for Oyster Mushroom (*Pleurotus Ostreatus*) Cultivation to Increase Family income; *Studies on Break-Event Point Analysis*

To cite this article: M Sayuti *et al* 2019 *IOP Conf. Ser.: Mater. Sci. Eng.* **536** 012132

IOP Conf. Series: Materials Science and Engineering **536** (2019) 012132 doi:10.1088/1757-899X/536/1/012132

Potensial Use of Backyard for Oyster Mushroom *(Pleurotus Ostreatus)* Cultivation to Increase Family income; *Studies on Break-Event Point Analysis*

Sayuti, M[1], Cindenia Puspasari[2], Khairul Anshar[1] and Muhammad Zeki[1]
[1]Department ofIndustrial Engineering, Faculty of Engineering, UniversitasMalikussaleh, 24351 Aceh Indonesia.
[2]Department of CommunicationScience, Faculty of Social and Political Science, UniversitasMalikussaleh, 24351 Aceh Indonesia

Corresponding author: sayuti_m@unimal.ac.id

Abstract. The utilization of backyard for oyster mushroom cultivation has been done in Panggoi Village, Muara Dua sub-district, Lhokseumawe-Aceh City, Indonesia. Besides becoming source of food and meeting nutritional needs, this cultivation program has also increased family income living in the area. In addition, this activity encourages consumption of various local ingredients through a balanced diet, which is expected to help reduce dependency on rice consumption. The cultivation area is 4m x 4m which is enough to accommodate 1,000 baglog. For the program to be sustainable, a feasibility study for Break-Event Point (BEP) has been conducted. The results show that cultivating 1,000 units of baglog of white oyster mushroom creates IDR 9,496,889 worth of profit at every one production cycle (4 months). Based on the calculation, it can be concluded that BEP is reached when 220,12 kg of mushrooms are sold (BEPproduction). As for the BEP Unit, the break-even point is on the cultivation of 46 baglog. This implies that the use of backyard for the cultivation of oyster mushrooms is feasible to be performed in hope for an increase in family income.

1. Introduction

An increase in population demands adequate food supply. The fulfillment of food needs can be started from the household by taking advantage of the backyard as traditional private home garden, and as an integrated system with close relationships between humans, plants and animals. On the other hand, the yard is defined as a plot of land that has certain limits on which there is a residential building and has functional, economic, biophysical and socio-cultural relations with its inhabitants. The yard has a multipurpose function since from this relatively narrow land, it can produce foods such as tubers, vegetables, fruits, herbs and medicinal ingredients. Implementing the sustainable food house area intensively to be utilized with local resources wisely will guarantee the continuity of the provision of quality and diverse source of food for the household. Benefits that will be gained from optimal yard management include meeting family consumption and nutrition needs, saving expenses, and also can provide additional income for the family[1].

Mushrooms are plants that do not have chlorophyll so they cannot carry out photosynthesis to produce their own food. Mushrooms are classified as heterotrophic plants, because they live by taking food substances, such as cellulose, glucose, lignin, protein, and starch compounds from other organisms. Mushrooms which have been known and popular as a delicacy since the XIV century AD are considered to contain carbohydrates, various minerals such as calcium, potassium, phosphorus, and iron as well as vitamins B, B12 and C [2]. In addition, they have various types, one of which is white oyster mushroom (Pleurotos ostreatus). This name is given since the shape of the mushroom hood is rounded, oval and

curved like an oyster shell. The surface of the oyster mushroom hood is smooth, somewhat oily if moist, and the edges are bumpy. Oyster mushroom (Pleurotus ostreatus) is of the family Agaricaceae and is cultivated by the community because it is one of the products that can be developed with a relatively simple technique and it has a large nutritional content that is beneficial to human's health. Besides it is delicious to eat, oyster mushrooms are also believed to have medicinal properties for various diseases, such as liver, diabetes, anemia, as an antiviral and anti-cancer, reduce cholesterol levels, increase the body's resistance to polio and influenza attacks and malnutrition. In addition, oyster mushrooms are also believed to be able to help with weight loss due to high fiber content and help with digestion[3][4].

The nutritional value of Oyster mushroom is almost the same as the nutritional value of chicken eggs when viewed in terms of the total amount of amino acid content. However, the results of the research by Stamets (2005) suggest that besides protein, fiber content of oyster mushrooms which are rich in chitin is good enough to improve the performance of digestive metabolism[5]. The low-fat content of oyster mushrooms is well-liked by the public because it helps to reduce fat levels in the blood so it will be able to prevent coronary heart disease and blood sugar, so the nutritional value of oyster mushrooms is very suitable for people who are on a diet and for those who suffer from high cholesterol and high blood pressure. In addition, it turns out that the results of the analysis of the nutritional content of Oyster mushrooms (white, gray, and brown) state that this type of mushroom has the potential to become nutritious food for people who are on diet because the protein and fiber are quite high, while it is low in fat and carbohydrates. But something very surprising is that oyster mushrooms contain glutamic acid which results in a pleasant taste, savory and delicious, so it is quite potential as a flavoring ingredient in food[6].

Nutritional value and calorie and mineral content (Nutrition Profile)of Oyster mushroom in 100 grams serving are: 360g of Calories / Energy, 27.25g of Protein, 2.75g of Fat, 1.16g of polyunsaturated fat, 1.32g of unsaturated fat, 0.20g of saturated fat, 56.33g of carbohydrate , 38.45g of carbohydrate complex, 18.10 g of sugar, 33.44g of fiber, 0g of cholesterol, 0 IU of Vitamin A, 0 IU of Thiamin (B1), 12.30 mg of Pantothenic acid (B5), 0 mg of vitamin C, 116 IU of vitamin D, 20 mg of calcium (Ca) , 1.69 mg of Copper (Cu), 9.1 mg of Iron (Fe), 2700mg of Potassium (K), 54.30 mg of Niacin, 2.04mg of ribofl avin, 0.035mg of Selenium (Se), 48mg of Sodium (Na), 6.73g of moisture, 6.74g of ash [7]. this composition is often reported to be effective in reducing cholesterol from some mushrooms found in forest land [8].

Wang and Ng (2000) identified ubiquitin-like from oyster mushrooms that inhibit the activity of HIV-I reverse transcription which causes the splitting of RNA transfer. The unique form of ubuquinon seems to affect / rule cell division, inhibiting cells that have been infected by HIV[9][10][11]. Piraino and Brandt (1999) have also identified a ubiquitin from Postreatus that is useful as an antiviral [12]. Donald Abraham- the oncologist director of a general hospital in San Francisco had conducted a clinical trial aimed at evaluating the short-term safety and potential benefits of oyster mushroom (Pleurotus ostreatus) used to treat hyperlipedemia in HIV-infected patients who consume "Kaletra" which is Protease Inhibitor (PI) which is usually used for Highly Active Antiretroviral Therapy (HAART)[13][14].

Break Even Point (BEP) is the point where the position of total income and costs is equal or balanced so that there is no profit or loss in a business process. Break Even Point is used to analyze the projections to what extent the number of units produced or how much money must be received to get a break-even point [15]. Oyster mushroom cultivation is able to bring very tempting benefits both on small and large-scale due to the high demand and selling value of the mushrooms. Oyster mushroom cultivation activities in Indonesia are still relatively low when compared to the needs or demands of consumers every day. This can be seen from the increase in demand for oyster mushrooms which has increased each year. Given the potential oyster mushrooms, this study aims to analyze the BEP in utilizing home yards for cultivation of oyster mushrooms to increase family income, with studies on BEP analysis[16].

2. Methodology

This research was conducted in Panggoi village in Lhokseumawe with an area of > 400m^2. *Kumbung* (mushroom house) was constructed with a size of 4m x 4m behind the house, the walls were made of bamboo and thatched with thatch leaves and the number of mushrooms cultivated was 1000 baglogs.

2.1. Oyster Mushroom Cultivation.

1. Preparation of Mushroom spawns and *kumbung*. In the cultivation of oyster mushrooms, materials and facilities such as mushroom spawns, planting media and *kumbung* are needed. Mushroom spawns prepared were F1, F2, F3(Filial), which means derivatives to 1,2, and 3. F1 is the first generation (I), which greatly affects the quality of seedlings in the next generation. For this study, mushroom seeds that have been included in polybags (log bags) were purchased directly from *Koperasi Detasemen Arhanud Rudal-001* in Pulo Rungkom, North Aceh.
2. Preparation of *Kumbung.* Preparation of *Kumbung* is the first step in mushroom cultivation. The temperature in Kumbung is 30-32°C, close to water sources and other production facilities. Environmental factors such as lighting and oxygen are very important for fruit body growth, because fungi need oxygen, moisture, temperature, and acidity (pH) of about 6. Kumbung was equipped with doors, windows to regulate air circulation with 5 shelves where each shelf can accomodate 20 baglogs. Kumbung was sterilized by sprinkling lime and insecticide and then after 1-2 days, the inoculated baglogs were put into it (Fig. 1a).
3. Preparation of Planting Media. Mushrooms planting media consisted of sawdust that has been sifted, and mixed ingredients in the form of casts (CaSO4), lime (CaCo3), bran, TSP, mixed with water evenly to 60% of moisture content or when coated the media does not break. After well-mixed, the media was put into a plastic bag (baglog) measuring 20x35 cm. The weight of the planting media was 800-900 grams, covered with cotton and tied with a plastic ring.
4. Planting Media Sterilization. Sterilization is done to avoid contamination of other organisms that can affect fungal growth. Sterilization was carried out using autoclaves (temperature of 120°C, pressure of 1 atmosphere, for 5-6 hours).
5. Seed Inoculation. Seed inoculation is a step to fill the mushroom seeds into the cold planting media. The seeds used were F3 which was loaded aseptically (done near bunsen lamp / spirit lamp), using a sterile scalpel / tweezer, weighing approximately 10 grams / evenly on the surface of the baglog.
6. Incubation. Incubation of log bags that already contain seeds requires room temperature and good arrangement on shelves in the *kumbung* (Fig. 1b). The incubation temperature was approximately between 22°C - 28°C and shelves were filled horizontally and alternated with bamboo insulation. During 40-60 days, the mycelia had grown evenly. When the mycelia covered the baglog, the cover of the baglog was opened, keeping the humidity approximately 65% by spraying the media with water and for 1-7 days, the fruit bodies (buds) appeared from the mouth of baglog.
7. Maintenance. During the incubation period, maintenance of the organism is needed. Some disorders in the incubation period include the occurrence of contamination by other fungi Trichoderma.sp, the presence of pests such as mites that can damage the mycelium and inhibit fungal growth (Purbo, 2012). To overcome this, it is necessary to always maintain environmental sanitation, for example by sprinkling chalk on the cracks between polybag arrangements, removing contaminated polybags, repairing damaged *kumbung*.
8. Harvesting. Harvesting was started from 1-2 weeks after opening the cotton cap. Oyster mushrooms are ready to be picked when they are 2 days old from growing buds. Harvesting was carried out in the morning by pulling out the entire mushroom clump, then cleaned it in a plastic bag weighing 100 g / plastic to be marketed (Fig. 1c and 1d).

a b c d

Figure 1. a. *Kumbung*; b. Baglog; c. Ready to harvest mushrooms; d. Packaging

2.2. BEP Calculation

1. Calculation of Total Production Costs (TC). The total production cost of cultivating white oyster mushrooms can be calculated using the following formula

$$TC = FC + VC \quad (1)$$

where:
TC : Total Cost (IDR /planting period)
FC : Fixed Cost (IDR /planting period)
VC : Variable Cost (IDR /planting period) \

2. Total Revenue (TR). The revenue in this research can be calculated as follows:

$$TR = Y \times P_{kg} \quad (2)$$

where :
TR : Total Revenue (IDR /growing period)
Y : Production of white oyster mushrooms (kg/growing period)
P_{kg} : The price of white oyster mushroom (IDR /kg/growing period)

3. Net Income (Π). Net income in the research of land use business can be calculated using the formula:

$$\Pi = TR - TC \quad (3)$$

where:
Π : Net income (IDR /growing period)
TR : Total Revenue (IDR /growing period)
TC : Total production Cost (IDR /growing period)

4. $BEP_{production}$. Calculation of the value of the production BEP aims to find out the number of mushrooms must be produced from a total of 1,000 baglogs so that all the capital spent (constructing *kumbung* and shelves, buying machines, etc.) is back.

$$BEP_{production} = \frac{TC}{P_{kg}} \quad (4)$$

5. BEP_{unit}. The BEP unit value explains how many units of goods (in this case baglog) must be cultivated or available in *kumbung* so that it will reach break even point at the end of the period

$$\mathrm{BEP_{unit}} = \frac{\mathrm{FC}}{(\mathrm{P_{baglog}} - \mathrm{VC/baglog})} \quad (5)$$

6. BEP_{price}. This value explains how much the selling price of goods in the market (in units of IDR. / Kg) so that the production of a certain number of units and within a certain time can reach the break even point. BEP conditions in different term can be interpreted as conditions in which the Total Revenue (TR) obtained in a certain unit of time is the same as the total cost (TC) issued in the same time unit, so that the BEP price calculation can be stated as follows:

$$\mathrm{TR} = \mathrm{TC}$$
$$\mathrm{Y} \times \mathrm{P_{kg}} = \mathrm{FC} + \mathrm{VC}$$
$$\mathrm{BEP}_{price} = \mathrm{P_{kg}} = \frac{\mathrm{FC+VC}}{\mathrm{Y}} \quad (6)$$

3. Results and Discussion

3.1. Fixed Cost, variable cost and selling price

a. Fixed Cost (FC) is a fixed or unchanging cost in a certain period of time, regardless of the size of the company's sales or production. The fixed cost for the cultivation of oyster mushrooms can be seen in Table 1.
b. Variable Cost (VC) is a cost per unit that is dynamic in nature depending on the volume of production. If the planned production increases, it means that the variable cost will definitely increase. The cost variable can be carved out in Table 2.
c. Selling Price (P) is the selling price per unit of goods that have been produced. Assuming that each baglog unit is able to produce an average of 0.6 kg of mushrooms and the price of mushrooms for each kg is IDR 25,000 (Pkg) then the selling price of each baglog unit is IDR. 15,000 ($\mathrm{P_{baglog}}$).

3.2. Break Event Point Analysis

3.2.1. *Total Production Cost (TC).*By using formula 1, the TC can be calculated as follows:

$$\mathrm{TC} = \mathrm{FC} + \mathrm{VC}$$
$$\mathrm{TC} = 449.111 + 5.054.000$$
$$\mathrm{TC} = 5.503.111$$

From the above calculation, it can be concluded that for every one production cycle or one planting period, the funds that must be spent are IDR. 5,503,111. The fee consists of IDR. 5,054,000 for the purchase of baglog and mushroom packaging and IDR. 449,111 for the construction of *kumbung* etc. (fixed costs) which are assumed to be for four years and the costs are distributed equally in one growing period (4 months).

3.2.2. *Total Revenue(TR).* Revenue in this research can be calculated by using formula 2:

$$\mathrm{TR} = \mathrm{Y} \times \mathrm{P_{kg}}$$
$$\mathrm{TR} = 600 \times 25{,}000$$
$$\mathrm{TR} = 15{,}000{,}000$$

In one growing periodor one production cycle, the total income obtained from the cultivation of white oyster mushrooms is IDR. 15,000,000.

3.2.3. *Net Income (Π)*. The net income of this busineess can be calculated as the following by using formula 3:

$$\Pi = \mathrm{TR} - \mathrm{TC}$$
$$\Pi = 15{,}000{,}000 - 5.503{,}111$$
$$\Pi = 9{,}496{,}889$$

From the utilization of idle land, a profit of IDR 9,496,889 can be obtained for every one production cycle if the land is used for a minimum of three years because the fixed costs are estimated to last three years and in this calculation the costs are charged equally for each growing periodfor three years.

3.2.4. $BEP_{production}$. *By using formula 4, then* BEP production is ;

$$\mathrm{BEP}_{production} = \frac{\mathrm{TC}}{\mathrm{P_{kg}}}$$
$$\mathrm{BEP}_{\mathrm{production}} = \frac{5.503.111}{25.000}$$
$$\mathrm{BEP}_{production} = 220{,}12 \text{ kg}$$

From the calculation of the $\mathrm{BEP}_{production}$ above, it can be concluded that by producing 220,12 kg of mushrooms in a production cycle, the capital spent will reach the break even point. Production that exceeds that value will become a net profit. If it is in accordance with the initial estimation where1, 000 baglog will produce 600 kg of mushrooms, and then the remaining 379.88 kg of mushrooms become a net profit for the business people (family).

3.2.5. BEP_{unit}.BEP unit can be calculated by using formula 5.

$$\mathrm{BEP_{unit}} = \frac{\mathrm{FC}}{(\mathrm{P_{baglog}} - \mathrm{VC/baglog})}$$
$$\mathrm{BEP_{unit}} = \frac{449.111}{(15.000 - 5.054)}$$
$$\mathrm{BEP_{unit}} = 45{,}115 \approx 46 \text{ unit}$$

Based on the results of the above calculations, it can be seen that businesses must at least cultivate a number of 46 baglog units in one growing periodfor three years so that all spent capital can be returned. This also means that in order to get profit, the business must cultivate baglog mushrooms in more than 46 units with a maximum limit of 1,000 baglog for this calculation. The more baglog managed, the more productive it will be because the time needed to manage 50 units and 1,000 units of baglog is not much different.

3.2.6. $BEP_{price.}$ By using formula 6, then the calculation of BEP price is as the following:

$$\mathrm{TR} = \mathrm{TC}$$
$$\mathrm{Y} \times \mathrm{P_{kg}} = \mathrm{FC} + \mathrm{VC}$$
$$\mathrm{BEP}_{price} = \mathrm{P_{kg}} = \frac{\mathrm{FC} + \mathrm{VC}}{\mathrm{Y}}$$
$$\mathrm{BEP}_{price} \approx \frac{5.503.111}{600}$$
$$\mathrm{BEP}_{price} = \text{IDR } 9{,}172/\text{kg}$$

In the market, the selling price of production can vary. This selling price can be influenced by the number of requests, availability of goods, sales mechanism and many other factors. It is necessary to

consider the appropriate selling price (not experiencing capital losses) so that the costs incurred to cultivate 1,000 units baglog will be back. Based on the calculation of BEP_{price}, it can be concluded that the selling price of IDR. 9,172 / kg of mushrooms, so that the 600 kg of mushrooms obtained from 1,000 baglog units can return all the capital that has been spent. So that every one unit increase in rupiah from the BEP_{price} value, will add IDR 600 profit for each kg of mushrooms.

Tabel 1. Fixed cost for oyster mushroom cultivation

No.	Subject	Qty	Price		Total	
1	wood	1	IDR	900.000	IDR	900,000
2	Bolt	1	IDR	80.000	IDR	80,000
3	Roof, etc	1	IDR	435.000	IDR	435,000
4	Wall	1	IDR	270.000	IDR	270,000
5	Builder	1	IDR	750.000	IDR	750,000
6	Water instalator	1	IDR	55.000	IDR	55,000
7	Nail , etc	1	IDR	22.000	IDR	22,000
8	Rack	5	IDR	200.000	IDR	1,000,000
9	Water / 4 months	4	IDR	30.000	IDR	120,000
10	Scale	1	IDR	70.000	IDR	70,000
11	Water Sprayer	1	IDR	40.000	IDR	40,000
12	Plastic film sealer	1	IDR	300.000	IDR	300,000
	FC (Estimated for 3 years)				**IDR**	**4,042,000**
	FC (For 4 months)				**IDR**	**449,111**

Tabel 2. Variable cost for oyster mushroom cultivation

No.	Subject	Qty	Price		Total	
1	Oyster Mushroom Baglog	1000	IDR	5,000	IDR	5,000,000
2	Packaging Plastic	600	IDR	90	IDR	54,000
	VC (For 4 months)				**IDR**	**5,054,000**
	VC/baglog				**IDR**	**5,054**
	VC/kg				**IDR**	**8,423**

4. Conclusion

Cultivating 1,000 units of white oyster mushroom baglog has the potential to generate a profit of IDR 9,496,889 (Net Income) for every one production cycle (4 months). From several BEP calculations, it can be concluded that the BEP can be reached when at least 220.12 kg of mushrooms (BEP production) can be sold. On the other hand, if we pay attention to the amount of baglog, at least 46 units of baglog (BEP_{unit}) should be cultivated to reach the BEP. Another conclusion that can be taken is the lowest mushroom selling price to be able to reach the BEP with a production of 600 kgs in one growing periodis IDR. 9,172 / kg (BEP_{price}).

5. Acknowledgements

We would like to thank the Research Institute and Community Service of University of Malikusaleh, and *Koperasi Detasemen Arhanud Rudal-001*of Pulo Rungkom Aceh Utara that has become partner in supplying mushroom seeds, as well as other colleagues and friends who have contributed greatly in this program.

References

[1] T. B. Purwantini, S. Saptana, and S. Suharyono, “Program Kawasan Rumah Pangan Lestari (KRPL) Di Kabupaten Pacitan: Analisis Dampak Dan Antisipasi Ke Depan,” *Anal. Kebijak. Pertan.*, vol. 10, no. 3, 2012.

[2] R. C. . Corrêa, T. Brugnari, A. Bracht, R. . Peralta, and I. . Ferreira, “Biotechnological, nutritional

and therapeutic uses of Pleurotus spp. (Oyster mushroom) related with its chemical composition: a review on the past decade findings," *Trends. Food. Sci. Technol.*, vol. 50, pp. 103–117, 2016.

[3] S. Khatun, A. Islam, U. Cakilcioglu, P. Guler, and N. C. Chatterjee, "Nutritional qualities and antioxidant activity of three edible oyster mushrooms (Pleurotus spp.)," *NJAS-Wageningen J. Life Sci.*, vol. 72, pp. 1–5, 2015.

[4] E. Szabová, L. Rohalová, and M. Hedvigy, "Semi-solid fermentation of Pleurotus ostreatus," *J. Microbiol. Biotechnol. Food Sci.*, 1950.

[5] P. Stamets, *Mycelium Running: How Mushrooms Can Help Save the World.* Berkeley, California, USA, 2005.

[6] I. N. . Tridjaja, "Strategi Pemasaran Produk Jamur," in *Prosiding Pra Workshop Pengembangan Produk dan Industri Jamur Pangan Indonesia.*, 2005.

[7] P. Stamets, *Mycelium Running: How Mushrooms Can Help Save the World*. California, USA: Ten Speed Press, Berkeley, 2005.

[8] P. Bobek and S. Galbany, "Effect of Pleuran (betaglucan from Pleurotus ostreatus) on the anti-oxidant Status of The Organism and on Dimethylhydrazine Induced pre-cancerous Lesions in Rat Colon," *Br. J. Biomed. Sci.*, vol. 58, no. 3, pp. 164–168, 2001.

[9] W. H.X and T. . Ng, "Isolation of a Novel Ubiquitine-like Protein from Pleurotus Ostreatus Mushroom with antihuman Immudodefi ciency Virus, Translationinhibitory, and Ribonuclease Activities.," *Biomed. Biophys. Reseacrh Commun.*, vol. 276, no. 2, pp. 587–593, 2000.

[10] N. .Gunde-Cimerman, "Medicinal Value of Genus Pleurotus (Fr.) P.Kast. (Agaricales s.l. Basidiomycetes)," *Int. J. Med. Mushrooms*, vol. 1., no. 1, pp. 69–80, 1999.

[11]N. Gunde-Cimerman and A. Plemenitas, "Pleurotus sporocaps: A hypocholesterolemic nutaceutical," in *In Proceeding og the 7th International Mycological Congress*, 2002, p. 97.

[12] F. Pirainoa and C. R Brandt, "Isolation and partial characterization of an antiviral, RC-183, from the edible mushroom Rozites caperata," *Antiviral Res.*, vol. 43, no. 2, pp. 67–78, 1999.

[13] D. Abrams, "Antihyperlipidemic Effects of Oyster Mushrooms. Clinical trials. National Center for Complementary and alternative Medicine (NCCAM).," 2004.

[14] N. . Gunde-Cimerman and A. Cimerman, "Pleurotus Truiting bodies Contain the Inhibitor of 3-hydroxy-3-methylglutarylcoenzyme A Reductase Lovastatin," *Exp. Mycol.*, vol. 19, no. 1, pp. 1–6, 1995.

[15] M. Sayuti, *Analisis Kelayakan Pabrik*. Yogyakarta: Graha Ilmu, 2008.

[16] Yuliana, "Feasibility Analysis Seaweed (Eucheuma Cottonii) Long Line System in the Village District of Pa'jukukang Rappoa Bantaeng," *J. Soc. Dev. Sci.*, vol. 8, no. 1, 2017.