Techno Economic Modelling of Dried Black Potato (*Plectranthusrotundifolius*)

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Abstract*- The techno economic modeling of dried black potato (Plectranthusrotundifolius) was studied by employing electrical cabinet oven. The parameters investigated were including parameter obtained from analysis of capital budgeting, breakeven point and financial ratio of rentability. The obtained 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 value of net present value was equal to 1.207.982.611 rupiah. The value of gross profit margin and net profit margin were 0.97 and 0.87, respectively. Regarding to the positive value of net present value, the lower payback period value, and the high value of internal rate of return (74.47%) and also the profitability index (20.17), the modeling of techno economic was positively recommending the commercial application of dried black potato by using electrical cabinet oven.*

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

1. Introduction

Potato chips have been popular salty snacks for 150 years, and retail sales in the US are worth about $6 billion/year, representing 33 percent of the total sales of this market (Garayo and Moreira, 2002; Clark, 2003). In 2001 about 50 percent of the US potato crop was processed to produce 11 300 million kg of processed potatoes, of which 21.6 percent were made into chips. The worldwide trade over recent years indicates that about 7.4 × 107 kg of potato chips were exported, with a value of ~$165 million annually (Economic Research Service, 2004). (Franco Pedreschi, Domingo Mery, Thierry Marique, 2008)

Potato-based snacks can be made either exclusively from fresh, sliced potatoes or from potato dough. The chips in the latter case are called simulated potato chips. The steps involved in potato chip processing include selection, procurement and receiving, storage under optimum conditions, peeling and trimming of potato tubers, slicing, frying in oil, salting, or the application of flavored powders and packaging (Bawa & Sidhu, 2016). The peeled potatoes

are cut into slices 10–17 mm thick by rotary slicers. Slices must be very consistent in thickness in order to obtain uniformly colored chips. Slices with torn surfaces lose excess solubles from the ruptured cells, and absorb large amounts of fat. Starch and other materials released from cut cells are washed away prior to frying or drying. 'Dry crisp' foods are often manufactured and therefore their structure, and resulting texture, are under the control of the manufacturer (Duizer, 2013).

Black potatoes are Indonesian natural resources that are returned by ordinary people (Sotyati, 2016). While black potatoes have many advantages compared to yellow potatoes in general (Kishorekumar 2007, Nugraheni et al., 2011, 2013) as nutritious functional foods. The use of black potatoes has not been supported by optimal cultivation of black potatoes (Suwandi and Ashandi, 1986; Nkansah, 2004) regarding the inaccessibility of beneficial food. For this reason, this study discusses the potential of managing black potatoes into black crispy potatoes as functional snacks. The study aimed at economic evaluation, which

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focuses on the analysis of Capital Budgeting, Break-even Point and Rentability Financial Ratio as indicators of feasibility in establishing a business.

2. Methodology
2.1 Economic Evaluation

The fixed capital investment, both the direct and indirect costs, was estimated from actual condition in Indonesia and calculated computational on Excel worksheets. The annual fixed capital investment was calculated by corresponding to 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 [Hidayat, 2013]. Its annual working capital represented by multiplying the gross with the interest rate and added value tax (10 %). This economical 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 has possibility occur more than one year. There are several methods to determine the feasibility of an investment in fixed assets. It is better to use together for complete and comprehensive preview.

$$PBP = \frac{I}{CIF} \tag{1}$$

$$NPV = CIF_{pv} - I_{pv} \tag{2}$$

$$PI = \frac{CIF_{pv}}{I_{pv}} \tag{3}$$

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

2.3 Analysis of Breakeven Point

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

$$BEP_u = \frac{F}{P_u - V_u} \tag{5}$$

$$BEP_p = \frac{F}{1 - \frac{V_u}{P_u}} \tag{6}$$

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

$$MS = \frac{P_t - BEP_p}{P_t} \tag{7}$$

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

$$SDP_u = \frac{F}{MI_u} \tag{8}$$

$$SDP_p = \frac{F}{1 - \frac{V_t}{P_t}} \tag{9}$$

2.4 Financial Ratio of Rentability

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

$$GPM = \frac{Pr_{bt}}{P_t} \tag{10}$$

$$NPM = \frac{Pr_{at}}{P_t} \tag{11}$$

$$ROI = \frac{Pr_{at}}{A_t} \tag{12}$$

3. Results and Discussion
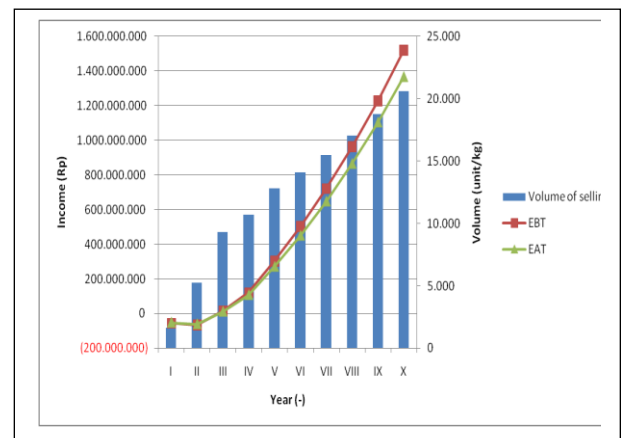### 3.1 Economic Evaluation

Fig. 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 the level of

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profitability of a business, or it can be called a profit and loss projection. This profit and loss represents the difference between the net sales of the product during a certain period and the total cost during the same period. Net sales are assumed that all products produced (after being reduced by loss of product during production) are sold all. Net profit earned (earning after tax, EAT) means as an operating profit obtained before tax (earning before tax, EBT) which is reduced by payment of taxes (Hidayat, 2013). 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 which show 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, so that 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, within a period of 10 years.

Table 2. Predicted cash flow of the black potato production process within 10 years

Cash Flow	Annual									
Estimated Annual Cash Flow	1	2	3	4	5	6	7	8	9	10
Beginning Balance (I)		(9,642)	(15,001)	71,320	183,190	370,354	576,235	802,704	1,051,820	1,325,848
A. Cash-In Flow										
Initial Capital	10,000	(9,642)	(15,001)	71,320	183,190	370,354	576,235	802,704	1,051,820	1,325,848
Accounting Receivable	68,654	224,574	398,973	458,819	550,583	605,641	666,205	732,826	806,108	886,719
Sub Total A (II)	78,654	214,932	383,972	530,139	733,773	975,996	1,242,441	1,535,530	1,857,929	2,212,567
B. Cash-Out Flow										
i. CAPITAL COST										
Down payment of oven dryer	30,000									
Dewatering machine	8,000									
Acquittance of oven dryer	15,000									
Sub Total i	53,000									
ii. VARIABLE COST										
Purchase of black potatoes	27,370	89,531	159,059	182,918	219,501	241,452	265,597	292,156	321,372	353,509
Purchase of bottle and table	319	1,045	1,856	2,134	2,561	2,817	3,099	3,408	3,749	4,124
Purchase of cardboard and duct tap	1,331	4,352	7,732	8,892	10,670	11,737	12,911	14,202	15,622	17,184
Factory Overhead	16,502	42,005	44,405	46,805	51,486	56,634	62,298	68,528	75,380	82,918
Sub Total ii	46	136,933	213,052	240,749	284,218	312,640	343,904	378,295	416,124	457,737
iii. FIXED COST	25,250	93,000	99,600	106,200	79,200	87,120	95,832	105,415	115,957	127,552
iv. START UP COST										
Commisioning	5,000									
PIRT, Halal, BPOM Certification	5,000									
Sub Total iv	10,000									
v. INVESTATION (i + iv)	63,000									
vi. WORKING CAPITAL (ii + iii)	25,296	229,933	312,652	346,949	363,418	399,760	439,736	483,710	532,081	585,289
Sub Total B (TOTAL CAPITAL, III)	88,296	229,933	312,652	346,949	363,418	399,760	439,736	483,710	532,081	585,289
Accumulated Cash Outflow	88,296	318,229	630,881	977,830	1,341,248	1,741,008	2,180,745	2,664,454	3,196,535	3,781,824
Ending Ballance (I + II - III)	(9,642)	(15,001)	71,320	183,190	370,354	576,235	802,704	1,051,820	1,325,848	1,627,278
Tax (10%)	(964)	(1,500)	7,132	18,319	37,035	57,624	80,270	105,182	132,585	162,728
Earning After Tax (EAT)	(8,678)	(13,501)	64,188	164,871	333,319	518,612	722,434	946,638	1,193,263	1,464,550
Accumulated Cash Inflow	(8,678)	(22,179)	42,009	206,880	540,199	1,058,811	1,781,245	2,727,883	3,921,146	5,385,697

3.2 Analysis of Capital Budgeting

Table 2 shows an analysis of the feasibility of the black potato production process within 10 years. From the feasibility analysis conducted, 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 shows 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 SDP shut down point). This analysis is carried out to determine the business decision that is produced is a profitable business and not only limited to returning all costs incurred. Break-even analysis (BEP) is a way of looking for a minimum quantity that must be sold where the company does not experience a loss or a minimum level of sales that produces profits equal to zero (Hidayat, 2013).

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 as much as 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 whether the business will continue or stop, stated in the shutdown point (SDP). The calculation results show that the business

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should be stopped if there is only selling of IDR 575.540 or 13 kg for every 70 kg of production.

3.4 Financial Ratio of Rentability

In addition, business feasibility is also indicated by the value of Gross Profit Margin (GPM) of 0.97, the value of Net Profit Margin (NPM) of 0.87 and the value of Return on Investment (ROI) of 1.21. The minimum requirements for the GPM and NPM values are positive values. The higher the ROI the better the business, whether the ROI can only be compare 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 profit margin and net profit margin were 0.97 and 0.87, respectively. Regarding to the positive value of net present value (IDR 1.207.982.611), the lower payback period value (2,96), and the high value of internal rate of return (74.47%) and also the profitability index (20.17), the modeling of techno economic was positively recommending the commercial application of dried black potato by using electrical cabinet oven.

5. Nomenclature

PBP	payback period
NPV	net present value
PI	profitability index
IRR	interval rate of return
BEP	breakeven point
MS	margin of safety
SDP	shut down point
GPM	gross profit margin
NPM	net profit margin
ROI	return on investment
I	investment
CIF	cash inflow
i	discount factor
F	fixed cost
P	price of selling
V	variable cost
Pr	profit
A	asset
pv *(subscript)*	present value
1 *(subscript)*	regarding to positive NPV
2 *(subscript)*	regarding to negative NPV
u *(subscript)*	unit
p *(subscript)*	currency
t *(subscript)*	total
bt *(subscript)*	before tax
at *(subscript)*	after tax

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