Techno Economic Modelling of Dried Black Potato (*Plectranthus rotundifolius*)

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***Abstract**- The techno economic modeling of dried black potato (Plectranthusrotundifolius) was studied by employing an electrical cabinet oven. The parameters investigated were capital budgeting, breakeven points and financial ratio of rentability. The payback period was 2 years 11 months by investing IDR 53,000,000 for machinery and IDR 10,000,000 for start-up cost as initial capital. By assuming 10 years of dried black potato production, the present net value was equal to IDR 1,207,982,611. The values of gross and net profit margin were 0.97 and 0.87, respectively. Regarding the positive net present value, the lower payback period, and the high internal rate of return (74.47%) as well as the profitability index (20.17), techno economic modeling was positively recommending the commercial application of dried black potato using an electrical cabinet oven.*

***Keywords -** black potato, techno economic, payback period, net present value, internal rate of return*

1. Introduction

For more than ten decades, potato chips had gained global notoriety for being a delicious crispy snack. Sales in the US reach higher than $6 billion/year, being 33% of the total sales of snack market [1,2]. The US potato crop was producing 11 billion kg of processed potatoes, while 21.6% were treated into chips. The worldwide trade over recent years indicates that about 74 million kg of potato chips were exported, with an annual value of up to $165 million [3,4].

Fresh, sliced, or dough potatoes are usually produced into snacks, including the black potato. Boiled black potatoes are highly favored in Indonesia, however their short lifetime requires another food processing method to gain longer storage and a wider scope for the potential market. The easiest process regarding mass production is turning black potatoes into chips. This process involves the selection of black potatoes, pretreatment by washing under

a water flow, slicing, then frying in oil or drying using electric oven. The final treatment is the application of flavored powders before being packaged [5,6]. Dry crisp foods are often manufactured with their structure and final texture under the control of the manufacturer [7]. However, for the small entrepreneur, the thickness, structure or even the texture provided lower requirement in order to minimize the final selling price.

Black potatoes are a natural resource in Indonesia that are grown by local farmers [8]. Black potatoes have many advantages compared to the yellow ones in relation to nutrition and function [9-11]. The use of black potatoes has not been supported by optimal cultivation however [12-14], especially in regard to the inaccessibility of beneficial food. For this reason, the study aims to discuss the potential of turning black potatoes into popular and functional snacks. There will be an economic evaluation that analyzes Capital Budgeting, Break-even Points and Financial

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Rentability Ratio as indicators of feasibility in establishing a business.

2. Methodology
2.1 Economic Evaluation

The fixed capital investment, both direct and indirect costs, were estimated from actual conditions in Indonesia and calculated on Excel worksheets. The annual fixed capital investment was calculated by assessing the 10-year life of the machine, 14 % of interest rate, and 10 % of depreciation. The reference year was 2017 and 8 working hours per day were assumed. The working capital investment was calculated according to the financial cash flow analysis [15]. Its annual working capital is represented by multiplying the gross rates with the interest and added value tax (10 %). This economic analysis is the preliminary design for the future techno-economic analysis on the dried black potato production.

2.2 Analysis of Capital Budgeting

Capital budgeting is an expenditure planning process in fixed assets with expected cash flows and can occur more than once year. There are several methods to determine the feasibility of an investment in fixed assets. It is better to use multiple for a complete and comprehensive review.

$$PBP = \frac{I}{CIF} \quad (1)$$

$$NPV = CIF_{pv} - I_{pv} \quad (2)$$

$$PI = \frac{CIF_{pv}}{I_{pv}} \quad (3)$$

$$IRR = i_1 + \frac{NPV_1}{(NPV_1 - NPV_2)}(i_2 - i_1) \quad (4)$$

2.3 Analysis of Breakeven Point

Breakeven point (BEP) is the level of selling which is covering all working capital costs. It is therefore necessary to divide the costs according to their properties, namely fixed and variable costs, before calculating the breakeven point. Breakeven points can be calculated in both units and in currencies.

$$BEP_u = \frac{F}{P_u - V_u} \quad (5)$$

$$BEP_p = \frac{F}{1 - \frac{V_u}{P_u}} \quad (6)$$

Decreasing the amount of selling unit is a common occurrence in a business, however it should be maintained to minimize losses. Margin of safety (MS) can be used to calculate the level of sales that cause losses.

$$MS = \frac{P_t - BEP_p}{P_t} \quad (7)$$

Breakeven points also decide whether a business should be continued or stopped as indicated by the shut down point value (SDP). Business should be stopped when the income has failed to cover the incurred cash costs. Cash costs are the immediate costs required for payment using the company's cash.

$$SDP_u = \frac{F}{MI_u} \quad (8)$$

$$SDP_p = \frac{F}{1 - \frac{V_t}{P_t}} \quad (9)$$

2.4 Financial Ratio of Rentability

The company's financial development can be analyzed using financial ratios, *i.e.* profitability. This ratio indicates the company's ability to provide profits.

$$GPM = \frac{Pr_{bt}}{P_t} \quad (10)$$

$$NPM = \frac{Pr_{at}}{P_t} \quad (11)$$

$$ROI = \frac{Pr_{at}}{A_t} \quad (12)$$

3. Results and Discussion
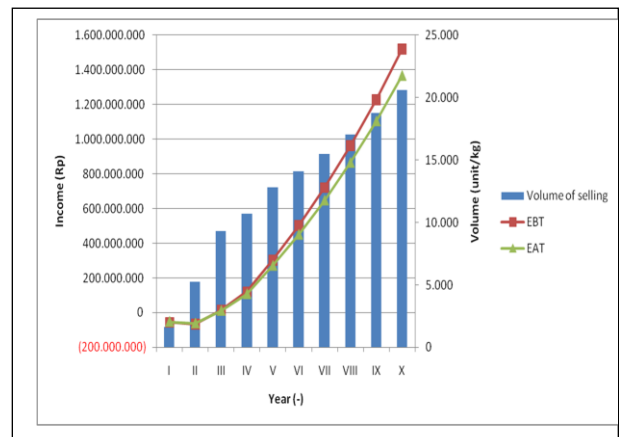### 3.1 Economic Evaluation

Figure 1. Predicted income (earning before and after tax) and predicted volume of selling annual

Financial projections which include cash inflows, financing and outflows are needed to determine profitability, or it can be called a profit and loss projection. This profit and loss represent the difference between the

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net sales of the product and the total cost during a certain period. Net sales are assumed that all products produced (after being reduced by loss of product during production) are sold. Net profit earned (earning after tax, EAT) refers to an operating profit (earning before tax, EBT) which is reduced by payment of taxes [15]. Estimated profit and loss can be seen on EBT and EAT lines in Figure 1. Tax is calculated as a value added tax (VAT) of 10% which is assumed to be fixed for 10 years of tool life and begins to be calculated in the year after cash flows are obtained – this shows a positive EBT value.

The total cash inflow for 10 years is estimated at IDR 4,711,813,827, while total capital (total production costs) is IDR 3,827,328,235. The total EBT is IDR 5,235,348,696. With a total tax of IDR 523,534,870, it is estimated that a total net profit of IDR 4,711,813,827 will be obtained over a period of 10 years.

3.2 Analysis of Capital Budgeting

Table 2 shows an analysis of the feasibility of the black potato production process over 10 years. It is concluded that the value of the Internal Rate of Return (IRR) was obtained at 74.47% with the Pay Back Period in the third year minus one month and the Net Present Value (NPV) of IDR 1,207,982,611. Using the assumption that the current bank interest rate is 14%, the 10-year IRR is still greater than the current bank interest. This suggests that the project is feasible to run. In addition, business feasibility is also indicated by the value Profitability Index (PI) of 20.17, where the minimum requirement of the PI is 1.00.

3.3 Analysis of Breakeven Point

Break-even analysis includes break event point (BEP) analysis, margin of safety (MS) and shut down point (SDP). This is carried out to determine if a business decision is profitable and not limited to returning all costs incurred. BEP is a way of looking for a minimum quantity that must be sold where the company does not experience a loss i.e. a minimum level of sales that produces profits equal to zero [15].

With investment in production equipment of IDR 53,000,000, the BEP value of the unit is 24,008 kg or equal in the rupiah as IDR 1,032,359,422. This shows that the minimum level of sales is 19,12% of the total production for 10 years. This result is also reinforced by the MS value of 80,88% or 101,552 kg. The value of MS indicates the maximum number of unsold products (a decrease in the level of sales) to achieve a return on costs incurred. In addition to these two factors, the critical condition will also determine the next step on whether the business will continue or stop, as stated in the shut down point (SDP). The calculation results show that the business should be stopped if only IDR 575,540 or 13 kg for every 70 kg of production is sold.

3.4 Financial Ratio of Rentability

In addition, business feasibility is also indicated by the value of a Gross Profit Margin (GPM) of 0.97, the value of a Net Profit Margin (NPM) of 0.87 and the value of a Return on Investment (ROI) of 1.21. The minimum requirements for the GPM and NPM values are positive. The higher the ROI the better the business, where the ROI can only be compared to the industry average ratio. These values are obtained by applying the selling price of black potatoes in the amount of IDR 43,000/kg.

4. Conclusion

The value of gross and net profit margin were 0.97 and 0.87, respectively. Regarding the positive present net value (IDR 1,207,982,611), the lower payback period value (2,96), and the high value of internal rate of return (74.47%) coupled with the profitability index (20.17), techno-economic modeling positively recommends the commercial application of dried black potato by using an electrical cabinet oven.

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