The Financial Performance Outlook of Crude Palm Oil Industry among Different Types of Production in Thailand

Anuman Chanthawong*, Benjawan Khongkon, Jintanee Ru-Zhue, and Krit Lemthanon

Abstract*— *Thailand is the third place for crude palm oil ranking whereas still found many barriers to development and competition in the world market. This study investigated the financial feasibility study of crude palm oil focuses on different production processing and production capacity for Fruit-kernel separated refinery plants (Plant A) through six main indicators as follows; benefit-cost ratio (BCR), Internal Rate of Return (IRR), Net present value (NPV), Payback period (PB), Modifield internal rate of return (MIRR), and Profit index (PI). The results obtained that crude palm oil mill gain profitability investment and remain received the profitability investment under the switching value test (SVT) with two scenarios increasing cost and reducing income. Crude palm oil Plant A with a production capacity of fewer than 30 tonnes/hour is the best alternative, for now, entrepreneur, concentration in labor cost and logistic cost will be generated increasing income for production processing. Increasing yield per rai and force new coming have owns oil palm planting area that reduces shortage supply and relief high material cost which increasing competition in the world market.

***Keywords*— Crude palm oil industry, financial feasibility study, financial analysis.**

1. INTRODUCTION

ASEAN area is the biggest crude palm oil production especially Indonesia and Malaysia with output around 85 % of global output that affected to determining price movements on world exchanges [1] whereas Thailand is in the third place in crude palm oil production ranking, but its provide supply only 3.8 % of global production which is influence on the prices on world markets is negligible [1]-[2]. Southern Region provide 85% of Thailand oil palm plantations with 118 crude palm oil mills or 81.37% of total national crude palm oil mills and are clustered particularly in the provinces of Krabi, Surat Thani, and Chumphon [1]-[2]. Currently total potential Thailand crude palm oil production capacity approximately 3,707 ton/hour or 23 million fresh palm oil per year with two processing technique operating namely; 1) Fruit-kernel separated refinery plants (Plant A) about 85 mill with total production capacity 3,505 tons per hour or 94% of nation production capacity, and 2) Fruit-kernel mixed plants (Plant B) are 60 plants. However, only 12.435 million tons of fresh oil palm or 54% of national crude palm oil production capacity was providing, resulting in competition for purchase the insufficient material that affected on fluctuation of fresh oil palm price and increasing production cost [1]–[5]. Based on adequate supply, the oil palm growers often harvest oil palm before it is fully ripe, resulting in lower oil exaction rate (OER) compared with Malaysia and Indonesia (Thailand oil exaction rate 17-18 %less than Malaysia's (21 %) and Indonesia's (22 %) [1], [6]. These issues conspire to make cost of crude palm oil production higher than Malaysia and Indonesia[1], [6]. Moreover, lack of clarity in the integration of government policies in the palm oil industry which is started from upstream especially increasing yield of oil palm, midstream is based on increasing comparative advantage to compete with two main world's exporter, and downstream centers on palm oil refinery plants [7], [8]. adequate of labor skill and scramble for labor skill are also barriers key driven for crude palm oil development [4], [5]. Since crude palm oil trading in future market, the liquidity of working capital and devoid the crude palm oil price risk analysis become the main significance factors for crude palm oil development [2],[4]-[5].

In our search for evidence of Thailand crude palm oil industry development, the results shed light on 3 dimensions as follow; 1) management processing through integration government' policies for crude palm oil industry and adequate of labor skill and scramble for labor skill , 2) insufficient supply , fresh palm oil quality, resulting in increases production cost that affected on production process, and 3) market competition including the liquidity of working capital and devoid the crude palm oil price risk analysis [4],[6],[8]. These three perspectives leads to increasing the crude palm oil production cost that effected to limitation ability to compete on world markets and the factors that we mentioned above is consistent with global palm oil industry [9]–[14]. On the other hand, increasing production cost some 10% by government interference in the market through the Department of Internal Trade, operating under the Ministry of Commerce, is responsible for setting the purchase price of oil palm and of palm oil at all stages of the supply chain. In detail, these are: 1) The purchase price of oil

Anuman Chanthawong and Benjawan Khongkon are with Management Sciences Faculty, Suratthani Rajabhat University, Thailand.

Jintanee Ru-Zhue.Author is with School of Management, Walailak University, Thailand.

Krit Lemthanon.Author is with Office of Agricultural Economics, Bangkok, Thailand.

*Corresponding author: Anuman Chanthawong; E-mail: anuman3@hotmail.com; anuman.cha@sru.ac.th.

palm fresh fruit bunch from growers is assumption OER 18 %, 2) price floor for crude palm oil is set with THB 19 per kg for factory gate industry, and 3) the retail price of bottled refined palm oil no more than THB 42 for a one liter bottle [1].

Despite many problems in crude palm oil industry of Thailand, however, we found that the number of crude palm oil increase from 83 plants in 2012 to 177 plants in 2017 with growth rate 112.5 %, Meanwhile, Jitrat (2017) argue in limitation of liquidity of working capital issues of barriers factors of crude palm oil mills development through analyze 30 financial performance and economic of scale of Southern crude palm oil, the results obtained that most of them have a good financial performance with high financial flexible, low debt risk and good profitability and asset management. More than that 20 mills have economy of scale which is illustrated that crude palm oil mill has ability to survive whereas the results of factors affecting on small scale of crude palm oil mill development consistent with the other previous studies which we mentioned earlier [15].

This article argues that crude palm oil industry not only profitable investment but still continuous gain profitable investment within uncertainty situation also. It first contrasts the claim of profitability investment feasibility of crude palm oil mill in difference processing technique operating including difference production capacity with the continued significance 3 barriers dimensions especially management processing, production process, and market competition. Against this background, switching value test (SVT) for crude palm oil mill with two scenarios are decreasing benefit of mill and increasing cost of mills, resulting in low debt risk and a good financial performance as well [15]–[18].

Comprehensive information on the overall crude palm oil mill analysis in terms of financial feasibility study and switching value test, results in of gai profitability investment and a good financial performance through two importance criteria namely, difference processing technique operating and difference production capacity in Thailand is lacking. Likewise, it is still not clear what possibilities exist to improve the financial performance and gain profitability investment in each scenario in the future. Based on the previous studies, only one attempt to analysis profitability investment by using financial feasibility study and financial performance under uncertainty situation scenarios focuses on Fruit-kernel separated refinery plants with utilized production technology of non-stream process [16].

Thereby, we address this gap by analysis the financial feasibility study including switching value test of crude palm oil mill in difference processing technique operating and difference production capacity. Such information is essential for policy makers as well as crude palm oil producers for future development plan to improve the sustainable economic performance of crude palm oil industry in Thailand.

2. LITERATURE REVIEW

2.1 Current situation of Thailand's crude palm oil industry

Thailand becomes the third largest palm oil producer which affected from started expansion oil palm planting area since 2009. In 2017 the total oil palm production around 14,103 thousand tonnes with yield per rai 2,918 tonnes and increases to 15,382 thousand tonnes with average output per rai 3,204 tons in 2018 and 16,772 thousand tonnes of oil palm production with yield per rai 2,994 tonnes in 2019, respectively. Thailand crude palm oil industry mostly supply for domestic both, refined palm oil (RPO) and biodiesel, which are main material for food industries, ole-chemical industries, chemical industries, and biodiesel industry. During 2015-2019 crude palm oil industry increases demand for food industry, chemical industry and ole-chemical industry and biodiesel industry, respectively (Table 1).

Table 1 Thailand palm oil stock balance 2015-2019

(Unit: thousand tonnes)

Factor	2015	2016	2017	2018	2019	Δ 2016	Δ 2017	Δ 2018	Δ 2019
Production (CPO)	2,068	1,804	2,626	2,778	3,180	-12.76	45.56	5.78	14.47
Import	3	14	6	3	3	-4.39	18.45	13.57	25.66
Domestic Consumption	1,887	1,804	2,137	2,427	3,050	-4.39	18.45	13.57	25.66
Refined Oil	1,053	988	1,166	1,227	1,370	-6.17	18.01	5.23	11.65
Biodiesel	833	816	971	1,200	1,680	-2.04	18.99	23.58	40
Export	68	56	347	343	290	-17.64	519.64	-1.15	-15.45
Ending Stock	335	293	485	466	309	-12.53	65.52	-3.91	-33.69

Source: [19]

Table 3. Literature reviews on financial feasibility study on crude palm oil mill

Author	Financial feasibility study indicators										
	Benefit cost ratio (BCR)	Rate of return	Gross Ratio (TR/TC)/ Profit margin (PM)/ Net Cash Flow	Expense Structure ratio (FC/TC)	Profitability index (PI),	Net present value (NPV)	MCFA	Total cost of production	Payback period	Weighted Average Cost of Capital (WACC)	Return on investment (ROI)
Elijah, I. O et al[20]*	√	√	√	√							
Essia. U [21]			√						√		
Sari. D [22]	√	√				√			√		
Kurniawan.PM et al [23]							√				
The Golden Star Oil Palm Plantation [18]	√	√				√			√		
Bahri S D.[24]								√			
Nuryadi A.et al.[25]		√								√	
Nsiah A.S.et,al.[26]*	√		√			√					√
Kantama. A et al.[27]						√		√			
Yaosuwan.W et,al [16]*		√			√	√				√	

Remark: TC is total cost, TR is total revenues and FC is total fixed cost, MCFA is the material flow cost accounting.
* is using Switching value test (SVT)

2.2 Literature reviews on financial feasibility study crude palm oil industry

This section attempts to classify previous studies in terms of financial indicators for analysis profitability financial investment of crude palm oil industry. Based on previous studies, benefit cost ratio (BCR), Internal Rate of Return (IRR), Net present value (NPV), Payback period, and Weighted Average Cost of Capital (WACC) are widely use to financial feasibility analysis through questionnaires and secondary data analysis. In case of Thailand, few studies focus on financial feasibility study but still in lab scale or case study and attempt to test Switching value test (SVT) (Table 3).

3. METHODOLOGY

This study uses quantitative research by face-to-face in-depth interviews through questionnaires. Collecting data from crude palm oil mills classify by difference processing technique operating including difference production capacity.

3.1 Study area

This study financial feasibility study analysis of crude palm oil in Thailand in 2017 classify by difference processing technique operating namely, 1) Fruit-kernel separated refinery plants (Plant A) and 2) Fruit-kernel mixed plants (Plant B). As following table 4 [2]. Collecting data from 50 crude palm oil mills by collects from Plant A 40 mills (50 % of total plant A in Thailand) through production capacity less than 30 tonnes/hour is 20 mills, 30-45 tonnes/hour approximately 17 mills, and more than 60 tonnes/hour about 3 mill, respectively which are 50 % of total crude palm oil mills in each groups. Moreover, selecting 10 Plant B mills is for sample size or 16 % of total national Plant B. We collected 10 mills of Plant B because of government force them to develop to Plant A [2].

Table 4. Population and sampling data

	Population	Sampling
Fruit-kernel separated refinery plants (Plant A)	**81**	**40**
Percent of Capacity	(94%)	
less than 30 tonnes/hour	20	20
30-45 tonnes/hour	35	17
morethan 60 tonnes/hour	6	3
Fruit-kernel mixed plants (Plant B)	**62**	**10**
Percent of Capacity	(6%)	

3.2 Data Collection

This study uses quantitative research by face-to-face in-depth interviews through 2 questionnaires focuses for Plant A and Plant B, validation the questions were done

by three specialists in crude palm oil industry, resulting the tools was consistency (Index of Consistency: I.O.C was higher than 60 %).The each questionnaires form consists of 5 main parts as follows; 1) basic information of crude palm oil mill and interviewee such as processing techniques operation, total production capacity, capacity use including interviewee position, 2) demand for oil palm, quantity of crude palm oil production, marketing channel and by product, 3) total revenues and total cost of crude palm oil mill production, 4) total revenues and total cost of crude palm oil operation including investment cost, and 5) problem and threat of crude palm oil mill.

3.3 Indicators for financial feasibility study

Baes on literature reviews in section 2.2, total 5 widely used indicators for financial feasibility study are benefit cost ratio (BCR), Internal Rate of Return (IRR), Net present value (NPV), Payback period, and Weighted Average Cost of Capital (WACC) whereas this study focuses on 6 indicators as follows; benefit cost ratio (BCR), Internal Rate of Return (IRR), Net present value (NPV), Payback period (PB), Modifield internal rate of return (MIRR), and Profit index (PI). Moreover, this study examine the Switching value test (SVT) under uncertainty situation scenarios by compared with Weighted Average Cost of Capital (WACC) .

The assumption criterias for this study was determined from the real situation data and concepts as follows; (1) crude palm life of 20 years [16], (2) Cost of debt 8.62 % which is using minimum loan rate (MLR) from Bank of Thailnd plus 1% for risk [16], (3) return on equity is 12.66 which is calculation by capital asset pricing model (CAPM) [16], and (4) Weighted Average Cost of Capital (WACC) for this study is 9.20 % according to porportion of capital source (private capital 40% and loan 60 %).

4. RESULTS

This section obtained financial feasibility analysis of crude palm oil in Thailand, six main groups of revenues and expenditure of the project are 1) Investment cost focuses on basic infrastructure such as land, buildings and constructions, machinery, vehicle including office supplies which only one time investment in the beginning of the project, 2) operation cost especially fees which is pay every year until end of project, 3) maintenance cost pay for attendance basic infrastructure for example land, buildings and constructions, machinery, including vehicle and insurance in each year , 4) variable cost is main cost for crude palm oil production such as labor cost, material cost and energy cost ,5) loan payment obtained the cost of mills which pay for financial institution, 6) revenues is from crude palm oil and other by product such as shells, kernel meal, fiber and cake decenter, and 7) Scrap value illustrates the remain cost of infrastructure such as land, buildings and constructions , mechinery and vehicle. The cost and revenues of crude palm oil in difference senarios is show in Table 5.

The value of investment cost depends on production capacity, Palnt A whcih is produciton capacity more than 60 tonnes/hour expense for investment cost approximately 402.275 million baht which higher than production capacity less than 30 tonnes /hour about 5 time whereas Plant B paid for investment cost about 35.140 millilon baht or 50 % of lowest production capacity of Plant A type. Based on variable cost, the lowest production capacity of Plant A type expens around 95 million baht which is higher defrayal than Plant B approximately 51 million baht meahwhile production capacity middle group of Plant A expense 664.6 million baht which is bigger than the lowest production capacity group is 6.6 time and the biggest group, production capacity more than 60 tonnes/hour disposal around 1,319 million baht that is bigger than first group is 13.2 time (Table 4).

In terms of revenues of Plant A, the biggest productiion capacity received the income is 1,495.46 million baht which is exceeding production capacity 30-45 tonnes/hour 709.90 million baht and upward than lowest production capacity group about 1,375.84 million baht, respectively whereas Plant B was generated income around 54.03 million baht that effected from production technique operation. On the one hand, by product from Plant B are fiber and cake decenter which cheaper purchase price from by product of Plant A especially shells and kernel meal (Table 4).

Results from financial feasibility study analysis obtained that all of difference crude palm oil mill groups are profitability investment which shown in positive sign of six main indicators (Table 4).

For payback period indicator (PB), crude palm oil mill type A production capacity 30-45 tonnes/hour is the best way for investment because it's recovered the cost shortest whereas biggest production capacity is longest break event time. However, crude palm oil mill is quite recovered the break-even time with maximum 5.21 years.

In contrast of net present value analysis (NPV), biggest production capacity of crude palm oil mill type A received the highest net return profit which total profit about 529.156 million baht, follow by production capacity 30-45 tonnes/hour of Plant A with net profit 490.254 million baht while Plant B is received lowest profit with 31.32 million baht.

On the other hand, based on internal rate of return and modified internal rate of return obtained that crude palm oil Plant A with production capacity 30-45 tonnes/hour is the best return from investment with 52.16 % of IRR and 22.06 % MIRR, follow by, production capacity more than 60 tonnes/hour with 32.57 % of IRR and 20.46 % of MIRR, respectively. All of crude palm oil mill types investment is profitability investment because of IRR and MIRR higher than weighted average cost of capital (9.20%) which illustrates that even though this project borrow loan from financial institution, but the return of the project remains generate gain profit.

The profit index analysis is obtained that Plant A got higher return than Plant B whereas the biggest production capacity is highest profit index with 24.95, follow by production capacity 30-45 tonnes/hour with profit index 21.59. For benefit cost ration, all of them generates nearly benefit cost ratio, which is more than 1,

resulting on this project gain profit from investment and production capacity 30-45 tonnes/hour is give highest ratio with 1.09.

Table 5. Results form financial feasibility study analysis in differnce senarios

(Unit:Million Baht)

Factors	Plant A			Plant B
	Group A	Group B	Group C	
1.Investment Cost (first year)	**74.156**	**306.275**	**402.275**	**35.140**
1.1 Land cost	6.612	10.129	16.738	3.00
1.2 Area improvement cost	1.200	10.00	9.500	0.80
1.3 Building and construction cost	32.566	56.276	88.037	20.00
1.4 Mechenery Cost	27.800	199.204	261.610	7.260
1.5 Oil storage tank cost	3.000	19.101	20.000	0.330
1.6 Office supplies cost	0.228	8.313	1.939	0.05
1.7 Vehicle cost	2.750	3.250	4.450	3.700
2.Operation Cost/year	**0.123**	**1.200**	**0.785**	**0.080**
2.1 Fees	0.062	1.100	0.765	0.06
2.1other operation cost	0.061	0.100	0.020	0.02
3.Maintanance Cost/year	**1.770**	**11.400**	**17.822**	**1.110**
3.1 Building and construction maintanance cost	0.030	0.100	3.216	0.050
3.2 Mechenery maintanance cost	1.140	10.00	11.540	1.000
3.3 Vehicle maintanance cost	0.250	0.300	0.550	0.040
3.4 Insurance cost	0.350	1.000	0.500	0.020
3.5 Dredge fee for wastewater treatment	0	0	2.000	0
4.Variable Cost/years	**95.082**	**664.610**	**1,319.612**	**44.123**
4.1 Labor cost	5.250	17.400	10.264	2.650
4.2 Suppliers cost	1.120	7.210	11.697	2.973
4.3 electricity cost	0.600	0.740	0.820	1.320
4.4 water supply cost	0.120	0.199	0.221	0
4.4 Fuel cost	0.240	3.960	4.153	0.84
4.5 Engine oil cost	0.042	0.220	0.296	0.009
4.6 firewood cost	0	0	0	1.560
4.7 Material cost (Oil palm cost)	88.712	640.000	1,297.649	38.500
4.8 Chemical cost	0.108	1.440	0.836	0
4.9 Other cost	0	0	5.370	0
5.Loan payment (all lifetime)	**56.431**	**271.136**	**328.256**	**28.647**
6.Total revenues/year	**119.630**	**785.565**	**1,495.469**	**54.039**
6.1 Crude palm oil revenue	115.088	760.489	1,484.451	52.131
6.2 Other revenues	4.541	25.076	11.018	1.907
7.Scrap value (End of project)	**6.612**	**10.129**	**16.738**	**3.00**
Financial feasibility analysis				
Payback period (PB) (year)	3.12	2.81	5.21	4.13
Net present value (NPV)(million baht)	94.097	490.254	529.156	31.324
Internal rate of return (IRR) (%)	39.50	52.16	32.57	32.46
Modifield internal rate of return (MIRR)(%)	19.86	22.06	20.46	18.76
Profit index(PI)	4.58	21.59	24.95	3.61
Benefit cost ratio (BCR)	1.11	1.09	1.05	1.08

Remark: Group A is production capacity less than 30 tonnes/hour, Group B is production capacity 30-45 tonnes/hour, and Group C is production capacity morethan 60 tonnes/hour

Table 6. Switching value test (SVT) of crude palm oil mills

Switching value test (SVT)	Plant A			Plant B
	Group A	Group B	Group C	
Change in cost of production; formulation ((NPV/PVC) *100				
Based case	12.43 %	9.84 %	5.45 %	8.91 %
Increasing cost 5 %	25.59 %	22.66 %	17.75%	18.08 %
Increasing cost 10 %	24.43 %	21.63 %	16.94 %	16.34 %
Change in revenues of the project, formulation ((NPV/PVB)*100				
Based case	11.27 %	9.05 %	5.19 %	8.25 %
Decreasing revenue 5 %	22.47 %	20.36 %	16.65 %	17.26 %
Decreasing revenue 10 %	21.45 %	19.43 %	15.89 %	16.34 %

Remark: Group A is production capacity less than 30 tonnes/hour, Group B is production capacity 30-45 tonnes/hour, and Group C is production capacity morethan 60 tonnes/hour

Although, the results of financial feasibility analysis through six main indicators was obtained that crude palm oil mill in Thailand generates profitability investment, but this study also analysis under uncertainty situation by using switching value test (SVT). We address two main assumptions are cost changing and revenue changing focuses on three scenarios namely, 1) based case, 2) increasing cost or revenues 10%, and 3) decreasing cost or revenues 10%, respectively.

Based on the SVT analysis with cost increasing consumption obtained that Plant A with production capacity less than 30 tones/hour can generate profitability investment until cost of crude palm oil mill is increasing over 12.43%, while, Group B is still gain profit investment, even though cost increases lower than 9.48 % and Group C will not recover investment cost when cost is increasing over 5.45%. For Plant B is still gain profit until cost is increasing over 8.91%. Another assumption revenue changing illustrates that all three group of Plant A still generated positive profit from investment until the revenue is decrease over 11.27% for Group A whereas income is decreasing not over 9.05% in case of Group B and 5.19% in Group C, respectively. Plant B still gain profit until revenues is loser than 8.25 %.

The result**s** from both assumption, cost changing and revenues changing, concentration on increasing cost decreasing revenues shown that the percentage of changing of all scenarios analysis is over than based cased which can imply that crude palm oil mill remain generated profitability investment even though cost is increasing 5-10%. The results also similarity with revenue scenarios by revenue is decreasing 5-10 %.

5. DISCUSSION

Based on variable cost of crude palm oil mill production, material cost or fresh fruit branch price of Plant A is highest in variable cost which over 93 % of total variable cost that effected from scramble to purchase fresh fruit branch through adequate supply and government interference in the market. This result is consistent with Chuasuwan C.(2018) and Adulthananusak N and Thammavitthayasakul L.(2018) in terms of meterial cost is led to 10 % of cost of production through insufficient supply and government price overtaking in market.

On the one hand, labor cost of production is second place rank in variable cost for Plant B with 6% of total variable cost that effected from lack of labor skill and competes for labor skill. Although, Plant A is also encountered both problem, lack of specialist labor and usurp for the skilled labor, but found that labor cost of Plant A with production capacity less than 30 tones/hour around 5.25 million baht or 5.52 % of total variable cost follow by Plant A with production capacity 30-45 tones/hour approximately 17.4 million baht or 2.61 % of total variable cost whereas the biggest production capacity group expense for labor cost is 10.264 million baht only 0.77 % of total variable cost. The results obtained that small and medium production capacity mills competing skill labor more than the biggest group and it's imply that exclude biggest production capacity group, crude palm oil mills in Thailand remained concentration on labor intensive production which is obtained by the number of worker use in production processing in each types are Plant A with production capacity less than 30 tonnes/hour is 30 worker, production capacity 30-45 tonnes/hour is 35 persons, production capacity more than 60 tonnes/hour is 60 labors, and Plant B provides 20 persons [2].

The financial feasibility study results illustrates that payback period of crude palm oil mill maximum 5.21 years, net present value of gain profit for Plant B is over 31 million baht whereas lowest gain profit for Plant A is 94 million baht, and IRR is more than 30% that led to induced new entrepreneurs playing in crude palm oil business, even though high competition production especially shortage of fresh fruit branch and lack of skill labor and scramble for labor skill. This consistent with the increasing of crude palm oil mill in Thailand during period 2012-2018 which is 83 plants in 2012 to 176 mills in 2018 with growth rate 112.1%.

The results from switching value test obtained that Plant A with production capacity less than 30

tonnes/hour is highest profitability investment under uncertainty situation which is remain gain profit until cost of production over 12.43% and revenues is decreasing upward 11.27%. The results also according to benefit cost ratio analysis which imply that new comer of crude palm oil industry should generate the mill with production capacity less than 30 tonnes/hour because they will get profitability investment and remain receive gain profit under uncertainty situation better than other investment scenarios

6. CONCLUSION AND RECOMMENDATION

This section obtained brief results and suggestions from this study. The crude palm oil industry remains to gain profitability investment all project life cycle (20 years) through six major financial feasibility study indicators namely; benefit-cost ratio (BCR), Internal Rate of Return (IRR), Net present value (NPV), Payback period (PB), Modified internal rate of return (MIRR), and Profit index (PI) moreover, they still gain profit under uncertainty situation by switching value test (SVT).

Based on financial feasibility analysis illustrates that crude palm oil Plant A with a production capacity of fewer than 30 tonnes/hour is the best alternative choice for new coming such as benefit-cost ratio and remain received gain profit better than other types of mills due to increasing cost and decreasing revenues. The government should give the financial feasibility analysis to the news coming.

From the results of insufficient supply, the government should force the new coming provides owns oil palm planting area for increased supply and reduced shortage supply or they should set the contract framing for solves this problem. On the one hand, increasing yield per rai is also necessary which is not only increased supply but decreasing the cost of production and competition in the world market also. Labor intensive for crude palm oil remains high production cost, they should reduce labor cost by training them to become a labor skill, using artificial intelligence for production processing and calculation enough suitable labor work in production processing. Moreover, reducing oil loss in production processing can generate increasing income that reduces the cost of production also. Logistic cost of supply is still problems because of the lack of supply many crude palm oil mills in the southern region such as Surat Thani, Krabi, and Chumporn provinces need to purchase fresh fruit branch from other excess supply provinces especially Nakhon Sri Thammarat and Phattaloung. Thus, the crude palm oil mill should consideration logistic costs also. Roundtable sustainable palm oil (RSPO) is alternative for Thailand crude palm oil industry that increasing the knowledge of smallholder growers to produced quality oil palm such as increasing yields, increasing oil percentage and environmental protection leads to decreasing production cost of the crude palm oil industry and sustainable in the future.

ACKNOWLEDGMENT

This research is one objective of the complete research report on the study of production efficiency and management of crude palm oil mill in Thailand. Under the research plan, aiming to meet the needs of national development urgently: Palm oil Received a research grant from the National Research Council of Thailand, fiscal year 2015, contract number POP5805021770.

REFERENCE

[1] Chuasuwan C. Thailand Industry Outlook 2018-2020;Palm oil industry. Bangkok, Thailand: 2018.

[2] Chanthawong A, Khongkon B, Ru-zhe J, Lemthanon K. A study of production efficiency and management of crude palm oil mill in Thailand. Bangkok, Thailand: 2018.

[3] Adulthananusak N, Thammavitthayasakul L. Thailand palm oil industry: in the new norm challenge. Bangkok, Thailand: 2018.

[4] Kingsaku C, Thinitjaya Jumroen, Sirinan Yimsaard, Supattra Hongcharoen, Praemwadee Edwards vanmuijen, Sunantinee Churasri, et al. Creating Competitive Advantage Of Enterprises Steamless Palm Oil Extraction System: Palm Pressing Technology Company Limited. Veridian E-Journal, Silpakorn Univ 2017;10:441–57.

[5] Nupeaug B, Kuntonlabud S. Competitive potential of thai oil palm industry in the global market. J Mark Manag 2018;5:15–27.

[6] Mano P. Supply Chain Management of the Entrepreneurs of Palm Oil in Chumporn Province. J Manag Sci Rev 2019;21:181–90.

[7] Chaisongkram N. The development for strategic administration government policy of oil palm. J MCU Nakhondhat Vol6 2019;6:1250–66.

[8] Nootim P, Wanatchapong Kongkaew, lNikorn Sirivongpaisa, Kanya Auckaraaree. A Location Analysis of the Fresh Fruit Bunch Collectors in Oil Palm Supply Chain under Zoning Designated Policy: A Case Study of Krabi Province. Thai J Oper Res 2018;6:32–45.

[9] Bose P. Oil palm plantations vs. shifting cultivation for indigenous peoples: Analyzing Mizoram's New Land Use Policy. Land Use Policy 2019;81:115–23. https://doi.org/10.1016/j.landusepol.2018.10.022.

[10] Lyons-White J, Knight AT. Palm oil supply chain complexity impedes implementation of corporate no-deforestation commitments. Glob Environ Chang 2018;50:303–13. https://doi.org/10.1016/j.gloenvcha.2018.04.012.

[11] Purnomo H, Okarda B, Dermawan A, Ilham QP, Pacheco P, Nurfatriani F, et al. Reconciling oil palm economic development and environmental conservation in Indonesia: A value chain dynamic approach. For Policy Econ 2020;111:102089. https://doi.org/10.1016/j.forpol.2020.102089.

[12] Pye O. Commodifying sustainability: Development, nature and politics in the palm oil industry. World Dev 2019;121:218–28. https://doi.org/10.1016/j.worlddev.2018.02.014.

[13] Tong YS. Vertical specialisation or linkage development for agro-commodity value chain upgrading? The case of Malaysian palm oil. Land Use Policy 2017;68:585–96. https://doi.org/10.1016/j.landusepol.2017.08.020.
[14] César A da S, Batalha MO, Zopelari ALMS. Oil palm biodiesel: Brazil's main challenges. Energy 2013;60:485–91. https://doi.org/10.1016/j.energy.2013.08.014.
[15] Jitrat P. An analysis of financial performance and economy of scale of palm oil extraction industry in Southern of Thailand. Prince of Songkha University, 2017.
[16] Yaosuwan W, Somboonsup S, Kanatnan T. A Feasibility Study of Investment on Crude Palm Oil Extraction Plant in Thung Yai District , Nakhon Si Thammarat Province. J South Technol 2017;10:35–43.
[17] Svatoňová T, Herák D, Kabutey A. Financial profitability and sensitivity analysis of palm oil plantation in indonesia. ACTA Univ Agric Silvic MENDELIANAE Brun 2020;63:1365–73.
[18] The Golden Star Oil Palm Plantation. The Golden Star Oil Palm Plantation (GSOPP) Mill Feasibility Study. Accra, Ghana: 2019.
[19] Sowcharoensuk C. Thailand Industry Outlook: Palm Oil Industry 2020-2022. Bangkok, Thailand: 2020.
[20] Elijah IO, Sylvester CI, Dorcas AE, Cletus IE. Small-Scale Palm Oil Processing Business in Nigeria; A Feasibility Study. Greener J Bus Manag Stud 2014;4:070–82. https://doi.org/10.15580/gjbms.2014.3.012714071.
[21] Essia U. Feasibility Report for Establishing a Small Scale Oil Palm Mill in Itu Local Government Area , Akwa Ibom State , Nigeria. J Phys 2019;1364:1–9.
[22] Sari DAP, Falatehan AF, Ramadhonah RY. The social and economic impacts of peat Land palm oil plantation in Indonesia. J Phys Conf Ser 2019;1364. https://doi.org/10.1088/1742-6596/1364/1/012017.
[23] Kurniawan MP, Guritno AD, Purwantana B, Supartono W. Production cost approach and material flow cost accounting as a step towards increasing responsibility, efficiency, and sustainability (RES): The case of palm oil mill in Banten Indonesia. IOP Conf Ser Earth Environ Sci 2020;425:1–11. https://doi.org/10.1088/1755-1315/425/1/012042.
[24] Bahri DS. Oil Palm by Product: How to Compute Its Cost of Production. IOSR J Bus Manag 2016;18:06–9. https://doi.org/10.9790/487x-1810010609.
[25] Nuryadi AP, Pratomo TB, Raksodewanto AA. Analysis of the feasibility of small-biomass power generation from the palm oil mill-study case: Palm oil mill in Riau-Indonesia. IOP Conf Ser Earth Environ Sci 2019;336:6–12. https://doi.org/10.1088/1755-1315/336/1/012018.
[26] Adjei-Nsiah S, Zu AKS, Nimoh F. Technological and Financial Assessment of Small Scale Palm Oil Production in Kwaebibrem District, Ghana. J Agric Sci 2012;4:111–20. https://doi.org/10.5539/jas.v4n7p111.
[27] Angsana K, Chaiwat P, Phavanee N, Piyapong H. Feasibility study of bio-hydrogenated diesel (BHD) production: A case study in Thailand. Adv Mater Res 2014;931–932:162–7. https://doi.org/10.4028/www.scientific.net/AMR.931-932.162.