CHAPTER VIII

SENSITIVITY ANALYSIS

This chapter presents the sensitivity analysis; dividing into two key parts of production capacity determination and the sensitivity analysis of the identified critical success factors and the selected production capacity.

8.1 Production capacity determination introduction

After critical success factors have been identified, the selection of the production capacity for project planning for setting up a biodiesel factory would be the following step. In order to find out the project planning criteria for setting up a biodiesel factory, the sensitivity analysis would be employed to determine the optimum plant production capacity of a biodiesel factory. It would be carried out by comparing three operational capacities with each of the selected factors. Among the three operational capacities, the one that appears with the highest score would be chosen operational capacity for the second part of this thesis, which is project planning for setting up a biodiesel factory with preferred production capacity.

For this study, five identified factors would be used to compare with the three operational capacities in the determination of the appropriate production capacity. The three operational capacities that would be employed are a production of 200,000 litres of biodiesel per day, a production of 100,000 litres of biodiesel per day, and a production of 10,000 litres of biodiesel per day correspondingly. Consequently, for the five selected factors that would be used in the comparison they are the availability of raw material, the price of raw material, capital required for setting up the factory (excluding the land), the additional earning from selling biodiesel by-product (glycerin), and last but not least, the effect upon increasing of the interest rate.

To conduct this sensitivity analysis, Microsoft Excel would be employed to facilitate the comparison of the three production capacities in relative terms. With the use of Excel Spreadsheet, it presents the opportunity to create a scenario-testing. Some scenarios related to the five identified factors would be tested to see the

sensitivity of each of the three identified production units. Hence, it would give a better picture of how each of the identified factor influences the financial prospect of the three different biodiesel production capacities. Among them, one production capacity that is most appropriate to the Thai biodiesel situation would be chosen for the furtherance of the second part of this thesis which is to plan a project of setting up a biodiesel factory.

8.2 Biodiesel Excel Spreadsheet

The Excel Spreadsheet used for this sensitivity analysis has been adopted from the Ethanol Success Spreadsheet "BuGal" used in the determination of the economic factors associated with success or failure of corn-based dry-mill ethanol plants. The Spreadsheet "BuGal" could be found in the Staff Paper Series (Staff Paper P03-7) entitling, Factors Associated with Success of Fuel Ethanol Producers, conducted by Douglas G. Tiffany and Vernon R. Eidman, Department of Applied Economics, College of Agricultural, Food, and Environmental Sciences, University of Minnesota (44).

Despite the similar format of the key criteria like Nameplate production, Investment required, Gross margin, Operating expenses, Net margin, Investor Return on Equity (ROE), and lastly the Incremental of Success/Failure to meet ROE, the context of the finding between these two researches are different. For this thesis, it has been modified and developed for the sensitivity analysis with the aim to determine the most appropriate biodiesel production capacity to set-up for Thailand at the present situation, whereby the original "BuGal" Spreadsheet is a research on sensitivity analysis of the changes in various economic factors; whether the corn price, ethanol price, natural gas price, ethanol yield, capacity factor, and interest rate-debt percent interactions, using the past decade information as a guideline to these changes comparing to the financial performance of today's modern, well-size dry-mill ethanol plants. Hence, this shows the dissimilarity of the context of the two researches despite the similar tool used to derive at the findings.

Moreover, for the key data input in this spreadsheet, they have been obtained from two feasibilities conducted for The Krabi Oil Palm Farmer Co-operatives. One of the feasibilities is conducted upon a request of The Krabi Oil Palm Farmer Co-operatives proposing to the Governor of Krabi province; The Feasibility Study of Krabi Oil Palm Farmer Co-operatives' 10,000 litres per day Commercial Biodiesel Production (45). For the other one, it is conducted upon a request of Department of Alternative Energy Development and Efficiency, Ministry of Energy. Ministry of Energy has foreseen the future importance of the alternative energies; one of them is biodiesel. Therefore, Ministry of Energy contacted TMB Bank Public Company Limited to conduct a feasibility study of a biodiesel factory; the Feasibility Study in the Set-up of 100,000 litres per day Commercial Biodiesel Factory (5). As a result, both the feasibility studies would be used in this thesis as references to determine the appropriate production capacity to set-up a biodiesel factory.

Table 8.1: Comparison of three production capacities using Microsoft Excel

Biodiesel Plant Spreadsheet				Unit: 1,000 Baht	
			Biodiesel production (litre/day)		
Nameplate Biodiesel production			200,000	100,000	10,000
Capital Required for setting up a factory			593,000	484,000	18,500
Debt-Equity Assumptions					
Factor of Equity	0.5				
Factor of Debt	0.5	**Initial Debt**	**296,500**	**242,000**	**9,250**
Interest Rate Charged on Debt	0.09 - 0.11				
Rate of Return On Equity (ROE)	0.13				
Raw material					
Crude Palm Oil (in kilograms)		**Total required**	**63,600,000**	**31,800,000**	**3,180,000**
Gross Margin	**Price per Unit**				
Biodiesel Revenue	25.00		1,500,000	750,000	75,000
Glycerin Revenue	40.00		168,000	84,000	8,400
Total Revenue		**Total Revenue**	1,668,000	834,000	83,400
Cost of Crude Palm Oil	17.50		1,113,000	556,500	55,650
Gross Margin		**Gross Margin**	**555,000**	**277,500**	**27,750**
Operating Expenses					
Chemical Cost			**274,056**	**137,028**	**13,703**
Cost of Methanol	20.00		240,000	120,000	12,000
Cost of Sodium Hydroxide for Biodiesel	30.00		27,000	13,500	1,350
Cost of Sodium Hydroxide for Glycerin	30.00		2,520	1,260	126
Cost of HCl	40.00		3,360	1,680	168
Cost of Act.-C	40.00		1,176	588	59
Energy cost			**102,000**	**51,000**	**5,100**
Cost of Energy for Biodiesel			60,000	30,000	3,000
Cost of Energy for Glycerin			42,000	21,000	2,100
Water cost			**1,200**	**600**	**60**
Other Processing Costs			**142,247**	**105,096**	**6,437**
Cost of Labors			4,272	3,408	1,284
Cost of Depreciation			47,230	40,895	1,850
Interest Expense			26,685	24,200	1,018
Others			64,060	36,593	2,285
	Total Processing Expenses		**519,503**	**293,724**	**25,299**
Net Margin			**35,497**	**-16,224**	**2,451**
Required 15% ROE			44,475	36,300	1,203
Increment of Success/(Failure) to ROE			**(-8,978)**	**(-52,524)**	**1,248**
% of Biodiesel Plant Profits to the Investment			**6**	**-3**	**13**

8.3 Comparative results of three identified production capacities

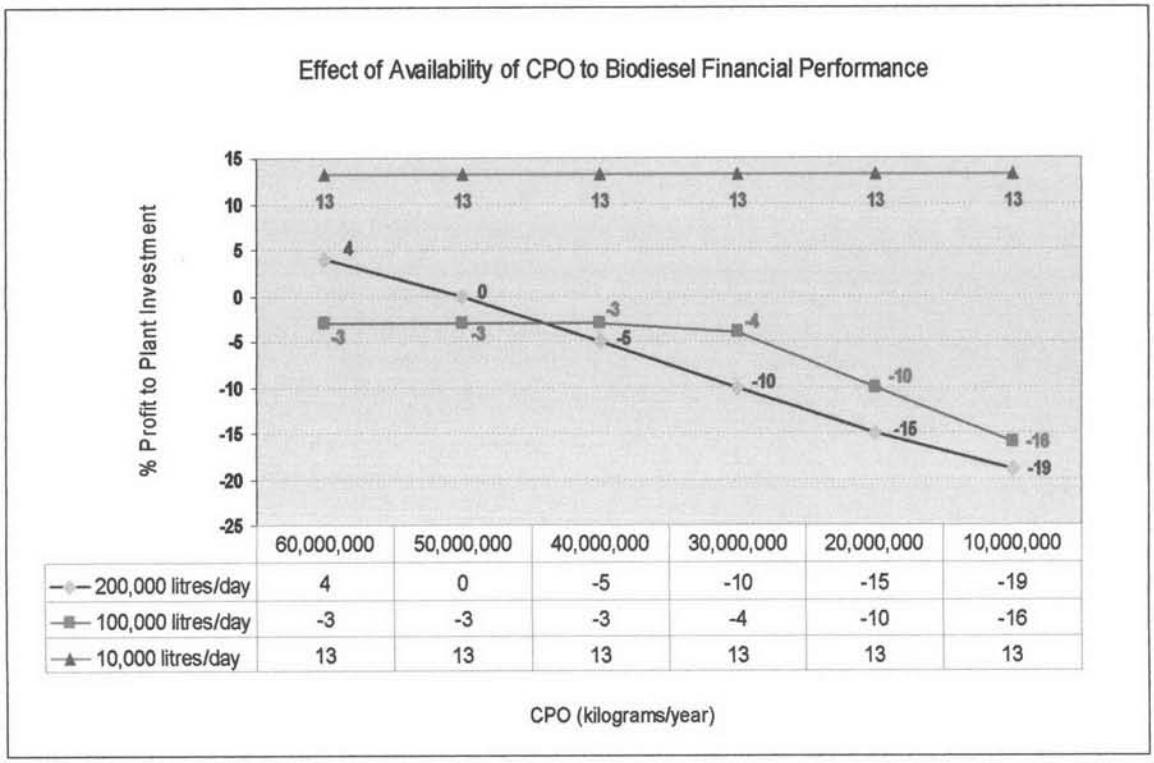
As mentioned earlier, this study would compare the five identified factors of the availability of raw material, the price of raw material, capital requirement for setting up the selected production capacity, the additional earning from selling biodiesel by-product (glycerin), and the effect upon increasing of the interest rate, with the three operational capacities of 200,000 litres of biodiesel per day, a production of 100,000 litres of biodiesel per day, and a production of 10,000 litres of biodiesel per day. The findings are shown as followed:

8.3.1 Availability of raw material

At the present time where palm cultivating area is still limited, this causes the acquiring of palm fruits to produce biodiesel to be slightly challenging. Hence, this has to be taken into account when considering in the setting up of a biodiesel factory. Table 8.1 shows that with the production capacity of 200,000 litres per day, 100,000 litres per day, and 10,000 litres per day, it requires a total amount of crude palm oil of 63,600,000 kilograms per year, 31,800,000 kilograms per year, and 3,180,000 kilograms per year correspondingly.

Accordingly, a scenario-testing is conducted to see how well each of the three production capacities is best at handling the limited amount of crude palm oil. Figure 8.1 shows the declining ability to acquire crude palm oil (CPO) for biodiesel production in comparison to the financial performances of the three different production capacities of 200,000 litres per day, 100,000 litres per day, and 10,000 litres per day. The result shows that as the availability of crude palm oil lessens the financial performances of both 200,000 litres per day and 100,000 litres per day production capacities show negative result. Figure 8.1 indicates that as the availability of crude palm oil for biodiesel industry reduces, a biodiesel plant with small production capacity is liable to survive better than a biodiesel plant with large production capacity.

Therefore, for this study, it seems that choosing to produce biodiesel with 10,000 litres per day production capacity would be a prudent decision considering the availability of inadequate crude palm oil.



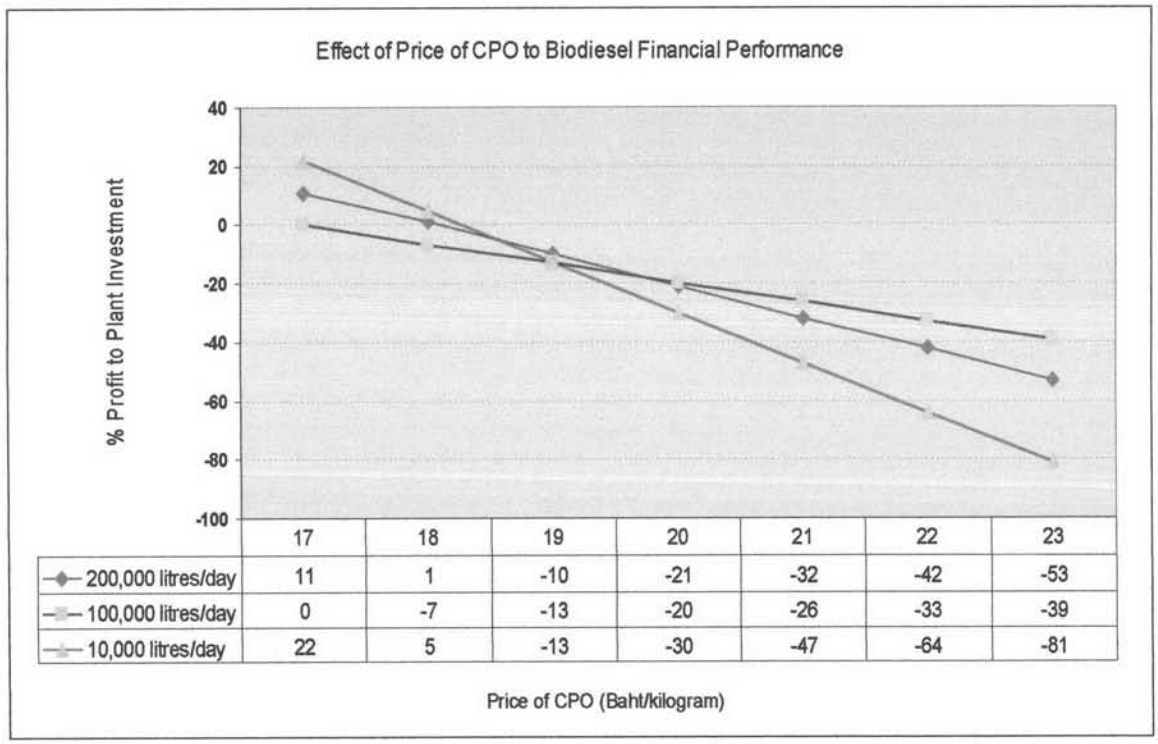
	60,000,000	50,000,000	40,000,000	30,000,000	20,000,000	10,000,000
200,000 litres/day	4	0	-5	-10	-15	-19
100,000 litres/day	-3	-3	-3	-4	-10	-16
10,000 litres/day	13	13	13	13	13	13

Figure 8.1: Effect of Availability of CPO to Biodiesel Financial Performance

8.3.2 Price of raw material

In biodiesel industry, the law of demand-supply also applies as well. As the demand of crude palm oil increases, the price of crude palm oil keep rises. As a result, escalating price of raw material, which in this case is the key raw material is the crude palm oil (CPO), should be taken in account before setting up a biodiesel factory. Consequently, this is done by comparing the biodiesel financial performances of the three production capacities to find out which one of these is best at handling the increasing price of crude palm oil.

The result, as shown in Figure 8.2, turns out that as the price of crude palm oil augments, the small biodiesel plant of 10,000 litres per day production capacity suffers the first. Secondly, it follows by large biodiesel plant with a production capacity of 200,000 litres per day. For the price of raw material, it seems that a medium-sized biodiesel plant with a production capacity of 100,000 litres per day handles the situation best, in comparison to the other two production capacities, as the price of raw material increases.



	17	18	19	20	21	22	23
200,000 litres/day	11	1	-10	-21	-32	-42	-53
100,000 litres/day	0	-7	-13	-20	-26	-33	-39
10,000 litres/day	22	5	-13	-30	-47	-64	-81

Figure 8.2: Effect of Price of CPO to Biodiesel Financial Performance

8.3.3 Capital required for setting up biodiesel factory

In term of capital required for setting up biodiesel factory, it would include the cost of plant construction to utilities integration and equipments and machineries acquiring and installation. However, it does not include the cost of land and the operational expenses. For this factor, it is another determinant that influences success or failure of setting up a biodiesel factory. According to Table 8.1, it shows the

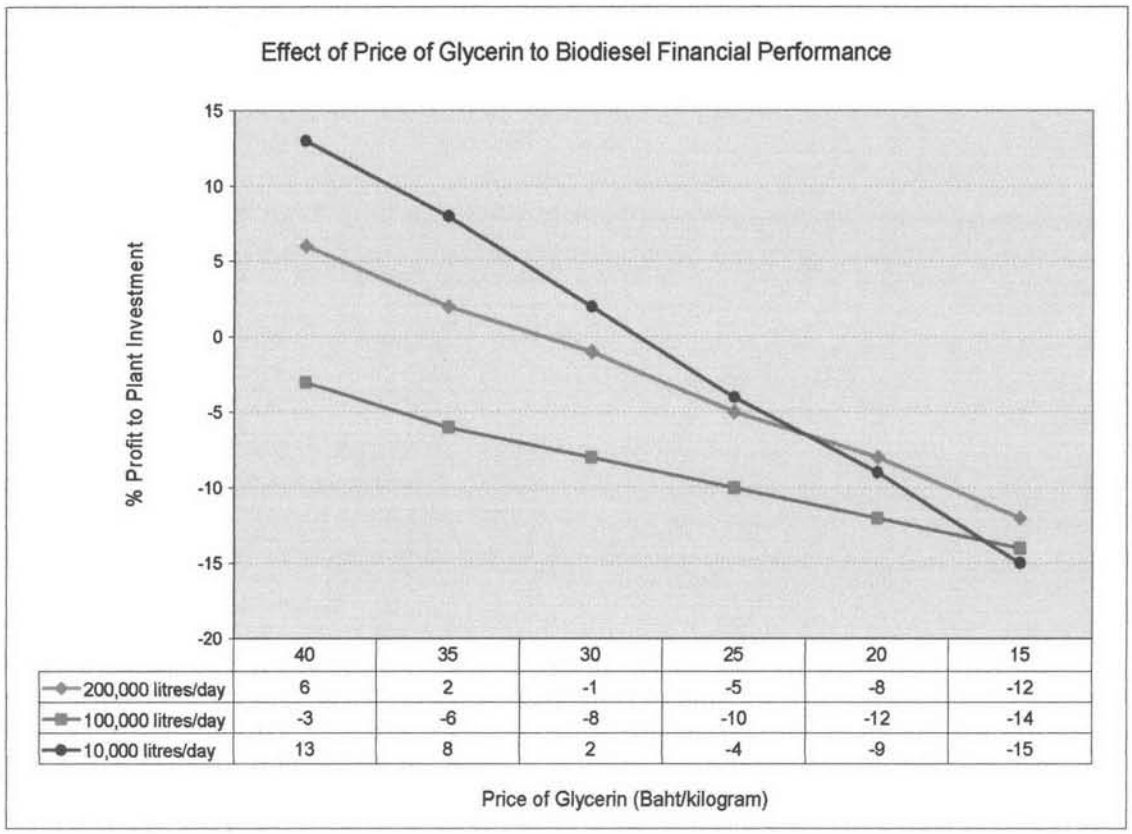
different amounts of capital required to invest in three different production capacities for setting up a biodiesel factory; 593 million Baht for production capacity of 200,000 litres per day, 484 million Baht for production capacity of 100,000 litres per day, and 18.5 million Baht for production capacity of 10,000 litres per day.

From the study, it turns out that despite with much lower net margin computed of 10,000 litres per day production capacity among the three production capacities, the percentage of biodiesel plant profits to the capital investment turns out very pleasing of 13% – especially when compare to the results of 200,000 litres per day and 100,000 litres per day production capacities of 6% and -3% correspondingly.

As a result, for this study, it appears that, yet again, choosing to produce biodiesel with 10,000 litres/day production capacity would be a prudent decision considering the much lower capital investment needed to set-up a biodiesel factory.

8.3.4 Additional earning from selling biodiesel by-product (glycerin)

For the additional earning from selling biodiesel by-product – the glycerin, although it is not the determining key success or failure factor, yet it has a huge impact on the biodiesel financial performances. According to Table 8.1, it indicates that revenue gained from selling glycerin is about 10% of the total revenue. Moreover, as more and more biodiesel factories are setting up, the availability of glycerin would increase. This would lead to a decline in the selling price of glycerin. To see how well each of the three production capacities copes with the declining price of glycerin, the percentage of biodiesel plant profits to the investment would be measured as shown in Figure 8.3.



	40	35	30	25	20	15
200,000 litres/day	6	2	-1	-5	-8	-12
100,000 litres/day	-3	-6	-8	-10	-12	-14
10,000 litres/day	13	8	2	-4	-9	-15

Figure 8.3: Effect of Price of Glycerin to Biodiesel Financial Performance

From Figure 8.3, it shows that as the price of glycerin decreases, the financial performances of the three different production capacities result negatively. A biodiesel plant with large production capacity is liable to endure financially better than a biodiesel plant with small production capacity as the price of glycerin decreases. As a result, for this study, it appears that for the factor of declining in price of glycerin, the recommended production capacity is 200,000 litres per day biodiesel production.

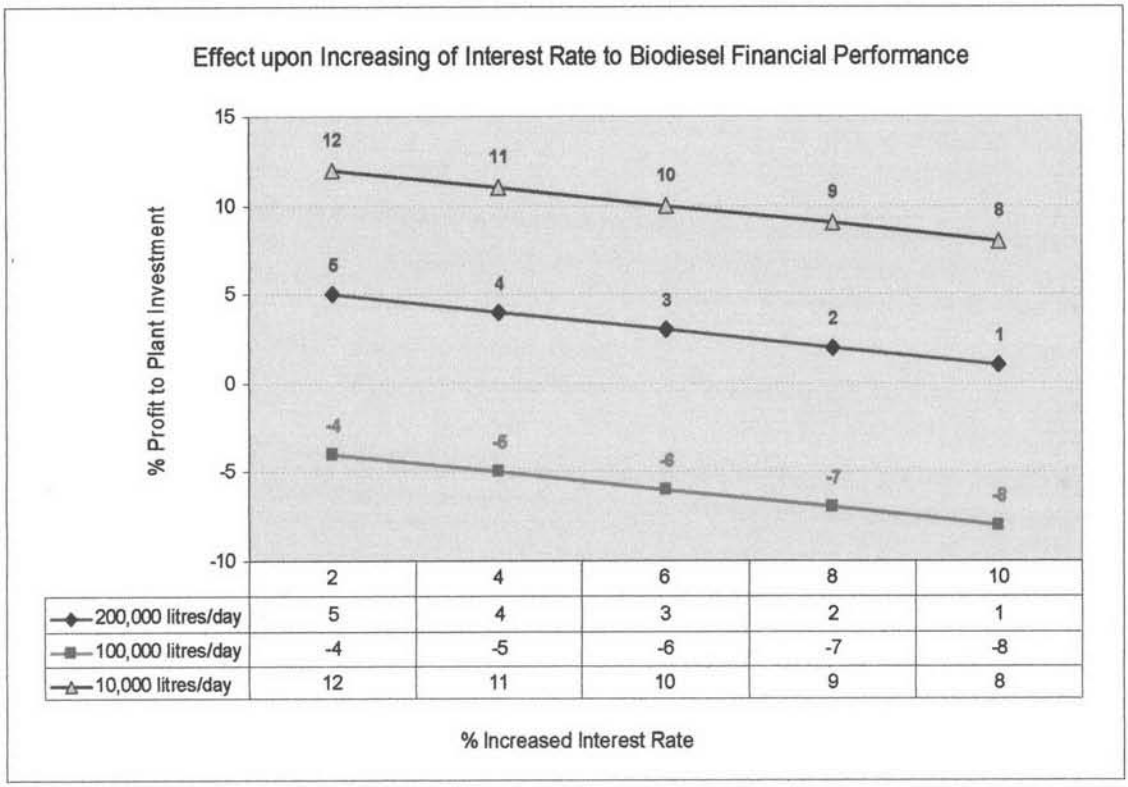
8.3.5 The effect upon increasing of the interest rate

The last element for this study is to consider the effect of increasing interest rate to the financial performances of the three production capacities. For the interest rate calculations of the three production capacities, they have been calculated

differently as the higher the loan the lesser the interest rate requested from the banks. Hence, for the production capacity of 200,000 litres per day, the interest rate calculation is at 9% per annum. For the production capacity of 100,000 litres per day, the interest rate calculation is at 10% per annum. For the production capacity of 10,000 litres per day, the interest rate calculation is at 11% per annum.

Upon the increasing of the interest rate of 2% as shown in Figure 8.4; so the calculation of the interest rate for the production capacity of 200,000 litres per day is at 11% per annum, the calculation of the interest rate for the production capacity of 100,000 litres per day is at 12% per annum, and the calculation of the interest rate for the production capacity of 10,000 litres per day is at 13% per annum, the result turns out that all of the financial performances of the three production capacities drop off to 5, -4, and 12 from originally 6, -3, and 13 correspondingly. From Figure 8.4, it indicates that this trend continues as the interest rate escalates.

Hence, for this study, it appears that setting up a small biodiesel factory with a production capacity of 10,000 litres per day would be a good decision; despite that it reflects the declining trend, it still results with the highest positive returns in comparison to the other production capacities as the interest rate decreases.



	2	4	6	8	10
200,000 litres/day	5	4	3	2	1
100,000 litres/day	-4	-5	-6	-7	-8
10,000 litres/day	12	11	10	9	8

Figure 8.4: Effect of Interest Rate to Biodiesel Financial Performance

8.4 Selection of the most-suited biodiesel production capacity

After the comparisons between the three operational capacities to each of the five identified factors have been carried out, the next step is to weigh the significance of each of the three operational capacities to each of the five identified scenarios. For the weighting system, 3 points would be given to the most-suited operational capacity for the identified factor, 2 points would be given to the moderately-suited operational capacity for the identified factor, and 1 point would be given to the least-suited operational capacity for the identified factor. The total points would be calculated at the bottom of the column as shown below. For the highest amount of points, it would indicate the most-suited operational capacity for setting up a biodiesel factory.

From the analysis, Figure 8.1 showed that in term of the availability of raw material, 10,000 litres per day production capacity is the most-fitted production

capacity for Thailand at the moment where raw material is limited and scarce. Moreover, Figure 8.2 indicated that as the price of raw material increases, it affects negatively on 10,000 and 200,000 litres per day production; whereas 100,000 is the best choice for Thailand among these three production capacities since limitation of palm cultivation area resulted in limitation of raw material and causes the price of raw material to escalate continuously. For the set-up cost, with high production capacities of 100,000 and 200,000 litres per day production capacities, they need to employ sophisticated technology that cost expensively; whereas with small of 10,000 litres per day could use locally produced equipments that cost much cheaper. Hence, 10,000 litres per day production capacity is the best choice for Thailand at this moment where biodiesel technology know-how and development is still lacking. Furthermore with additional factor like additional earning gained from selling biodiesel by-product, glycerin is a valuable by-product; where the higher the biodiesel production the more glycerin would be obtained. As a result, 200,000 litres per day production would be earning most among the three production capacity in selling glycerin. And last but not least, with the uncertainty in Thai's economic condition as suggested earlier, interest rate might increase any day. So, for this factor, setting up small biodiesel factory of 10,000 litres per day with lowest set-up cost among these three would be the best choice to handle the fluctuation of the Thai's economic condition.

Figure 8.5 would show the search for the most-suited production capacity based on five selected factors from both the identified critical success factors and other additional factors. Together with the weighting system used to determine the most suited production capacity; where the most-suited would be given 3 points, moderately-suited with 2 points and least-suited with 1 point, the production capacity with highest score would be the most-suited production capacity to set-up a biodiesel factory for Thailand at the present time.

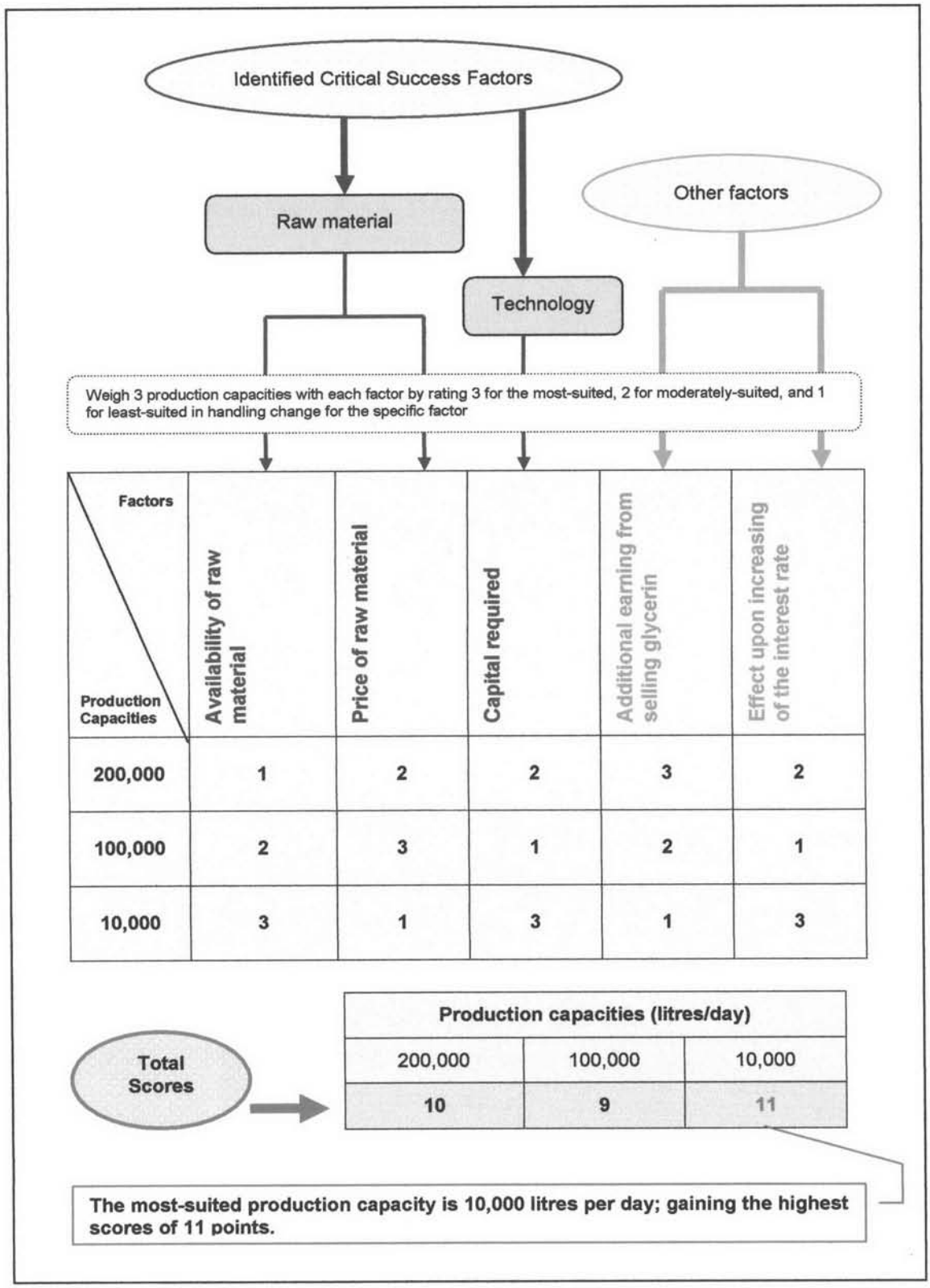


Figure 8.5: The search for the most-suited production capacity to set-up a biodiesel factory in Thailand at current situation

From Figure 8.5, it indicates that the most-suited production capacity goes to the small production capacity of 10,000 litres per day, with the highest total score of 11 points. While the large production capacity of 200,000 litres per day and the medium production capacity of 100,000 litres per day received the scores of 10 and 9 points correspondingly.

Moreover, according to Figure 8.5, the result also shows that of the five identified factors, the small production capacity of 10,000 litres per day are the most-suited production capacity to three out of five identified factors. These three identified factors are the availability of the raw material, capital required, and the effect upon increasing of the interest rate. The two factors that it loses the advantages are the price of raw material, which in this case refers to the price of crude palm oil (CPO), and additional earning from selling glycerin.

8.5 The feasibility study background of 10,000 litres per day production capacity of Krabi Oil Palm Farmer Co-operatives

From the feasibility study of Krabi Oil Palm Farmer Co-operatives (45), the total capital required to set up a biodiesel factory is 18,500,000 Baht (excluding the land). Moreover, from the feasibility study, it also indicated that the biodiesel production plan has been scheduled to produce at the rate of 250,000 litres each month or up to 3,000,000 litres each year. With the indicated biodiesel selling price of 25 Baht per litre and the indicated glycerin selling price of 40 Baht per kilogram, the revenue received each year would be concluded at 83,400,000 Baht; from biodiesel 75,000,000 Baht and from glycerin 8,400,000 Baht.

For the biodiesel factory operational expenses, each month the factory would need around 6,660,983.33 Baht to run the production. The total operational expenses per month would be illustrated in Table 8.2 as followed:

Table 8.2: Total operational expenses of a biodiesel factory

Expenses	Baht
Biodiesel processing cost	6,005,000.00
Glycerin processing cost	204,400.00
Human resources expense	107,000.00
Depreciation cost	154,166.67
Lab cost	50,000.00
Transportation cost	75,000.00
Communication cost	20,000.00
Maintenance cost	15,416.67
Advertisement cost	10,000.00
Others	20,000.00
Total	**6,660,983.33**

Source: The Krabi Oil Palm Farmer Co-operatives' feasibility study (45)

With known revenue received and the total operational expenses, the cash flow of the biodiesel factory could be constructed. Table 8.3 would illustrate the ten-year cash flow of Krabi Oil Palm Farmer Co-operatives' feasibility study (45).

Table 8.3: 10-Year cash flow of Krabi Oil Palm Farmer Co-operatives' feasibility study

Year	Revenue (Baht)	Running Expenses (Baht)	Net Cash Flow (Baht)	Cumulative Net Cash Flow (Baht)
1	83,400,000	79,931,800	3,468,200	3,468,200
2	83,400,000	79,931,800	3,468,200	6,936,400
3	83,400,000	79,931,800	3,468,200	10,404,600
4	83,400,000	79,931,800	3,468,200	13,872,800
5	83,400,000	79,931,800	3,468,200	17,341,000
6	83,400,000	79,931,800	3,468,200	20,809,200
7	83,400,000	79,931,800	3,468,200	24,277,400
8	83,400,000	79,931,800	3,468,200	27,745,600
9	83,400,000	79,931,800	3,468,200	31,213,800
10	83,400,000	79,931,800	3,468,200	34,682,000

Source: The Krabi Oil Palm Farmer Co-operatives' feasibility study (45)

8.5.1 Project financial performance evaluation

From the provided information of the Krabi Oil Palm Farmer Co-operatives' feasibility study, the project capital investment appraisal would also be conducted. For this project, three investment appraisal tools of payback time, Net Present Value (NPV), and Internal Rate of Return (IRR) would be calculated.

- Payback time

To determine the payback time for this project, the cumulative cash flow of Table 9.2 would be used. By the end of year 5, 17,341,000 Baht of the initial capital cost of 18,500,000 Baht would be paid back. The remaining 1,159,000 Baht would take another 0.33 year to be repaid. Hence, the payback time of this project would be 5.33 years altogether.

- Net Present Value (NPV)

The Net Present Value (NPV) of the Krabi Oil Palm Farmer Co-operatives' feasibility study from the calculation by using Microsoft Excel software is concluded at 2,555,080 Baht; at the discount factor of 10%. With the positive NPV result, it indicates that the project is financially acceptable.

- Internal Rate of Return (IRR)

Similarly, to determine the Internal Rate of Return (IRR) of the Krabi Oil Palm Farmer Co-operatives' feasibility study, Microsoft Excel is employed. The result turns out that the Internal Rate of Return (IRR) for the project is 13%. With IRR more than 10%; from the financial institution point of view, it is considered to be financially acceptable.

8.6 Sensitivity analysis for the selected production capacity

After the production capacity has been selected; which in this case is to operate at 10,000 litres per day, the next step would be to study the sensitivity of the identified critical success factors and the selected production capacity. The three key success factors that have been identified earlier are the raw material, the technology, and the human resource.

8.6.1 Raw material

8.6.1.1 Price of raw material

Table 8.4: Effect of IRR on the change in price of crude palm oil (CPO) and biodiesel

Price		Biodiesel (Baht/litre)				
		30.00	30.50	31.00	31.50	32.00
CPO (Baht/kg)	26.00	-	-	-	-	-9%
	25.50	-	-	-	-8%	7%
	25.00	-	-	-7%	8%	19%
	24.50	-	-6%	8%	19%	29%
	24.00	-5%	9%	20%	29%	38%

8.6.1.2 Availability of raw material

Table 8.5: Effect of IRR on the change in the availability of crude palm oil (CPO)

Input \ Output		Biodiesel (litres)				
		2773585	2830189	2886792	2943396	3000000
CPO (kilograms)	265,000	-	-	-	-	19%
	255,000	-	-	-	12%	-
	245,000	-	-	3%	-	-
	235,000	-	-9%	-	-	-
	225,000	-	-	-	-	-

From the sensitivity study of the raw material, it reveals that for this project to be financially feasible by obtaining the IRR more than 10% the difference in the crude palm oil price and biodiesel price should be of at least 7 Baht. Similarly for the availability of the raw material, for the project to be financially feasible by obtaining the IRR more than 10%, the factory must be able to secure of at least 255,000 kilograms of crude palm oil (CPO) each month or up to 3,000,000 kilograms each year.

Furthermore, for the project to be feasible, the diesel selling price must be above the biodiesel selling price. However, on the 5th December 2007 (as a reference), the biodiesel (B100) was sold at 35.95 Baht per litre while the diesel fuel was sold at 28.94 Baht (25). Hence, another criterion in term of price is that the price of diesel fuel must be higher than the price of biodiesel for B100 fuel for biodiesel to be distributed country-wide and accepted by the Thai public. In addition, to further stimulate the usage of biodiesel, the biodiesel selling price should be lower than the diesel price of about 3.7 – 4 Baht; like the difference between Octane 91 and Gasohol 91, and Octane 95 and Gasohol 95 E10 (25).

8.6.2 Technology

Table 8.6: Effect of IRR on the change in the set-up investment

		IRR						
Set-up investment (Baht)	42,500,000	-	-	-	-	-	-	0%
	38,500,000	-	-	-	-	-	2%	-
	34,500,000	-	-	-	-	4%	-	-
	30,500,000	-	-	-	7%	-	-	-
	26,500,000	-	-	10%	-	-	-	-
	22,500,000	-	14%	-	-	-	-	-
	18,500,000	19%	-	-	-	-	-	-

From the sensitivity study of the technology in term of the increasing price of technology available that result in the increase of the set-up investment, it reveals that for this project to be financially feasible by obtaining the IRR more than 10%, the price of biodiesel production technology employ and the project set-up investment should not be over 26,500,000 Baht.

8.6.3 Human resource

Table 8.7: Effect of IRR on the increase in cost of human resource

		IRR				
Cost of Human resource per month (Baht)	507,000	-	-	-	-	-
	407,000	-	-	-	-14%	-
	307,000	-	-	1%	-	-
	207,000	-	11%	-	-	-
	107,000	19%	-	-	-	-

Table 8.8: Effect of IRR on the efficiency of the production process

		IRR				
Biodiesel produced (litres)	250,000	-	-	-	-	19%
	247,500	-	-	-	12%	-
	245,000	-	-	3%	-	-
	242,500	-	-8%	-	-	-
	240,000	-	-	-	-	-

For the human resource, as identified from the critical success factor's section that with the shortage of biodiesel specialists, foreign experts would be needed. As a result, this would increase the cost of human resource for the project. For this one, in order to be financially feasible by obtaining the IRR more than 10%, the cost of human resource involvement should not be more than 207,000 Baht per month. Moreover, as identified in the critical success factor's section as well that with the lack of biodiesel specialists small biodiesel producers would be experiencing in the reduction of biodiesel production efficiency. Table 8.8 shows that the IRR effect on the decreasing biodiesel production as a result of the reduction in the production efficiency, it reveals that in order to be financially feasible by obtaining the IRR more than 10% the biodiesel production obtained should be more than 247,500 litres per month with the input of 265,000 kilograms of crude palm oil (CPO) per month.

8.6.4 Summary of the sensitivity study of the selected production capacity

The summary of the sensitivity analysis findings of 10,000 litres per day biodiesel production capacity on the identified three critical success factors of raw material, technology, and human resource would be presented below as followed:

- Difference in price of raw material and biodiesel: ≥7 Baht
- Amount of raw material that needs to secure: ≥255,000 kilograms per month
- Biodiesel selling price should be lower than the diesel price: ≥3.70 Baht
- Set-up capital due to technology employ: ≤26,500,000 Baht
- Cost of human resource employ (include the brought-in of the foreign experts if required): ≤207,000 Baht per month
- Biodiesel production obtained (with the input of 265,000 kilograms of crude palm oil (CPO) per month): ≥247,500 litres per month