การวิเคราะห์ทางการเงินในการผลิตปาล์มน้ำมันเชิงทดลองในประเทศไทย: กรณีศึกษาการปลูกต้นกล้าปกติและต้นกล้าข้ามปี

A Financial Analysis on Experimental Oil Palm Production in Thailand: The Cases of Normal and Over-year Seedling Plantation

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Received: June 27, 2023
Revised: July 21, 2023
Accepted: July 25, 2023

Abstract: Thailand has often unsold seedlings remaining in the nursery each year, especially during periods of low palm oil prices and limited replanting activities. This is deprived of maintenance and over-year seedling affected. Thailand has not been studied to investigate the financial aspects of over-year seedling usage. This study aimed to compare the financial investment of normal and over-year seedling types in 7 commercial oil palm cultivars. The data were recorded from an experimental field in Krabi province as seedling cost, field preparation, crop management and yield, then summarized in Microsoft Excel 365. Project assessment was applied to financial analysis by using NPV, IRR and BCR indicators. The finding points out that the normal seedling had higher NPV, IRR, and BCR values compared to over-year seedlings in most crosses that had a shorter payback period except Deli x AVROS-T. The recommended cultivar for planning investment was the crosses of Deli x Tanzania-T given the best financial indicator's values, whereas Deli x LaMe-F was the worst choice for plantations with the lowest monetary values.

Keywords: financial analysis, oil palm, normal and over-year seedling

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บทคัดย่อ: ประเทศไทยมักมีต้นกล้าที่ยังคงเหลืออยู่ในเรือนเพาะชำในแต่ละปี โดยเฉพาะในช่วงที่ราคาน้ำมันปาล์มตกต่ำและการปลูกซ่อมแซมมีจำกัด ต้นกล้าเหล่านี้ถูกละเลยในการดูแลและมีผลกระทบจากการเก็บไว้นานเกินปี ในประเทศไทยยังไม่ได้มีการศึกษาวิจัยในด้านการเงินเกี่ยวกับการใช้งานต้นกล้าข้ามปี งานวิจัยนี้มีวัตถุประสงค์เพื่อเปรียบเทียบการลงทุนทางการเงินของต้นกล้าปกติและต้นกล้าข้ามปีในการปลูกปาล์มน้ำมันเชิงพาณิชย์ 7 พันธุ์ ข้อมูลถูกบันทึกจากแปลงทดลองในจังหวัดกระบี่ในด้านต้นทุนต้นกล้า การเตรียมแปลง การจัดการพืชผล และผลผลิต จากนั้นสรุปในโปรแกรม Microsoft Excel 365 การประเมินโครงการถูกนำมาใช้ในการวิเคราะห์ทางการเงินโดยใช้ตัวชี้วัด NPV, IRR และ BCR ผลการวิจัยชี้ให้เห็นว่าต้นกล้าปกติมีค่า NPV, IRR และ BCR สูงกว่าต้นกล้าข้ามปีในเกือบทุกสายพันธุ์โดยมีระยะเวลาคืนทุนสั้นกว่า ยกเว้นสายพันธุ์ Deli x AVROS-T สายพันธุ์ที่แนะนำสำหรับการลงทุนคือสายพันธุ์ Deli x Tanzania-T ที่มีค่าตัวชี้วัดทางการเงินดีที่สุด ขณะที่สายพันธุ์ Deli x LaMe-F เป็นทางเลือกที่แย่ที่สุดสำหรับการลงทุนปลูกเนื่องจากมีค่าตัวชี้วัดทางการเงินต่ำที่สุด

คำสำคัญ: การวิเคราะห์ทางการเงิน, ปาล์มน้ำมัน, ต้นกล้าปกติและต้นกล้าข้ามปี

INTRODUCTION

Oil palm (*Elaeis quineensis* (Jacq)) is a significantly economic plant for use as an alternative energy. Originally, it was a native plant in west and southwest Africa, then expanded to Indonesia in Asia by the Portuguese in 1848 (Corley and Tinker, 2003). Found in Thailand, oil palm has firstly cultivated in Satoon and Krabi provinces since 1968. Oil palm cultivation has continuously expanded in southern of Thailand due to the appropriate climatic regions. Oil palm needs lots of water and moisture at every growing step. Individual crops have differently adapted in their biodiversity impacts, depending on how and where they are cultivated (Beaton *et al*., 1990; Tabatabaei *et al*., 2012). Research and development in oil palm breeding are realized to improve oil palm cultivars which are high yields and adaptable to Thailand's environment. Consequently, the growers stand to benefit from reducing import supply costs. The most commercial cultivar is the Tenera form, which produces fruit with a higher oil content (Rival and Levang, 2014). The high yield of oil palm is the most interesting for using alternative energy. One of the major attentions is biodiesel from palm oil. Thailand ranks the 3rd in the world of palm oil producers after Indonesia and Malaysia. It accounts for only 3.9% of global production, which has little influence on global palm oil prices. Accordingly, Thai government has promoted the cultivation of oil palms for renewable energy. Besides, Thai government policy has launched the Alternative Energy Development Plan: AEDP 2012-2021 to the expansion of oil palm planting areas, improve productivity, and increase the oil yield of fresh fruit bunches. The palm oil board has approved the strategy of oil palm and palm oil reformation for 20 years (2017-2037) with productivity improvement and increasing oil yield of fresh fruit bunches per unit.

In Thailand, seedlings of oil palm are divided into 2 types which are a normal seedling (10-12 months) and an over-year seedling (22 months). The over-year seedling has a higher stem diameter than the normal seedling. It generally has been used in

transplanting because it could be saved from rat destruction in the field. In terms of oil palm plantation investment, seedling is a major cost structure, whereas differentiation of seedling material affected the return on investment and profit, which are measured by the investment model as benefit-cost ratio (BCR), net present value (NPV), internal rate of return (IRR) and break-even point as well. (Sugden and Williams, 1978; Brent, 1998; Svatova *et al*., 2015). Consequently, this study aimed to compare the financial analysis of normal and over-year seedling types in 7 commercial oil palm cultivars.

MATHERIAL AND METHODS

Oil palm plantation

This study was conducted at Von Bundit Company Limited Partnership, AoLuk district, Krabi province. The plant material of oil palm was separated into 2 types of oil palm seedlings: normal seedlings (11–12 months after emergence: MAE) and over-year seedlings (22 MAE). The seven commercial oil palm seedling cultivars consisted of 3 hybrids from foreign countries, namely Deli ×Compact-F, Deli×AVROS-F, Deli× LaMe-F and 4 hybrids from Thai private companies or Thai government, namely Deli×AVROS-T, Deli×Yangambi-T, Deli×LaMe-T and Deli×Tanzania-T. The over-year seedling was abstained from fertilizer in the dry season and leaves and roots were cut by the diamond cut technique before transplanting to the field. Both seedling types were transplanted to the field with 9×9×9 m spacing in an equilateral triangle planting with a plant density of around 22 plants per rai. Moreover, the split plot in the randomized complete block design (RCBD) was used with the main plot (control) of both seedling types, normal seedling and over-year seedling, and similarly prepared in subplots were 7 commercial oil palm cultivars with 3 replications per treatment. Yield harvesting recordings on an individual palm basis were taken for a 12-month period, between January and December each year as fresh fruit bunch weight and fresh fruit bunch number. The yield data were analyzed for the young mature phase, which was from the 3rd to the 5th year of production.

Investment financial analysis

Financial analysis used full production costs for 2 types of seedlings, which included costs of personnel, resources, land preparation and administrative. The cost analysis was based on the distribution and the cost calculation by activity. The costs of production were capital and recurrent costs, including labor and material costs. Assessing the investment financials of normal and over-year seedlings was necessary to determine the financial statement of cash-flow, which might be acquired as income or expense. Then, following the determination of net cash flow, was the balance of net income and expenditure, which was discounted yearly over 20 years.

This study used financial indicators, including net present value, benefit-cost ratio, internal rate of return, and pay-back period (Gittinger, 1986), as follows:

1) net present value (NPV)

The net present value is used to determine the overall financial performance of the project (Sugden and Williams,1978; Brent, 1998). The net present value of the project is calculated and derived from the total discounted income and costs. The net present

value of a system over a time period is derived using Equation 1, where cash flow (CF) is specified for each year (r) over a time horizon of R (years), and i is the discount rate with a positive value of NPV for an acceptable project.

$$NPV = \sum_{r=0}^{r=R} \frac{CF_r}{(1+i)^r} \qquad \text{(Equation 1)}.$$

The NPV analysis was estimated for a 20-year time frame. There are 3 criteria for NPV analysis as follows;

NPV > 0, meaning that the project is feasible to run,

NPV = 0, meaning that the benefit is equal to the cost,

NPV < 0, meaning that the project is not feasible to run.

The cash flow was determined as the revenue (R) minus capital costs (*C*) minus recurrent costs (*T*) (Equation 2):

$$CF = R-(C+T). \qquad \text{(Equation 2)}$$

2) Benefit-cost return (BCR)

is the relationship between the summary of present value investment and the present value of all costs of the oil palm production project that is calculated from the total discounted income and costs portion andderived using Equation 3, where cash-flows (CF) are specified for each year (r) over a time horizon of R (years) and i is the discount rate with the initial investment of the current project. If the BCR is greater than 1, it means that the project is acceptable because it is expected to generate a positive net present value. If the BCR is less than 1, it means that the project is not acceptable.

$$BCR = \sum_{r=0}^{r=R} \frac{CF_r}{(1+i)^r} \qquad \text{(Equation 3)}.$$

The cash-flow is determined as the revenue (R) divided by capital costs (C) minus recurrent costs (T) (Equation 4):

$$CF = R-(C+T). \qquad \text{(Equation 4)}$$

3) Internal rate of return (IRR)

The internal rate of return (IRR) compares the amounts of benefit and cost. IRR is the value of the discount rate at which the present value of expected investment returns equaled the present value of investment expenditure. It is interested in the income expected from the investment plan. This breakthrough discount rate makes the value of cash outflows equal to the value of cash inflows. It is calculated using Equation 5, where: time (r), cash flow (CF), internal rate of return (IRR), net present value (NPV) (Svatova *et al*., 2015);

$$NPV = \sum_{r=0}^{r=R} \frac{CF_r}{(1+i)^r} \qquad \text{(Equation 5)}.$$

IRR estimation relied on the same formula as NPV equation. There are 3 criteria for IRR analysis:

IRR > discount rate, meaning that the project is feasible to run

IRR = discount rate, meaning that the benefit is equal to the cost

IRR < discount rate, meaning that the project is not feasible to run.

4) Payback Period

It is the time at revenue for recouping the initial amount invested in a project or investment. The benefit of oil palm products having rapid payback was presented with a comparison of normal and over-year seedlings

with 7 commercial oil palm cultivars. The formula for the payback period relied on the initial investment and annual cash flow. The annual cashflow was the difference between benefit and cost for each period. However, the payback period does not include the time value of money in the estimation.

Nonetheless, the limitation of project analysis on oil palm investment is necessary to predict given its assumption that, for 20 years of project life, the discounted rate as the loan interest rate is 7%, and the project started the first year as an investment cost with the land preparation, plantation cost, seeding cost, and infrastructure cost. In the 2nd–20th following year, mostly maintenance costs are labor costs, farm input costs, etc., whereas the return or benefit on oil palm production can be collected since yield cultivation in the 6–20th following year.

Data collection

Data were collected during the 5 years of oil palm transplanting in the field. Data related to quantities and costs of all inputs and outputs of the establishment, maintenance, production, harvesting, and sales. The further estimated amounts of inputs and outputs were estimated from the yield of the good oil palm cultivar with an appropriate planting, which generated a yield potential prediction equation to forecast the cost and revenue calculation since the 6th–20th years. A spreadsheet model, developed in the Microsoft Excel 365 version, was found to be an appropriate method of summarizing the data, and therefore it was necessary to specify basic criteria: The computation unit was one rai of plantation, the main time scale was one year, and recognize the impact of discounting the time value of money.

The area of the experiment was 288 rai. The typical life cycle of the oil palm production chain was supposed in 20 years. The costs of field replanting and seedling costs were summarized only in the 1st year. The main costs in each operation related to labor, machinery, and input materials. Labor costs were expressed in person-quantity of harvest and person-month. The wage of harvesting labor was 600 baht per ton, or 0.6 baht per kg of fresh fruit bunches harvested, and the labor cost of the manager position was 15,000 baht per month. The value of indicators in the financial analysis was compared to the effects of the different costs and selling prices of fresh fruit bunches. The price of a fresh fruit bunch varied with factors such as product availability and market demand. The market price for selling the FFB used in this study was 3–4 baht per kg when it was used to conduct this study in 2013–2017.

RESULTS AND DISCUSSION

The study focused on the financial analysis of a 20-year project of oil palm production with 7 different cultivars. At the experiment field, the yield data were collected for each cultivar starting in the 3rd -5th year, then forecasted for the 6th – 20th as a modeling assumption. First, the information on experimental oil palm seedling prices, both normal and over-year seedling, is shown in (Table 1) as an investment cost that differed based on their cultivars. The comparison between normal and over-year seedling indicated the over-year seeding for all cultivars was higher than normal seeding, and the Deli x Compact-F cultivar had the highest price.

Table 1 Investment cost of experimental oil palm seedling

Cultivars	Prices[1] (baht per unit)	
	Normal seedling	Over-year seedling
Deli x Compact-F	111.37	123.37
Deli x AVROS-F	66	78.00
Deli x LaMe-F	64.17	76.17
Deli x AVROS-T	76.62	88.62
Deli x Yangambi-T	66.72	78.72
Deli x LaMe-T	77.67	89.67
Deli x Tanzania-T	72.9	84.90

Note: [1]average price for investment cost

The data shown in (Table 2), is the term of benefit, which was the value of the harvested yield and its selling price. The production data started in the 3rd to 20th years due to it could not be harvested since the 1st and 2nd years. However, the project assumption given with their yield would increase in early year to 8th and 9th year having the highest yield, but slightly drop for the later year (10th-20th year). Comparing the yield of normal and over-year seedling, most normal seedling cultivars offered a yield greater than over-year seedling, except the Deli x AVROS-T cultivar. Additionally, Deli x Tanzania-T and Deli x Yangambi-T cultivars had high values over 20,000 baht per rai, whereas the lowest value was Deli x LaMe-F cultivar (14,592 and 13,079 baht per rai in normal and over-year seedling, respectively). The benefit and cost data shown in (Table 3) as the cash flow on a 20-year project pointed out that the 1st-5th year data collected from experimental fields then estimated the data in the 6th–20th year with the same amount of the 5th year as the assumption on experimental oil palm production that fixed the average cost of land preparation, investment cost, labor cost, input cost and maintenance cost but differed for seedling cost (Table 1) and selling value correlated with their harvesting yield in each cultivar (Table 2). Estimated at the 7% discounted rate on the financial analysis model, the results indicated all oil palm production with normal and over year seedling of the 7 cultivars were profitable in every financial indicator: NPV, BCR, IRR, and also had a good return on pay-back period.

Considering the financial indicator: net present value (NPV), the difference between the total present value of net cash flows, it showed a positive value in every oil palm plantation in the 20-year project, where the normal seedling had a positive NPV value and tended to be higher than the over-year seedling in the majority of cultivars. The highest NPV value was the Deli x Tanzania-T combination at 62,706 and 44,542 baht and the minimum value was the Deli x LaMe-F combination at 23,503 and 14,864 baht. Furthermore, BCR was the ratio between the net present value of cash flow, and the result confirmed the acceptable projects for most of the oil palm experiments with BCR values greater than 1. The Deli x Tanzania-T

cultivar had the maximum values of normal and over-year seedling of 1.70 and 1.52, whereas the Deli x LaMe-F cultivar had the lowest values of normal and over-year seedling of 1.29 and 1.18, respectively. Furthermore, the internal rate of return (IRR) was an annual rate of return calculated as a discount rate at the net present value (NPV) of the investment, which was zero or referred to as the discount rate at 7%. From the analyzed results, it was found that normal palm oil seedling had an IRR value higher than over-year seedling in most oil palm cultivars, the Deli x Tanzania-T palm had the highest IRR value at 27.61% and 22.49% in normal and over-year seedling, respectively; nevertheless, the Deli x LaMe-F species had the lowest value at 16.60% and 13.60%, respectively. On the payback period (PB) indicator, the finding suggested that the oil palm project on the experimental field was worthy of investment because normal seedling could return quicker than over-year seedling for most cultivars. The Deli x Tanzania-T cultivar had the best PB values for normal and over-year seedling at 0.83 and 1.11, respectively. Alternatively, the Deli x AVROS-T cultivar figured out the opposite result with the normal seedling was worse than the over-year seedling in every indicator. See the similarly related study of Suthijit *et al*. (2020), who analyzed the financial analysis of smallholder oil palm production in unsuitable areas of Surat Thani Province, Thailand, over 25 years and applied a 7% discount rate. A positive NPV of 71,215.17 baht, an IRR of 38.72 % and a BCR of 2.25. pointed out that the oil palm cultivation in unsuitable areas was a worthwhile investment or profitable in all indicators. Likewise, Anuraksakornkul *et al*. (2016) studied on financial investment in medium to large-scale oil palm plantations in Chon Buri province in 2013 over a period of 25 years with 15 farm sizes. The financial indicators (NPV, IRR and BCR) with the discount rate (loan interest rate) of 4%, showed that the investment in oil palm was profitable as the NPV was 74,547.78 baht per rai, the BCR was 3.52, and the IRR was 29.67%, in the non-suitable areas. Moreover, the study of Svatonova *et al*. (2015) on the financial profitability and sensitivity analysis of palm oil plantations in Indonesia figured that the oil palm investment in 8,000 ha for 25 years with the default discount rate (10%) was very profitable with a NPV of USD 10,670, a ROI of 73.50%, an IRR of 14.83%, and a payback period of 6.75 years. Additionally, Nwawe *et al*. (2015) researched the economic assessment of oil palm projects in Nigeria, and the results confirmed that the NPV was positive, the IRR was 33%, and the BCR was 1.06 at a 32% interest rate.

Table 2 The selling value of experimental oil palm harvested yield for 20 years project

Crosses	Seedling type	Year (baht per rai)																			
		1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th	11th	12th	13th	14th	15th	16th	17th	18th	19th	20th
Deli x Compact-F	Normal	0	0	1,489	6,750	11,513	15,282	15,882	16,291	16,291	16,091	16,091	15,962	15,682	15,682	15,682	15,482	15,282	15,081	14,881	14,881
	Over-year	0	0	1,725	6,419	9,545	11,003	13,167	13,506	13,506	13,340	13,340	13,234	13,001	13,001	13,001	12,835	12,669	12,503	12,337	12,337
Deli x AVROS-F	Normal	0	0	2,800	6,923	12,829	17,028	17,698	18,153	18,153	17,930	17,930	17,787	17,474	17,474	17,474	17,251	17,028	16,805	16,582	16,582
	Over-year	0	0	1,716	6,492	11,131	14,775	15,355	15,750	15,750	15,557	15,557	15,433	15,162	15,162	15,162	14,968	14,775	14,581	14,387	14,387
Deli x LaMe-F	Normal	0	0	2,136	6,150	10,312	13,688	14,226	14,592	14,592	14,412	14,412	14,297	14,046	14,046	14,046	13,867	13,688	13,508	13,329	13,329
	Over-year	0	0	1,187	7,596	9,243	12,269	12,751	13,079	13,079	12,919	12,919	12,816	12,591	12,591	12,591	12,430	12,269	12,108	11,948	11,948
Deli x AVROS-T	Normal	0	0	3,367	8,276	11,556	15,339	15,942	16,352	16,352	16,151	16,151	16,023	15,741	15,741	15,741	15,540	15,339	15,138	14,937	14,937
	Over-year	0	0	2,589	8,272	12,106	16,069	16,701	17,130	17,130	16,920	16,920	16,785	16,490	16,490	16,490	16,279	16,069	15,858	15,648	15,648
Deli x Yangambi-T	Normal	0	0	2,699	9,067	14,528	19,283	20,041	20,557	20,557	20,304	20,304	20,143	19,789	19,789	19,789	19,536	19,283	19,031	18,778	18,778
	Over-year	0	0	2,799	9,166	12,434	16,505	17,153	17,595	17,595	17,378	17,378	17,240	16,937	16,937	16,937	16,721	16,505	16,288	16,072	16,072
Deli x LaMe-T	Normal	0	0	2,868	8,727	11,708	15,541	16,152	16,567	16,567	16,363	16,363	16,233	15,948	15,948	15,948	15,744	15,541	15,337	15,133	15,133
	Over-year	0	0	2,018	7,081	10,257	13,615	14,150	14,514	14,514	14,335	14,335	14,221	13,971	13,971	13,971	13,793	13,615	13,436	13,258	13,258
Deli x Tanzania-T	Normal	0	0	3,298	10,389	14,723	19,542	20,310	20,833	20,833	20,577	20,577	20,413	20,054	20,054	20,054	19,798	19,542	19,286	19,030	19,030
	Over-year	0	0	2,434	7,636	12,809	17,002	17,670	18,124	18,124	17,901	17,901	17,759	17,447	17,447	17,447	17,224	17,002	16,779	16,556	16,556

Note: estimated the data: oil palm planted at 22 trees per rai would produce an annual yield of 500-3,000 kg/rai in the 3rd -5th year and estimated of 3,000-4,000 kg/rai in 6th -13th year and then declining in 14th -20th year. The market price for selling FFB was 3-4 baht/kg conducted in 2013-2017.

Table 3 Cash flow on experimental oil palm production for 20 years project

Cost-Benefit	Items	Year					
		1st	2nd	3rd	4th	5th	6th – 20th [1]
Cost	Land preparation	4,500	153	76	0	311	0
	Investment cost (machine/instrument)	611	583	577	588	588	588
	Seedling cost[2]	See table 1					
	Labor cost (wages)	3,370	3,370	3,370	3,370	3,370	3,370
	Input cost (chemical)	690	1,033	1,745	1,134	1,736	1,736
	Maintenance cost (utility support)	83	83	83	83	83	83
Benefit	Selling Values[3] (yield)	See table 2					

Note: [1] estimated the value data in 6th – 20th year with the same amount as the assumption on experimental oil palm production that fix the average cost of land preparation, investment cost, labor cost, input cost and maintenance cost,

[2] seedling cost (table 1)

[3] selling values up to their harvesting yield (table 2).

Table 4 Financial analysis index of the experimental oil palm (cultivar and seedling type) for 20 years

Crosses	Financial analysis 20 years Index							
	Net Present Value: NPV (> 0 Baht)		Internal Rate of Return: IRR (>7%)		Benefit Cost Ratio: BCR (>1)		Pay-back Period	
	Normal seedling	Over-year seedling	Normal seedling	Over-year seedling	Normal seedling	Over-year seedling	Normal seedling	Over-year seedling
Deli x Compact-F	30,411	14,962	17.93	13.16	1.37	1.18	1.54	2.42
Deli x AVROS-F	44,926	29,836	22.84	18.35	1.53	1.36	1.05	1.45
Deli x LaMe-F	23,503	14,864	16.60	13.6	1.29	1.18	1.66	2.23
Deli x AVROS-T	35,600	39,260	20.69	21.28	1.42	1.46	1.3	1.24
Deli x Yangambi-T	60,005	40,229	26.67	21.7	1.68	1.47	0.84	1.18
Deli x LaMe-T	36,748	24,976	20.94	17.23	1.44	1.3	1.28	1.73
Deli x Tanzania-T	62,706	44,542	27.61	22.49	1.7	1.52	0.83	1.11

Note: estimated the discounted rate at 7%

CONCLUSIONS

In summary, this study proposed that the long-term investment performance of oil palm cultivation based on NPV, IRR, BCR and Payback Period were common indicators. The recommended finding was that normal seedling was the better choice than over-year seedling for plantation investment and the best choice was the Deli x Tanzania-T cultivar with the highest profit value and shortest return time over the others. For suggestions, the farmers or smallholders had a variety of hybrids for usage, while they had limited knowledge of the aspects of compatibility between the investment performance of each seedling type and hybrid. The conclusion and the finding also helped

sustain farming practices. Further research should be expanded to include an investment model for forecasting investment performance on oil palm, which will aid farmers in making investment decisions based on indicators.

ACKNOWLEDGEMENTS

This research was supported by The Thailand Research Fund (TRF) and the Agricultural Research Development Agency for financial support. Von Bundit Co., Ltd. for supporting an experimental field and operating costs in this experimental field.

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