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The study of rubber tapping technology quality in Memot Rubber Plantation Co., Ltd.

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Abstract The quality of rubber tapping technology was assessed at Memot Rubber Plantation Co., Ltd, located in Memot District, which is located on the east of the provincial capital of Tboung Khmum province, Cambodia. The research finding was conducted from March 20 to June 20, 2018 with 140 of rubber tappers and inspected 140 tapping tasks of tapping plots (6 tr/task ration with the length cut S/2 d3 7d/7 of the clones RRIM600 and GT1, 2008). The grading quality of rubber tapping technology was recorded. The factors with tapping technology quality and rubber bark consumption was determined the variable evidence and analyzed the relationship between eight factors with grade of rubber tapping technology quality. The results showed that 140 rubber tappers the assessed rubber tapping technology quality as following of a very good, good, fairly good, fairly, and poor grade approximately 13%, 4%, 18%, 22%, and 43%, respectively. Most of rubber tapping quality were in poor grade level such as 12.7A, 12.7B, 12.7C, 12.7D, 12.6B, 12.6C, 11.6C, 14.7B, 14.7C, 14.7D, 14.6C approximately 73.68%, 74.22%, 72.64%, 72.11%, 71.40, 72.23%, 71.27%, 71.82%, 74.55%, 72.60%, 65.30%, respectively. There were only two plots in fairly grade level such as 11.6B, 15.7C approximately 76.82%, 75.09%, respectively. Amongst of eight factors, there was X_8 bark consumption had relationship with rubber tapping technology quality (Y) ($P<0.05$) and all of eight factors showed that (X_4) horning of tapping knives, (X_7) training, (X_8) tapping quality had relationship with rubber bark consumption (Y) ($P<0.05$).

Keywords: Tapping technology, Clones RRIM 600, GT1, *Hevea brasiliensis*, Bark consumtion, latex Yields

Introduction

Rubber is a useful plan not only world economic strategies but also for the use of living of humankind. The more social flourish, the more needed of products made of rubber latex for people is gaining every day (Somboonsuke, 2009c). The transfer of technology is a continuous process involving coordinated efforts of the research and extension agents. It also require technologies suited to the needs of the rubber growers and the condition of the holdings (Somboonsuke, 2009b). The rubber smallholdings

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were characteristically normal, conventional farm, sometime called rubber forestry or rubber community forestry(Somboonsuke, 2009a). Improving the productivity of rubber farming systems is important, especially for rubber smallholding farms, which account for 70% of the world's natural rubber production (Somboonsuke *et al.,* 2009).

Cambodia has a geographical location between 10° to 15° of east latitude, and longitude between 102° to 108 ° in the tropics. It's suitable for farming. Cambodia is a developing country as most of Cambodian people live in rural areas to do farming for subsistence. Labor forces in agricultural and fisheries sector, industrial sector, and service field occupied 67, 25, and 5 percent, respectively (FAO, 2014). Agricultural sector has contributed around 29 percent of the national budget in 2010. Beside rice, rubber is another plantation priority grown in Cambodia (OECD, 2013). Rubber is considered as an agro-industries crop and rubber plantation is considered agro-farm not a forest. An economically important plant that produces natural rubber for various industrial uses is rubber tree (Pramoolkit *et al.,* 2014) and among of the major tropical economic tree crops of the world is rubber tree (*Hevea brasiliensis* Mull.A. rg.). Rubber is originating from the Amazonian tropical rainforests and it's intrinsically suitable for climates that are worm, moist throughout the year (Priyadarshan *et al.,* 2005). In 1910, in Cambodia was introduced *Hevea brasiliensis* (Wild. Ex Adr. De Juss.) which is the major source of natural rubber. Initially, in the 1980s, rubber development in Cambodia was restarted with only a few clones suach as GT1, PR 107, PB 86 were planted and many other clones were introduced (Phean *et al.,* 2016). In 2016, the estimated current area under rubber cropping in Cambodia now at about 432,126 hectares, with the production about 145, 000 tones, as a large production is still immature. In Cambodia has been between 40 and 50 of number of rubber tree clones available, actually cultivated with about 20 of them, for more than ten years (Phen *et al.,* 2016). The S/2 d3 7d/7 tapping system is used in routine in Cambodia. Not use any more intensive tapping frequency like d2 the estates, as well as smallholders (Hav *et al.*, 2016). The rubber smallholders were considered the correct tapping method and latex preservation methods as the most important techniques. Poor plantation management, use of conventional clones, low fertility of soil, use of old tapping systems, poor skill of tappers and poor knowledge of rubber smallholders on rubber management techniques is attributed low rubber yields, these are an important factor in increasing the rubber yields (Aun *et al.*, 2010). When tree reach 33 years old of age is the standard planting span and in estate rubber plantation is 555 trees per hectare of the planting density (Shigematsu *et al.,* 2011). The important strategic raw material is natural rubber for manufacturing a wide variety of industrial products. However, the commercial source is *Hevea brasiliensis* (the Brazilian rubber tree) only, the latex-producing plant species has at least 2,500 different (Puskas *et al.,*

2014). To improve skill and knowledge of rubber tappers on rubber tapping techniques is an important factor for the rubber plantation company and owner's rubber plantation to increase the rubber yield and manage the age of economic is bark consumption of trees. A better result can be achieved by correction with the tappers.

Materials and Methods

Location and experimental design

The procedures in this study was conducted in Memot Rubber Plantation Co., Ltd, located in Memot District, which is located on the east of the provincial capital of Tboung Khmum province, Cambodia.

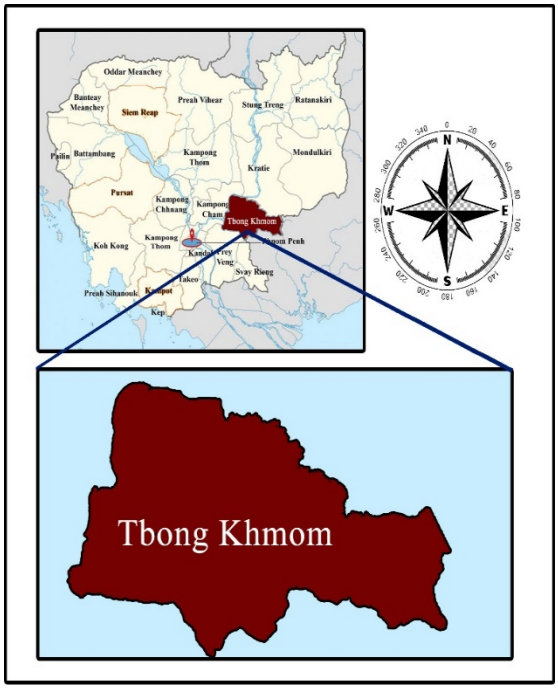

Figure 1. Map of Memot Rubber Plantation Co.,Ltd in Tboung Khmum province, Cambodia

The study was conducted from March 20 to June 20, 2018. There were four stages to collecting sampling: 1) purposive sampling used to choose the cultivated plots, there wewre 13 plots with the clone GT1, RRIM 600 and growing year 2008, 2) sample size used to determine the sample size, a total of 140 tappers or 140 tasks were selected from among of 216 tappers to observe by Taro Yamane formula of Yamane (1967) as follows:- $n = \frac{N}{1+N(e)^2}$, 3). The stratified sampling duse to choose the number of

tappers sample from the total plot by Judith Zweers formula(2002) $\text{ni} = \frac{(n)Ni}{N}$ in Table 2, and 4) simple random sampling used to select the tappers to observe among of the total tappers in the plots.

Table 1. Stages of sampling

Stages	Sampling	Describing
1	*Purposive sampling*	Plots: 12.7A, 12.7B, 12.7C, 12.7D, 12.6B, 12.6C, 11.6B, 11.6C, 15.7C, 14.7B, 14.7C, 14.7D, 14.6C
2	*Sample size*	Number of tappers
3	*Stratified sampling*	Number of tappers sample
4	*Simple random sampling*	Tappers that will be observed among of the total tappers in the plots

Table 2. Tappers sampling in each plot

Plots	Number of total tappers (N_i)	Percentages (%)	Observation Sample (n_i)
12.7A	29	13	19
12.7B	22	10	14
12.7C	15	7	10
12.7D	29	13	19
12.6B	18	9	11
12.6C	18	9	11
11.6B	16	7	10
11.6C	15	7	10
15.7C	7	3	5
14.7B	12	6	8
14.7C	15	7	10
14.7D	11	5	7
14.6C	9	4	6
Total	216 tappers	100 %	140 Tappers

Data collection, analysis and hypothesis

The purpose of interviewing to get more detail information about tapper's tapping technology quality that they were practicing by using questions with multiple choice answers and inspected the tapping technology quality each task in plots were determined by inspecting the errors of tapping technology quality, one task ratio with the length cut (S/2) was inspected six trees per tapping task. These were the parameters of the errors tapping technology that collected from inspecting, a) wound of panel tapping cut, b) shortage of tapping depth, c) less longer tapping cut, d) slope of tapping cut, e) sequence of tapping cut, f) movement of tapping walk and rubber collecting, g) over bark consumption, h) cleanliness, i) skip of tapping tree, and j) skip of latex harvesting (Table 3).

Data analysis and assessment the tapping technologies quality, the obtained data were computed in Microsoft Excel program.

The tapper's rubber tapping technologies quality after note on the controlling was assessed (Table 3), then extracted the number of tasks that were errors putting in each error column in the Table 3 and calculated the total rate of value phase.

Table 3. Table of parameters to be Controlled

Description	Wound of panel tapping cut			Shortage of tapping depth		less longer tapping (S/2)	Slope of tapping cut	Cleanliness	Sequence of tapping	Movement of tapping walk and rubber collecting	Skip of latex harvesting	Skip of tapping tree	Over bark consumption	Value Phase	Grad of tapping
	Small (2x5mm)	Medium(3x10mm)	Big (5x10mm)	Weak (1,6-2mm)	Strong (2mm)										
Number of tapping tasks															
% Coefficient	1	2	3	1	2	1	1	1	1	2	1	3	2		

Source: Ministry of Agriculture, Forestry and Fishery (2001).

Line 1 was the task number after inspected from each error among of 13 errors at the top of the table and over rubber bark consumption error put in the number of totals over tapping. Line 2 was an error rate of task number from inspecting, will be calculates to percentage of the total task number. Line 3 was a coefficient of errors types. Line 4 was a multiply product between data of line 2 and 3. The percentage of over bark consumption was calculated by formula below:

$$\text{Over tapping\%} = \frac{\text{Number of all over tapping} \times 100}{\text{Number of control tapping task} \times \text{Number of tapping}}$$

The value phase was a rate of correct tapping method for tappers, after calculated all of total data in line 4, then continued to calculate the value phase by formula:

$$\text{Value phase} = \frac{2200-(3 \times [\text{Sum}(\% \times \text{Coefficient})] \times 100}{2200},$$

Then presumed the observation based on each error parameters from the table, finally assessment the totally by putting grade (Table 4).

Table 4. Rate of value phase table

Rate of value phase	Grade
$\mathbf{90 < X \leq 100}$	Very good
$\mathbf{85 < X \leq 90}$	Good
$\mathbf{80 < X \leq 85}$	Fairly good
$\mathbf{75 < X \leq 80}$	Fair
$\boldsymbol{X \leq 75}$	Poor

Source: Ministry of agriculture, Forestry and Fishery, (2001).
Note: $\boldsymbol{X}$ is a numeric of value phase

Determining the other factors with tapping technology quality and rubber bark consumption, variable evidence X_1, X_2, X_3, X_4, X_5, X_6, X_7, X_8 and Y were computed in IBM SPSS Statistics 20 to calculate the relationship between other factors with grade of rubber tapping technology quality were analyzed by binary logistic regression (Table 5,6).

Table 5. Describing other factors with tapping technology quality

Independent variable	Descriptions
(X_1) Gender	(1) Female, (2) Male
(X_2) Age	Year
(X_3) Experience	Year
(X_4) Honing of tapping knives	Number of times
(X_5) Education level	(1) No, (2) primary, (3) Secondary, (4) High school
(X_6) Yield	Gram
(X_7) Training	(1) No, (2) yes
(X_8) Bark consumption	Number of tapping
Dependent variable	Description
(Y) Tapping technologies quality	(1) Poor, (2) Fairly

For the options above the null and alternative hypotheses are given below:
H_0 = There are no factors relationship with tapping technology quality (y)
H_1 = There are factors relationship with tapping technology quality (y)

Table 6. Describing other factors with bark consumption

Independent variable	Descriptions
(X_1) Gender	(1) Female, (2) Male
(X_2) Age	Year
(X_3) Experience	Year
(X_4) Honing of tapping knives	Number of times
(X_5) Education level	(1) No, (2) primary, (3) Secondary, (4) High school
(X_6) Yield	Gram/t
(X_7) Training	(1) No, (2) yes
(X_8) Tapping technologies quality	(1) Poor, (2) Fairly
Dependent variable	Description
(Y) Bark consumption	(1) Non-over, (2) Over

Regression equation $\log(\rho) = \beta 0 + \sum \beta_i + x_i$

$$P(y) = \frac{1}{1 + e^{-(\beta 0 + \sum \beta_i x_i)}}$$

For the options above the null and alternative hypotheses are given below:
$H_{0.1}$ = There are no factors relationship with bark consumption (y)
$H_{1.1}$ = There are factors relationship with bark consumption (y)

Results

Social Characteristics of Rubber Tappers

According to the interviewed and inspected rubber tapping quality technology of 140 tappers at Memot Rubber Plantation, Cambodia the data were prepared and analyzed as follows:

Table 7. Social characteristics of rubber tappers

Items	Numbers	Percentages%
Gender (X_1)		
Male	63	45
Female	77	55
Age (X_2)		
18-30	57	41
31-40	43	31
41-50	32	23
≥ 51	8	6
Education levels (X_5)		
None	15	11
Primary School	113	81
Secondary School	7	5
High School	5	4
Status		
Married	112	80
Single	21	15
Divorced	3	2
Widow	4	3
Religion		
Buddhism	113	81
Muslim	24	17
Christian	3	2
Work experience in rubber tapping (years) (X_3)		
1-10	83	59
11-20	28	20
≥ 21	12	9
None	17	12
The attended the training course (X_7)		
Yes	43	31
No	97	69
Total income (baht/month)		
≤ 1000		
1001- 5000		
5001- 10000	140	100
≥ 10001		
Age of the rubber (Year)		
Over bark consumption (time) (X_8)		
None	11	8
≥ 1	129	92
times of tappers horn tapping knives per month (X_4)		
1-10		
11-20		
21-30	140	100
Rubber yield (X_6)		
1-10	3	2
11-20	83	59
≥ 21	54	39
Tapping technology quality		
Very good	18	13
Good	5	4
Fairly good	25	18
Fairly	31	22
Poor	61	43

Most of 140 rubber tappers, there were 45 percent of male and 55 percent of female had showed above, result showed that the amount of female rubber tappers there were more than the male rubber tappers approximately 55 percent. The data of survey showed that most of the rubber tappers at the ages from 18 to 30 years old, 31 to 40 years old, 41 to 50 years old and the age more than 51 years old approximately 41 percent, 31percent, 23 percent, 5 percent respectively. Thus, this result confirmed that most of the total of tappers were an axillary of the ages 18 to 30 years old around 41 percent, the level of this age enough of labor force to fulfill parental obligations for the farm. The education levels were separated in four levels such as, the first one was none educated, the second was primary school, third was secondary school and the last one was high school. Those four levels of 140 tappers education level the results showed that the tappers none educated one was 11 percent, attended in primary school was 81 percent, secondary school level was 5 percent and high school level was 3 percent. The results expressed that most of the tappers were studied at primary school, encountered the problem of the tappers to get the technique from training program. Due to the results most of the rubber tappers were got married approximately 80 percent, single about 15 percent, divorced one was 2 percent and widow was 3 percent. Normally and depending on the community, the people believed on the Buddhism approximate 81 percent, Muslim around 17 percent and Christian about 2 percent of rubber tappers in the village. The tapper's experience on tapping from 1 to 10 years approximately 59 percent, 11 to 20 years about 20 percent, over 21 years around 12 percent and the tapper did not had tapping experience about12 percent. Result showed that the most of the tappers had experience from 1 to 10 approximately 59 percent, no experience around 12 percent and the rubber plantation company should train the tappers. The latex yield gets from the tapping of rubber hence, the attending on training of rubber tapping technique course was very important for tapping implementation. According from the data collection there were 31 percent of rubber tappers attended the training course of rubber tapping technique and 69 percent of rubber tapper did not attend. It is showed that most of the rubber tappers did not attend the training course of rubber tapping technique from the company.

Managing the rubber bark consumption is the main factor to be attention span and the tappers must be tapping as the correct calibration bark consumption which was given by the office of the company. Due to the inspection from the rubber plantation, showed that amount of the total tappers approximately 92 percent of over bark consumption and around 8 percent was corrected calibration bark consumption. Results showed that most of the tappers were over bark consumption. That was the main problem to loss and impact on the economic life of rubber bark. This factor in contrast to the amount of the tappers who attend the training course, the

training course was ineffective. Thus, the company should be careful to solve this problem as soon as possible to avoid of wasting rubber bark consumption. The latex yields of the tappers per tapping knives were divided into 3 categories (low level from 1 to10g, medium level from 11 to 20g and high level from 21g up). Based on the yield from the number of total tappers resulted to low latex yield between 1 to 10g/t/tr approximately 2 percent, from 11 to 20g/t/tr around 59 percent and over 21g/t/tr of latex yield about 39 percent. The latex yield from the tappers showed that most of them got medium level and high level approximately 39, 59 percent, respectively.

The study showed that 140 rubber tappers were assessed rubber tapping technology quality as very good, good, fairly good, fair, and poor grade approximately 13, 4, 18, 22, and 43 percent, respectively (Figure 1). The results from inspection of rubber tapping quality are shown the most of tappers were in poor and fair grade that the company must to improve the tapping training and restriction the tapping control to tappers to correct tapping method.

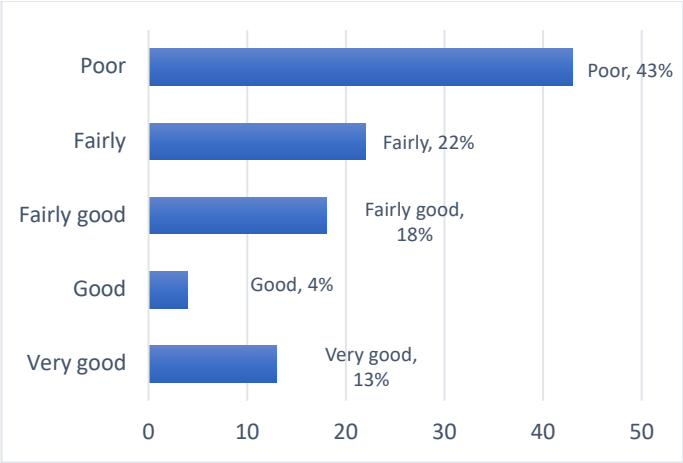

Figure 1. The overall of tapping technology quality of rubber tappers

The relationship between eights factors with rubber tapping technology quality

The relationship between eight factors with rubber tapping technology quality of the tappers (Y) was recorded, the options were shown below the null and alternative hypotheses are given below:

- $H_{0.1}$ = There is no significant difference factors relationship with tapping technology quality (y)
- $H_{1.1}$ = There is a significant difference factors relationship with tapping technology quality (y)

Table 8. Omnibus tests of relationship between eights factors tapping quality (Y)

	Chi-square	Df	Sig.
Model	137.295	8	0.000

The analysis showed that the significant value 0.000 (P<0.05) thus hypothesis ($H_{0.1}$) was denied and accepted hypothesis ($H_{1.1}$), there was a significant difference factors relationship with tapping technology quality.

Table 9. Relationship between eights factors with rubber tapping technology quality (Y)

Factors	B	S.E.	Wald	df	Sig.	Exp(B)
X_1 Gender	-0.294	0.762	0.149	1	0.700	0.745
X_2 Age	-0.492	0.483	1.038	1	0.308	0.612
X_3 Experience	-0.042	0.085	0.249	1	0.618	0.959
X_4 Horning of tapping knives	0.142	0.187	0.576	1	0.448	1.153
X_5 Education level	0.195	0.731	0.071	1	0.790	1.215
X_6 Yield	0.108	0.119	0.822	1	0.365	1.114
X_7 Training	1.174	0.840	1.952	1	0.162	3.235
X_8 Bark consumption	-2.015	0.377	28.603	1	0.000	0.133
Constant	1.845	5.728	0.104	1	0.747	6.331
-2 Log likelihood = 54.465						

Amongst of eight factors, there was X_8 bark consumption had relationship with rubber tapping technology quality (y) (P<0.05). The logistic regression equation of eight factors relationship between eight factors with rubber tapping technology quality as follows:

$$\text{Log}(Y) = 1.845 - 0.294\ X_1 - 0.492\ X_2 - 0.042\ X_3 + 0.142\ X_4 + 0.195\ X_5 + 0.108\ X_6 + 1.174X_7 - 2.015\ X_8$$

The relationship between (X_8) bark consumption with rubber tapping quality (Y) , the hypothesis showed as follows:

- $H_{0.2}$ = There is no significant difference (X_8) bark consumption factor relationship with tapping technology quality (y)
- $H_{1.2}$ = There is a significant difference (X_8) bark consumption factor relationship with tapping technology quality (y)

Table 10. Omnibus tests of relationship between (X_8) bark consumption factors with tapping quality (y)

	Chi-square	Df	Sig.
Model	131.276	1	0.000

The logistic regression showed that the significant value 0.000 (P< 0.05), thus hypothesis ($H_{0.2}$) was denied and accepted hypothesis ($H_{1.2}$) there was a significant difference (X_8) bark consumption factor relationship with tapping technology quality (y).

Table 11. Relationship between eights factors with rubber tapping technology quality (y)

Factors	B	S.E.	Wald	df	Sig.	Exp(B)
X_8 Bark consumption	-1.997	0.358	31.054	1	0.000	0.136
Constant	8.041	1.511	28.321	1	0.000	3105.657
-2 Log likelihood = 60.485						

According to the results analyzed the logistic regression of the relationship between (X_8) bark consumption with tapping technology quality are shown as following:-

$\text{Log}(Y) = 8.041 - 1.997\ X_8$

The relationship between eights factors with rubber with bark consumption

The relationship between eight factors with rubber bark consumption (y) was recorded, the options below the null and alternative hypotheses are given below:

- $H_{0.1}$ = There is no significant difference eights factors relationship with rubber bark consumption (y)
- $H_{1.1}$ = There is a significant difference eights factors relationship with rubber bark consumption (y)

Table 12. Omnibus tests of relationship between eights factors with rubber bark consumption

	Chi-square	Df	Sig.
Model	58.043	8	0.000

The analyzing showed the significant value 0.000 ($P<0.05$), thus hypothesis ($H_{0.1}$) was denied and accepted hypothesis ($H_{1.1}$). There was a significant difference factors relationship with rubber bark consumption.

Table 13. Relationship between eights factors with rubber bark consumption (y)

Factors	B	S.E.	Wald	Df	Sig.	Exp(B)
X_1 Gender	-0.842	0.501	2.828	1	0.093	0.431
X_2 Age	-0.149	0.277	0.290	1	0.590	0.862
X_3 Experience	0.022	0.052	0.175	1	0.676	1.022
X_4 Horning of tapping knives	0.245	0.111	4.845	1	0.028	1.278
X_5 Education level	0.287	0.424	0.458	1	0.499	1.332
X_6 Yield	0.033	0.078	0.183	1	0.669	1.034
X_7 Training	1.204	0.525	5.263	1	0.022	3.334
X_8 Tapping quality	-4.586	1.084	17.894	1	0.000	0.010
Constant	1.288	3.766	0.117	1	0.732	3.625
-2 Log likelihood = 105.666						

All of eight factors showed that (X_4) horning of tapping knives, (X_7) training (X_8), tapping quality had relationship with rubber bark consumption (y) ($P<0.05$) and others factors such as (X_1) gender (X_2) age (X_3) experience, (X_5) education level and (X_6) yield did not related to the bark consumption ($P>0.05$). The logistic regression equation of relationship between eight factors with rubber bark consumption (y) are as bellow:

$$\text{Log}(Y) = 1.288 - 0.842\ X_1 - 0.149\ X_2 + 0.022\ X_3 + 0.245\ X_4 + 0.287\ X_5 + 0.033\ X_6 + 1.204\ X_7 - 4.586\ X_8.$$

The relationship between (X_4) horning of tapping knives with bark consumption (y), the options below the null and alternative hypotheses are given below:

- $H_{0.2}$ = There is no significant difference (X_4) horning of tapping knives factor relationship with rubber bark consumption (y)
- $H_{1.2}$ = There is a significant difference (X_4) horning of tapping knives factor relationship with rubber bark consumption (y)

Table 14. Omnibus tests of relationship between horning of tapping knives factors rubber bark consumption (y)

	Chi-square	**Df**	**Sig.**
Model	3.692	1	0.055

The analyzing showed the significant value 0.055 ($P>0.05$), thus hypothesis ($H_{1.2}$) was accepted. There was not significant difference horning of tapping knives factors relationship with rubber bark consumption.

The relationship between (X_7) training with bark consumption (y), the options below the null and alternative hypotheses are given below:

- $H_{0.3}$ = There is no significant difference (X_7) training factor relationship with rubber bark consumption (y)
- $H_{1.3}$ = There is a significant difference (X_7) training factor relationship with rubber bark consumption (y)

Table 15. Omnibus tests of relationship between training factor rubber bark consumption (y)

	Chi-square	**Df**	**Sig.**
Model	1.486	1	0.223

The analyzing showed the significant value equal 0.223 was higher than 0.05 ($P>0.05$,) thus hypothesis ($H_{1.3}$) was accepted. There was not a significant difference training factors relationship with rubber bark consumption(y).

The relationship between (X_7) training with bark consumption (y) the options below the null and alternative hypotheses are given below:

- $H_{0.4}$ = There is no significant difference (X_8) tapping quality relationship with bark consumption (y)
- $H_{1.4}$ = There is a significant difference (X_8) tapping quality factor relationship with bark consumption (y)

Table 16. Omnibus tests of relationship between (X_8) tapping quality factors with bark consumption (y)

	Chi-square	Df	Sig.
Model	44.303	1	0.000

The logistic regression showed that the significant value 0.000 ($P<0.05$), thus hypothesis ($H_{0.4}$) was denied and accepted hypothesis ($H_{1.4}$) there was a significant difference (X_8) tapping quality factor relationship with bark consumption (y).

Table 17. Relationship between (X_8) tapping quality factors with rubber bark consumption (y)

Factor	B	S.E.	Wald	Df	Sig.	Exp(B)
X_8 tapping quality	-3.968	1.033	14.746	1	0.000	0.019
Constant	8.062	2.029	15.785	1	0.000	3171.429
-2 Log likelihood = 119.406						

Results showed that the logistic regression equation of the relationship between (X_8) tapping quality with rubber bark consumption as follows:

$\text{Log}(Y) = 8.062 - 3.968\ X_8$

The relationship between three factors with bark consumption (y) was analyzed.

Table 18. Omnibus tests of relationship between three factors with bark consumption (y)

	Chi-square	Df	Sig.
Model	53.952	3	0.000

Omnibus tests of the model showed that the significant value 0.000 ($P<0.05$). The independent factors had relationship with dependent factor.

Table 19. The relationship between three factors with bark consumption (y)

Factors	B	S.E.	Wald	df	Sig	Exp(B)
X_4 Horning of tapping knives	0.216	.104	4.332	1	0.037	1.242
X_7 Training	1.086	.500	4.717	1	0.030	2.961
X_8 Tapping quality	-4.258	1.050	16.456	1	0.000	0.014
Constant	1.282	3.431	0.139	1	0.709	3.602
-2 Log likelihood=109.757						

The results showed that the independent factors such as (X_4) horning tapping knives, (X_7) training, (X_8) tapping quality had relationship with dependent factor (y) bark consumption ($P<0.05$).

Table 20. Comparing of -2 Log likelihood value

Models summary	-2 Log likelihood
X8 Tapping quality	119.406
Models X_4, X_7, X_8	109.757

According to the comparision of -2 Log likelihood value showed that three independent models such as (X_4) horning tapping knives, (X_7) training, (X_8) tapping quality were corrected the models because of the -2 Log likelihood value was lower (109.757) than others. The logistic regression equation of the relationship between three factors with bark consumption (y) as follows:

$Log(Y) = 1.282 + 0.216\ (X_4) + 1.086\ (X_7) - 4.258\ (X_8)$ or,

$$\text{Log(bark consumption)} = \frac{1}{1 + e^{-(1.282 + 0.216\ (X4) + 1.086\ (X7) - 4.258\ (X8))}}$$

According to the equation above, it is concluded that if horning of tapping knives increased one time and other factors were not fluctuation induce the bark consumption decrease 1.242 times. If training increased one time and other factors were not fluctuation induced the bark consumption decreased 2.961 times. If tapping quality increased one time and other factors were not fluctuation induced the bark consumption decreased 0.014 times. All the equation above showed that three factors had relationship with rubber bark consumption.

Discussion

According to the results, the inspected on rubber tapping technology quality were very good, good, fairly good, fairly, and poor grade approximately 13%, 4%, 18%, 22%, and 43%, respectively. The value phase of rubber tapping technology quality of Cambodia recommended $X \leq$ 75% was poor grade level (Ministry of agriculture, Forestry and Fishery, 2001). The results showed most of tappers were in poor grade at level of tapping technology quality. This poor grade was made an impact on economic life span of rubber trees, income and yields stability. This study used on inspecting the parameters of rubber tapping technology quality of the rubber tappers while the exploiting stage of rubber tapping implementation.

The results of the relationship in different eight factors (X_1, X_2, X_3, X_4, X_5, X_6, X_7, X_8) with rubber tapping technology quality (y), it was concluded that there was relationship different between (X_8) rubber bark consumption factor with rubber tapping technology quality ($P<0.05$). Due to

the inspection from the rubber plantation, it showed that amount of the total tappers approximately 92% was excessive bark consumption. The capital value was lost and reduced in economic life span of trees when the bark consumption was excessive. (Aun *et al.*, 2010). Based on the results of the relationship different eight factors (X_1, X_2, X_3, X_4, X_5, X_6, X_7, X_8) with rubber bark consumption (y), showed that there were relationship difference between (X_4) horning of tapping knives, (X_7) training, (X_8) tapping quality factors with rubber bark consumption (y) ($P<0.05$). The correct tapping technology, properly bark consumption, efficiency training and increased for horning tapping knives method were the most important factors which should be strengthened for the rubber tappers. The production was sustainable, if the correct tapping method is the main reasons. The consumption was corrected, and rubber trees were healthy (Aun *et al.*, 2010). The poor tapping was the most critical factor to make very low latex yields in the Philippines is recorded (Alcala *et al.,* 2005).

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References

Alcala, T. B., Taponsok, L. A., Testado, A. M. and Testedo, R. A. (2005). Assessment of the status, problems and constraint of the Philippine rubber smallholders. Proceeding of the national rubber conference, Philippines.

Aun, S., Touch, V., San, V. and Chhun, T. (2010). Rubber Farmers' Perception of Rubber Technologies in Dambae and Peam Cheang, Kampong Cham. International Journal of Environmental and Rural Development. 1-1:25-30.

FAO (2014). Socio-economic Context and Role of Agriculture. Country Fact Sheet on Food and Agriculture Policy Trends. pp. 1-6.

Hav, S., Eric, G., Chhek, C., Mak, S. and Regis, L. (2016). Yield Potential of Clone IRCA 230 in Cambodia. CRRI&IRRDB International Rubber Conference 2016, Siem Reap, Cambodia. pp. 269-280.

Ministry of agriculture, Forestry and Fishery, Cambodia (2001). Rubber tapping control. office of rubber technology.

OECD (2013). Structural Policy Country Notes Cambodia. Structural Policy country notes for emerging asia. Retrieved from https://www.oecd.org/site/seao/cambodia.pdf.

Phean, C., Phen, P., Hak, B., Regis, L., Chhek, C., Mak, S. and Eric, G. (2016). Yield Performance of 8 Rubber Clones after 14 years of Tapping in Cambodia. CRRI & IRRDB International Rubber Conference 2016, Siem Reap, Cambodia. pp. 281-285.

Phen, P., Phean, C., Hak, B., Regis, L., Mak, S., Eric, G. and Chhek, C. (2016). Early Clonal Selection of Hevea Brasiliensis Based on Latex Physiological Parameters in Cambodia. CRRI&IRRDB International Rubber Conference 2016, Siem Reap, Cambodia. pp. 286-297.

Pramoolkit, P., Lertpanyasampatha, M., Viboonjun, U., Kongsawadworakul, P., Chrestin, H. and Narangajavana, J. (2014). Involvement of ethlene-responsiv microRNAs and their targets in increased latex yield in the rubber tree in response to ethylene treatment. Plant Physiology and Biochemistry. 84:203-212.

Priyadarshan, P. M., Hoa, T. T. T., Huasun, H. and Goncalves, P. d. S. (2005). Yielding potential of rubber (Hevea brasiliensis) in sub-optimal environments. The Haworth Press Inc.: Philadelphia. pp. 221-247.

Puskas, J. E., Chiang, k. and Barkakaty, B. (2014). Natural rubber (NR) biosynthesis: perspectives from polymer chemistry. Universtiy of Akron, USA. *2*:30-67. https://doi.org/10.1533/9780857096913.1.30.

Shigematsu, A., Mizoue, N., Ide, K., Khun, K., Pheng, M., Yoshida, Kohroki, K. and Sato, N. (2011). Estimation of Rubberwood Production in Cambodia. New Forests. 42:149-162.

Somboonsuke, B. (2009a). Dynamic of Thai Rubber Smallhollings Sector. In Agriculture System of Para Rubber Smallholding Sector in Thailand. Prince of Songkla University, Thailand. pp. 89-123.

Somboonsuke, B. (2009b). Technology and Innovation of Rubber Smallholding Sector. In Agriculture System of Para Rubber Smallholding Sector in Thailand. Prince of Songkla University, Thailand. pp. 124-176.

Somboonsuke, B. (2009c). Thai Natural Para Rubber and Rubber Smallholding Sector. In Agriculture System of Para Rubber Smallholding Sector in Thailand. Prince of Songkla University, Thailand. pp. 31-88.

Somboonsuke, B, Pacheerat, K. and Wettayaprasit, P. (2009). A Socio-economic Simulation of Rubber Smallholding Systems: A Case Study of Phatthalung and Songkhla Provinces in Southern Thailand. Chiang Mai University Journal of Social Sciences and Humanities. 3:113-134.

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