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SUKANYA CHERDCHOONGAM ¹, VICHAI RUNGREUNGANUN ²

^{1,2} King Mongkut's University of Technology North Bangkok Bangkok, Thailand

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AN APPLICATION OF ANALYTICAL HIERARCHY PROCESS FOR RANKING FACTORS AFFECTING THAI NATURAL RUBBER RIBBED SMOKED SHEETS NO. 3 (RSS3) PRICE

SUKANYA CHERDCHOONGAM ^{1*}, VICHAI RUNGREUNGANUN ²

^{1,2} King Mongkut's University of Technology North Bangkok Bangkok, Thailand

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Abstract. The objectives of this research are to determine the criteria and order of magnitude of the criteria affecting natural rubber prices of Thailand, emphasizing rubber ribbed smoked sheets No.3 prices (RSS3). The study began with the interview on natural rubber prices with the people from the government, public, agricultural, and financial sectors relevant to the Thailand rubber industry. The researcher asked for their suggestions on the significance of criteria affecting RSS3 prices. The questionnaire was used to verify the criteria. Analytical Hierarchy Process (AHP) was the instrument for sorting the order of magnitude of the criteria affecting RSS3 prices. Results indicated seven main criteria that affected RSS3 prices, i.e., the quantity of natural rubber, demand for natural rubber, currency exchange rate, crude oil price, world economic situation, Thailand's situation, and advanced market speculation. The results reflected the criteria affecting the movement of RSS3 prices, which were beneficial for predicting the tendency of RSS3 prices.

INTRODUCTION

Natural rubber is the industry that is vital to the economy of Thailand and has been used in industrial sector. The top six rubber products made with natural rubber are rubber car tires, rubber glove, elastic, rubber motorcycle tires, rubber band, and condom. Therefore, the change of rubber price has a great effect on the overall industry of Thailand. The price of rubber is changing constantly according to environmental criteria. For example, the rubber price in the first two months of 2001 was high and tended to be increasing every day. The highest price was 183.64 baht per kilogram on 21 February 2011. After that, the price stayed high but decelerated. However, the price rapidly decreased to lower than 100 baht per kilogram for the first time in 12 months. Rubber price had decreased after the earthquake in Japan on Friday, 11 March 2011 but it happened only for a short time. Then, the price decreased continuously because of the server flood over 10 southern provinces of Thailand. From the flood, there was the damage on 50,000 rai of rubber trees which resulted in the shortage of rubber. Moreover, China decelerated purchasing rubber from Thailand, and the political unrest in the Middle East and North Africa since January to today, which reflected the price of crude oil from 89.58 US dollar per barrel in January to 102.98 US dollar per barrel, caused the change of rubber price. From this information, there were only some criteria that affected rubber price in a short period which showed the change of price obviously.

Thus, applying Analytical Hierarchy Process (AHP) to analyze the criteria affecting natural rubber prices would determine criteria and order of magnitude of criteria that affect natural rubber prices to predict the tendency of RSS3.

METHOD AND MATERIALS

This research applied AHP to determine criteria and factor weightages affecting natural rubber prices emphasizing on RSS3 price. AHP is popular because of its advantages such as the result was more reliable because it applied the pair wise comparison before answering question, had hierarchy chart imitating human's thinking process which facilitate the application and understanding, and presented numeric result from which it was easy to sort the order of magnitude.

The research studied the prior researches, conducted the interview and distributed the questionnaires to people, from government, public, agricultural, and financial sectors, relevant to rubber in Thailand on the situation of natural rubber and asked the interviewees to suggest the significant criteria affecting RSS3. From the general researches [1]-[8], criteria that were used to analyze natural rubber prices were quantity of natural rubber, demand of using natural rubber, currency exchange rate, crude oil price, world economic situation, situation in Thailand, and market speculation. These criteria were the main criteria that

*Corresponding author: Sukanya Cherdchoongam
E-mail: s.cherdchoongam@gmail.com

affected natural rubber prices. Each criterion had sub criteria which could be concluded as shown in Figure 1.

To sort the order of factor weightages affecting natural rubber prices which comprised of 7 main criteria and 15 sub-

criteria, the researcher collected data from the questionnaire completed by 24 experts to calculate the overall magnitude of vertical. The sample from the first informant is shown in Table 2.

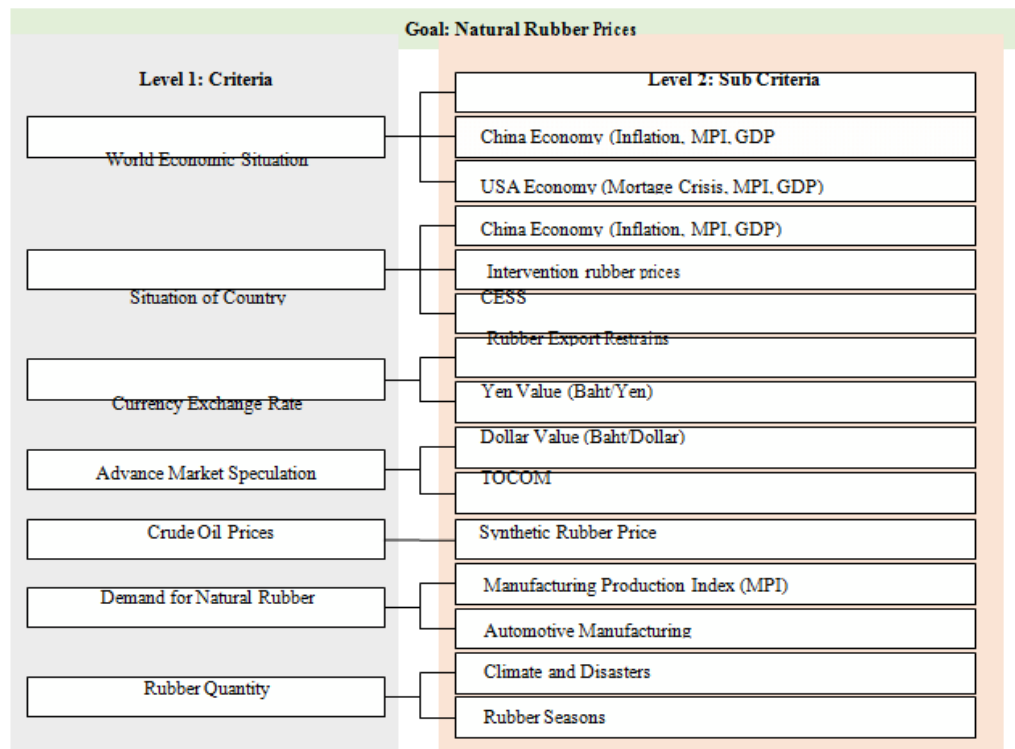


Fig. 1. An illustrative decision hierarchy for natural rubber prices

TABLE I
SCALE OF AHP PAIR-WISE COMPARISON [9]

Scales	Degree of preferences	Explanation
1	Equally	Two activities contribute equally to the objective.
3	Moderately	Experience and judgment slightly to moderately favor one activity over another.
5	Strongly	Experience and judgment strongly or essentially favor one activity over another.
7	Very strongly	An activity is strongly favored over another and its dominance has shown in practice.
9	Extremely	The evidence of favoring one activity over another is of the highest degree possible of an affirmation.
2, 4, 6, 8	Intermediate values	Used to represent compromises between the preferences in weights 1, 3, 5, 7 and 9.
Reciprocals	Opposites	Used for inverse comparison.

RESULTS

To sort the order of factor weightages affecting natural rubber prices which comprised of 7 main criteria and 15 sub criteria, the

researcher collected data from the questionnaire completed by 24 experts to calculate the overall magnitude of vertical. The sample from the first informant is shown in table 2.

TABLE II
PAIR-WISE COMPARISON MATRIX BETWEEN MAIN CRITERIA OF THE 1ST INFORMANT

Main Criteria	(1)	(2)	(3)	(4)	(5)	(6)	(7)
(1) World Economic Situation	1	1	3	1	2	1	1/3
(2) Situation of Country	1	1	2	1	1	3	1/3
(3) Currency Exchange Rate	1/3	1/2	1	1/3	1/3	1/3	1/3
(4) Advance Market Speculation	1	1	3	1	1	1	1
(5) Crude Oil Prices	1/2	1	3	1	1	½	1/3
(6) Quantity of Natural Rubber	1	1/3	3	1	2	1	1/5
(7) Demand for Natural Rubber	3	3	3	1	3	5	1
Total Columns	7.83	7.83	18.00	6.33	10.33	11.83	3.53

From Table 2, examined factor score of the 1st informant from main criteria comparison was used for analysis whose results are shown in Table 3.

TABLE III
FACTOR WEIGHT OF MAIN CRITERIA AFFECTING NATURAL RUBBER PRICES OF THE 1ST INFORMANT

Main Criteria	(1)	(2)	(3)	(4)	(5)	(6)	(7)	Weight (W)
(1) World Economic Situation	0.13	0.13	0.17	0.16	0.19	0.08	0.09	0.14(3)
(2) Situation of Country	0.13	0.13	0.11	0.16	0.10	0.25	0.09	0.14(3)
(3) Currency Exchange Rate	0.04	0.06	0.06	0.05	0.03	0.03	0.09	0.05(7)
(4) Advance Market Speculation	0.13	0.13	0.17	0.16	0.10	0.08	0.28	0.15(2)
(5) Crude Oil Prices	0.06	0.13	0.17	0.16	0.10	0.04	0.09	0.11(6)
(6) Quantity of Natural Rubber	0.13	0.04	0.17	0.16	0.19	0.08	0.06	0.12(5)
(7) Demand for Natural Rubber	0.38	0.38	0.17	0.16	0.29	0.42	0.28	0.30(1)

From Table 3, it is shown that the 1st informant considered the demand for natural rubber as a priority, followed by advanced market speculation, world economic

situation, situation in Thailand, quantity of natural rubber, crude oil price, and currency exchange rate respectively. Multiply factor weightages by criteria comparison resulted in the product to find the consistency ratio of the 1st informant as shown in Table 4.

TABLE IV
COMBINED WEIGHT TO FIND THE CONSISTENCY RATIO OF THE 1st INFORMANT

Main Criteria	(1)	(2)	(3)	(4)	(5)	(6)	(7)	Combined Weight (AW)	AW/W
(1) World Economic Situation	0.14	0.14	0.16	0.15	0.21	0.12	0.10	1.01	7.45
(2) Situation of Country	0.14	0.14	0.11	0.14	0.14	0.36	0.10	1.11	8.03
(3) Currency Exchange Rate	0.05	0.07	0.05	0.02	0.02	0.04	0.10	0.34	6.47
(4) Advance Market Speculation	0.14	0.14	0.16	0.15	0.15	0.12	0.30	1.15	7.69
(5) Crude Oil Prices	0.07	0.14	0.16	0.11	0.11	0.06	0.10	0.74	6.89
(6) Quantity of Natural Rubber	0.14	0.05	0.16	0.12	0.24	0.12	0.06	0.87	7.38
(7) Demand for Natural Rubber	0.41	0.42	0.16	0.30	0.89	0.59	0.30	3.06	10.28
								λ_{max}	7.74

Divided total product from Table 4 by factor weightages from Table 3 to examine the consistency of rational of the 1st informant (λ_{max}). Then, calculated to find Consistency Index (CI), from equation (1) and calculated to find Consistency Ratio (CR), from equation (2) of the 1st informant. If CR was less than or equal to 0.1, the obtained data was consistent and practical. If CR was more than 0.1, the obtained data was inconsistent.

$$CI = \frac{\lambda_{max} - n}{n-1} \quad (1)$$

$$CR = \frac{CI}{RI} \quad (2)$$

If RI was the index value from random sampling selected by model assessment and had difference by the size of matrix table ($n = 7$) as shown in Table 5.

TABLE V
AVERAGE RANDOM INDEX (RI) BASED ON MATRIX SIZE

n	1	2	3	4	5	6	7	8	9	10	11	12
RI	0	0	0.58	0.90	1.12	1.24	1.32	1.41	1.45	1.49	1.51	1.58

From Table 4, λ_{max} could be calculated as follows.

$$\lambda_{max} = (7.45+8.03+6.47+7.69+6.89+7.38+10.28)/7 = 7.74$$

It was found that λ_{max} was close to the number of comparing criteria. It implied that it did not have 100% consistency to rational. When calculated λ_{max} to find Consistency Index, $CI = (7.74-7)/(7-1) = 0.12$ was obtained. Moreover, from

Table 5 were $n = 7$, $IR = 1.32$. the represented value in equation (2), $CR = 0.12/1.32 = 0.09$ was obtained where the value was less than 0.1. It indicated that the data from the 1st informant was consistent.

The factor weightages score of 24 informants was used to calculate the mean and the ratio of consistency to rational, as the results shown in Table 6 by the same method sample applied to the 1st informant.

TABLE VI
CONSISTENCY INDEX (CI) AND CONSISTENCY RATIO (CR) OF

Informant no.	λ_{max}	CI	CR	Informant no.	λ_{max}	CI	CR
1	7.74	0.12	0.09	13	7.69	0.12	0.09
2	7.43	0.07	0.05	14	7.78	0.13	0.10
3	7.72	0.12	0.09	15	7.62	0.10	0.08
4	7.87	0.15	0.11	16	7.55	0.09	0.07
5	7.78	0.13	0.10	17	7.74	0.12	0.09
6	8.00	0.17	0.12	18	7.76	0.13	0.10
7	7.37	0.06	0.05	19	7.78	0.13	0.10
8	7.09	0.02	0.01	20	7.72	0.12	0.09
9	7.98	0.16	0.12	21	7.87	0.15	0.10
10	7.69	0.12	0.09	22	7.69	0.12	0.09
11	7.69	0.12	0.09	23	7.43	0.07	0.05
12	7.87	0.15	0.11	24	7.37	0.06	0.05
				Mean	7.68	0.11	0.09

Table 6 found that λ_{max} value obtained was close to the number of comparing criteria, which indicated that it did not have 100% consistency to rational.

When calculated the mean of λ_{max} , CI = 0.11 and CR = 0.09 were obtained, which were less than 0.1. It indicated that

the data of all informants were consistent and practical to apply for calculating factor weightages. To calculate factor weightages of each criterion, both main criteria and sub criteria with AHP, it could be done accordingly. The summary of factor weightages and sorting order of magnitude results was shown in Figure 2.

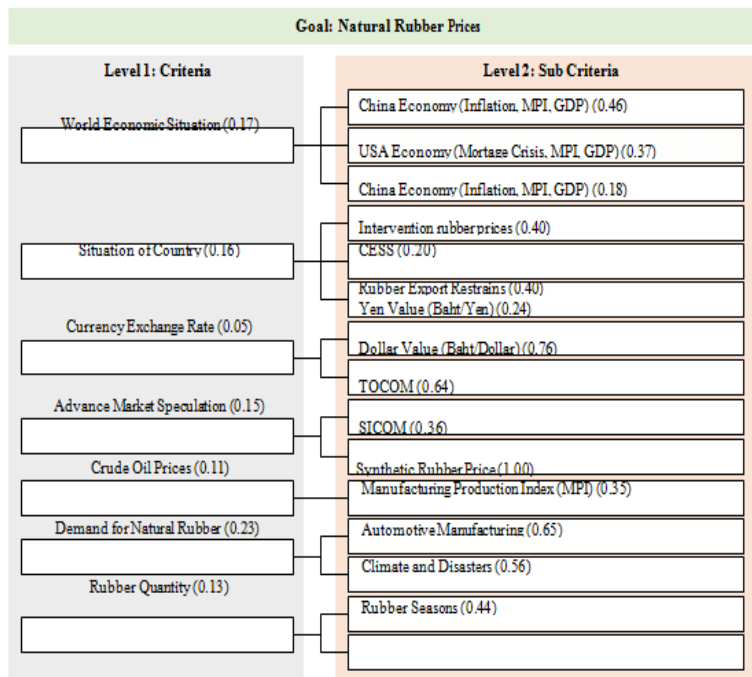


Fig. 2. Order of magnitude and factor weightages affecting natural rubber prices

From Figure 2, the highest weightages were the one to demand for natural rubber (0.23), followed by world economic situation (0.17), situation of Thailand (0.16), advanced market speculation (0.15), quantity of natural rubber (0.13), crude oil price (0.11), and currency exchange rate (0.05) respectively

CONCLUSION AND RECOMMENDATIONS

From weightages and importance of criteria calculated, it was found that most of the experts considered the demand of using natural rubber as a priority when they predicted natural rubber prices. Since Thailand rather exported natural rubber than used it in the country, the rubber price, thus, mainly depended on the demand for natural rubber [10], particularly the demand from automobile industry [11], which was the main industry of the country. From the data, it was found that the demand for natural rubber of the world varied according to the change of world economic situation, particularly China's economic situation, which was the country with the highest demand of using natural rubber in the world. Recessions affected the decreasing of demand of using natural resources and resulted in the low price of natural rubber prices. However, after the world economic recovery, the demand of using the natural rubber would increase, especially from the automobile industry. Moreover, world economic situation had effect on situation in Thailand so the government had to look for the measure to support agricultural sector by intervening into the rubber price determination and industrial sector by applying rubber export

restrain measure in order to develop domestic rubber products. Furthermore, the rubber future exchange by some merchants caused the deviation of the actual demand which resulted in fluctuation of rubber price, especially in TOCOM, which was the basic price for global rubber market. TOCOM, however relied on crude oil price which, consequently, affected the market prices because crude oil was used to produce synthetic rubber, substituted for natural rubber. If crude oil prices decreased, synthetic rubber also decreased accordingly and affected the decreasing of natural rubber prices. From the high volume of natural rubber export of Thailand, the currency exchange rate became one of the criteria affecting natural rubber prices. If the value of money of the exporter or importer had strengthened, rubber prices calculated in the exporter's or the importer's currency decrease, particularly US dollar, which was the highest trading currency. When there was the product substituted for natural rubber, the quantity of natural rubber was considered as a low priority. The variation of quantity of natural rubber depended on climate and disasters.

Declaration of Conflicting Interests

This study has no conflicts of interest.

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— This article does not have any appendix. —